8.0 Recommendations

Many in-lake improvement options and site-specific structural BMPs were evaluated as to their feasibility and cost-effectiveness in the course of this UAA. Ultimately, the recommended approach for improving the Lake Owasso water quality involves adaptive management, or a management approach that involves monitoring the outcomes of implemented projects, and based on the results, modifies or improves on the way the system is managed. Several BMPs were evaluated that may significantly improve the water quality in Lake Owasso. While the main goals of the recommended BMPs are to reduce phosphorus concentrations and increase water clarity, an added benefit of the increases in water clarity may be the enhancement of native macrophyte community. The recommended BMPs include those that should be implemented first, either in the lake or within the watershed, to begin addressing the loads to Lake Owasso. A second tier of “Future BMPs” are identified as possible projects to be implemented once the impact of the first BMPs implemented can be evaluated.

In addition to the implementation of BMPs to improve water quality in Lake Owasso, there were potential sources of phosphorus to the lake identified that are not fully understood at this time, such as the internal loading in the Central Park – East and West wetlands and the Charlie Pond system. Modeling has demonstrated that reductions in these loads can result in a significant improvement in Lake Owasso’s water quality. To better understand these systems, and to help develop appropriate management plans to reduce loading to Lake Owasso, additional monitoring and studies are recommended before any specific BMPs are implemented.

The following sections summarize the recommended monitoring and studies for Lake Owasso and its watersheds, as well as the structural, in-lake, and nonstructural BMPs recommended for Lake Owasso.

8.1 Additional Monitoring & Study Recommendations

8.1.1 Water Quality Monitoring in Central Park – East and West Wetlands and Charlie Pond System

It was determined from the 2007 and 2008 runoff monitoring efforts and the Lake Owasso watershed water quality modeling that some of the wetlands within the Lake Owasso watershed experience some internal phosphorus loading that contributes to the overall total phosphorus loading to Lake Owasso.

To better understand the water quality in these ponds, and wetlands through the summer, water quality monitoring for an additional summer is recommended. This water quality monitoring should occur in the deepest portions of the Central Park – East wetland, the Central Park – West wetland, and the Charlie Pond system. Sampling should begin in early-May and continue through the end of September. Samples should be collected every two weeks

The water quality monitoring should focus on collecting grab samples (to be analyzed for total phosphorus, dissolved phosphorus, chlorophyll *a,* and total suspended solids). Additionally, dissolved oxygen, temperature, and pH profiles in the deepest locations in each of these wetlands should also be collected.

The estimated cost for this additional monitoring is expected to range from $7,000 to $9,500 including field work, laboratory analysis, and a brief technical memorandum discussing the laboratory results. See Appendix N for a more detailed breakdown of the cost estimates.

8.1.2 Fisheries Impact Study on Water Quality

Carp, along with other benthivorous (bottom-feeding) fish, can have a direct influence on the phosphorus concentration in a lake or water body (LaMarra, 1975). They can also cause resuspension of sediments in shallow ponds and lakes, causing reduced water clarity and poor aquatic plant growth, as well as high phosphorus concentrations (Cooke et al., 1993).

MDNR fisheries surveys for Lake Owasso (2001) and Bennett Lake (2006) indicate that carp are present in low numbers in both lakes. A 2006 MDNR population assessment also supports that carp are present in Lake Owasso. From the 2007 Lake Owasso user survey, 42 percent of respondents indicated that the fishery in Lake Owasso includes a large rough fish population, including carp. Additionally, carp were observed in the Central Park – West (County Road C) wetland in both the spring and summer of 2008.

Carp activity may contribute to the estimated internal phosphorus load within the Central Park – West (County Road C) wetland. Additionally, carp activity within Lake Owasso may also be source of phosphorus to the lake. To better understand the carp activity in the system and the potential contribution of carp to the phosphorus loads to Lake Owasso, a study is recommended to better understand the fishery, focusing mainly on carp and other benthivorous fish.

The results of this study should provide a better understanding of carp populations in the system, including Lake Owasso, Bennett Lake, and the Central Park – West (County Road C) and Central

Park – East wetlands. Because these water bodies are directly-connected to each other with very little change in elevation between the water bodies, carp populations likely move between the water bodies. Therefore, potential items to be considered when scoping this study should include:

- Quantifying carp population in all four water bodies
  - Typically, netting significantly underestimates carp populations in MDNR fishery surveys (e.g. Lake Owasso and Bennett Lake fishery surveys).
  - Netting is typically difficult in shallow areas and may not be able to be done in the Central Park – West and Central Park – East wetlands.
  - Electrofishing may be an option in the wetlands although backpack electrofishing may be limited by depth of wetland and by substrate on the bottom of the wetland. However, access with a boat equipped with electrofishing equipment may also be limited.
- Tracking carp movement between the water bodies in the system, throughout the course of a year (Dr. Peter Sorenson from the University of Minnesota has done similar tracking of carp in several west metro area lakes)
- Identification of the key carp spawning locations within the system
  - Understanding of how other Lake Owasso fish populations may use the Central Park – West wetland (spawning, feeding, etc.)
- Collection of water quality grab samples in the Central Park – West wetland during the study period to estimate potential impacts of carp activity on water quality (total phosphorus and total suspended solids) (See discussion Section 8.1.1)

Because of the need for more detailed investigation into the scope of this project as well as the potential variability in the scope, estimated costs for this study have not been developed. However, potential partnerships with the University of Minnesota and the MDNR may be possible as there is significant interest in carp management in lakes, and there is currently research being conducted to better understand this invasive fish.

If the study of the fishery concludes that the activity of carp in the system is having a significant impact on the water quality of Lake Owasso and the Lake Owasso-Central Park West wetland – Bennett Lake system indicates that carp management may be an option, a typical management strategy would include the combination of the following key steps: elimination of reinfestation, suppressment of recruitment, and removal of adult carp (Sorenson, 2009). Removal and management of carp would require permitting and guidance from the MDNR.

Supressment of recruitment involves preventing the eggs from hatching or preventing the young from surviving. This can be achieved by preventing adult carp from spawning in nursery areas along with removal of adult carp. A single female carp can lay up to 2 million eggs during spawning (Sorensen, 2009). Elimination of reinfestation means “blocking” the movement of carp between waterbodies. Both the suppressment of recruitment and the elimination of reinfestation can be achieved through the use of fish barriers. Physical barriers and electric barriers have been used to control the movement of carp between water bodies. More recently, sonic barriers (using bubble curtains) are being studied and implemented to control carp movement.

Many electric fish barriers have been installed to control the movement of carp between water bodies. Although these barriers can be fully effective at preventing the movement of carp, their success is linked to the maintenance of the electrical current. As a result, automatic back-up generators are required to maintain the electric field during power outages. Also, a dropping fine screen is recommended should there be complete power failure. Electric barriers require a budget for monthly operation and maintenance costs, as they need to be constantly supplied with electricity. Current cost estimates for installations of electric fish barriers on two lakes in southern Minnesota ranged from $250,000 to $300,000. This cost includes equipment and installation but does not include the estimated monthly operation and maintenance costs.

The final step in carp management includes the harvesting of adult carp in the lakes. Carp harvesting has been performed on many lakes in the Twin Cities metropolitan area. It is important to note that carp harvesting, and its potential impact on the long term management of carp populations, may not always be an option for a lake (Sorensen, 2009). A study of the carp within the Lake Owasso system should provide a better understanding of the carp population as well as the potential to manage this species.

8.1.3 Sediment Core Collection and Analysis

Release of phosphorus from sediments within water bodies within the Lake Owasso watershed may contribute to the estimated internal phosphorus load from the watershed. Collection and analysis of sediment cores will help better understand the mobile phosphorus associated with the sediments in these waterbodies and their potential contribution to the phosphorus loads to Lake Owasso. Along with mobile phosphorus, the sediment cores will be analyzed for organic phosphorus and total iron. Additionally, the water quality monitoring proposed for these water bodies (see Section 8.1.1) will help determine reasons for the phosphorus release from sediment (e.g., Is the release the result of anoxic conditions along the sediments? Is the release of phosphorus as the result of pH conditions?).

The collection of 10 sediment cores is proposed for anytime after ice out (April). Cores would be collected in the following water bodies (# of cores proposed):

- Central Park – East (Dale Street) wetland (1)
- Central Park – West (County Road C) wetland (4)
- Bennett Lake (2)
- Charlie Pond System (3)

The estimated cost for the sediment cores collection and analysis is $7,900. See Appendix N for a more detailed breakdown of the cost estimate.

8.1.4 Water Quality Monitoring in Lake Owasso – Shallow Area

Although the deep areas of the lake strongly stratify, mixing and sediment resuspension are likely occurring in the shallow areas as the result of wind and motorboat activity. It is unclear what the potential mixing in the shallow areas of the lake has on the overall water quality observed in Lake Owasso. Therefore, additional monitoring in the shallow area of the lake is recommended to help understand the water quality and mixing dynamics in the shallow areas of Lake Owasso, Sampling should begin in May and continue through the end of September. Sampling should occur monthly (a minimum of 5 samples collected through the summer) should include the collection of samples at 1 meter depth increments, at a minimum sampling at the surface and along the bottom sediments. Monitoring should include analysis of the following parameters: total phosphorus, total dissolved phosphorus, Secchi depth, chlorophyll *a*, dissolved oxygen, temperature, pH, and specific conductivity.

This recommendation assumes that Ramsey County will collect the water quality samples at the shallow monitoring site, and that monitoring at Site 5401 (the north, deep basin) will be performed as part of Ramsey County’s regular lake monitoring program. The estimated cost for water quality monitoring at a second site in Lake Owasso for one year, including field collection, laboratory analysis, and a brief technical memorandum discussing the laboratory results is expected to range from $1,800 to $2,800. See Appendix N for a more detailed breakdown of the cost estimate.

8.2 Structural BMP Recommendations

Several structural BMPs were evaluated as part of the feasibility analysis, including the implementation of NURP water quality treatment ponds, the implementation of regional infiltration BMPs as well as the development of extended detention in the bay on the southside of Lake Owasso. However, of the structural BMPs evaluated, the implementation of infiltration BMPs throughout the watershed appears to provide the most benefit to Lake Owasso water quality, as discussed in the following section.

8.2.1 Infiltration BMPs Incorporated in the Watershed

The watershed and in-lake water quality modeling of Lake Owasso has demonstrated that infiltration of stormwater runoff throughout the watershed can reduce the total phosphorus load to the lake and improve the overall water quality in Lake Owasso. Several potential sites for more regional infiltration BMPs were evaluated as part of the feasibility study. Though no single project would result in a dramatic improvement in water quality in Lake Owasso, the cumulative impact of infiltration BMPs distributed throughout the watershed can improve the overall lake water quality.

No specific infiltration projects are recommended at this time; however, we recommend that the GLWMO and the Cities of Roseville and Shoreview continue to promote the use of infiltration BMPs as opportunities associated with redevelopment and road reconstruction arise and where site conditions are conducive to infiltration.An excellent example of incorporating infiltration BMPs along with road reconstruction and other infrastructure improvements projects is the *Woodbridge Street Neighborhood Road Reconstruction Project* in the City of Shoreview. This project, to be completed during the summer of 2009, incorporates the use of pervious pavement on several streets in the Lake Owasso watershed on the eastside of the lake, including Woodbridge Street, Owasso Lane East, Jerrold Avenue, Edgewater Avenue, and Soo Street. As designed, the proposed stormwater management for the project will infiltrate stormwater runoff for storms up to the 10-year event and will eliminate a direct stormwater discharge to Lake Owasso. This project will provide runoff volume reduction and phosphorus load reduction in a portion of the watershed where runoff is currently untreated.

8.3 In-Lake BMP Recommendations

Several in-lake BMPs were evaluated as part of the feasibility study including the management of Curlyleaf pondweed in Lake Owasso as well as a whole-lake alum treatment to minimize release of phosphorus from the lake's bottom sediments. Because the treatment of Curlyleaf pondweed is estimated to have the most significant impact on Lake Owasso's water quality, it is the primary recommended in-lake water quality BMP.

8.3.1 Herbicide Treatment of Curlyleaf Pondweed

Curlyleaf pondweed can be managed by treatment with herbicide. Because Curlyleaf pondweed is such a significant portion of the phosphorus budget, it is the recommended management approach for

Lake Owasso. Herbicide treatment of Curlyleaf pondweed consists of annual spring herbicide treatment until this species is removed from Lake Owasso. Treatment would occur in late-April or early-May when the water temperature is approximately 55 to 60º F. Assuming normal plant growth conditions, treatment would be completed by the second week of May. Curlyleaf pondweed would be treated with the herbicide Endothall at a dose of approximately 1 mg/L. To remove this species from the lake, treatment would need to continue annually until Curlyleaf pondweed and viable turions are eliminated. Treatment would be expected to continue for four years, although some spot treatments could occur after this period to attain the project goal. The estimated total cost of the 4-year Curlyleaf pondweed management program is $649,000, including obtaining the treatment permit from the MDNR, treatment of the lake, as well as the monitoring and reporting that is required by the MDNR. Detailed cost estimates for the Curlyleaf pondweed treatment in Lake Owasso can be found in Appendix N.

It is also important to note that the management of Curlyleaf pondweed as described in this section is different than the macrophyte management that currently happens in Lake Owasso. Since this BMPs would reduce the amount of Curlyleaf pondweed in the spring and result in increased clarity, it is possible that native macrophytes will expand their range. Also, since the MDNR permit would be specifically for the management of Curlyleaf pondweed, it may not be possible to manage for other macrophytes later in the summer as is currently done.

8.3.1.1 Treatment Permit

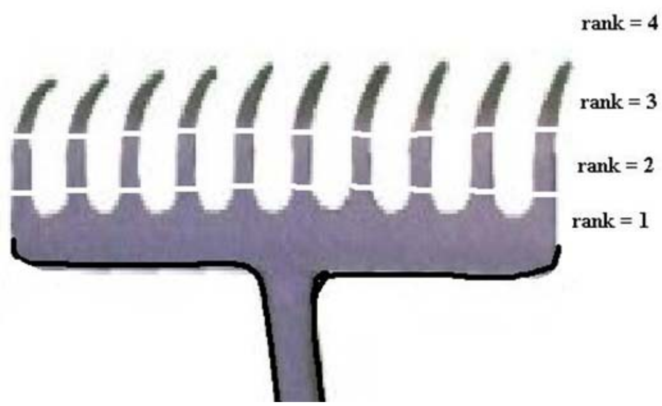
An aquatic plant management control permit must be obtained from the Minnesota Department of Natural Resources (MDNR) prior to herbicide treatment of Lake Owasso. In addition, since more than 15 percent of the lake would be treated with herbicide, a letter of variance must be obtained from the MDNR. To maximize the effectiveness of the treatment, lake home owners would be asked to sign a permission form granting GLWMO permission to treat the area from the property boundary to 150 feet out. Should any residents not choose to sign the permission form, the area from property boundary to 150 feet out would not be treated for these residents, but the rest of the lake would receive treatment.

The estimated cost to attain a letter of variance, treatment permit, and letters of permission to treat within 150 feet of riparian property boundaries is $6,500. The treatment permit would require monitoring to determine treatment effectiveness. Monitoring details are discussed in the following sections.

8.3.1.2 Aquatic Plant Monitoring

The MDNR requires a pretreatment aquatic plant survey be conducted after the water temperature reaches 48 degrees Fahrenheit. The primary purpose of the pre-treatment survey would be to determine Curlyleaf pondweed coverage prior to treatment. The survey would also determine native species present at the time of treatment. Two post treatment surveys would also be required to determine treatment effectiveness and treatment effects on the native plant community. Post treatment surveys would occur during June and August.

Point- intercept sampling methodology would be used for the pre-treatment and post treatment surveys. This method requires the creation of a regular grid of sample points over an orthorectified map or aerial photo of the lake. Each sample point would be numbered and downloaded into a GPS unit to allow for navigation to each sample point in the field. The MDNR would create the sample grid to use for the survey and provide it as an electronic file to the GLWMO. These sample points would be used for each sample date. The number of sample points and sampling grid spacing varies depending upon the size of the lake. In general, a minimum 125 sample points would be located in the littoral zone of the lake (i.e., shallow area of the lake where plants grow) and the maximum distance between adjacent points in the sample grid would be 300 feet. At each of these points, water depth would be measured with an electronic depth finder for depths greater than 8 feet, or depth stick for depths less than 8 feet. All plant taxa retrieved on a plant rake sampler or observed within one square meter of sample site would be recorded. The plant rake sampler would be constructed from a double-headed garden rake tied onto the end of a rope at least 25 feet long or attached to a 16-foot pole. Taxa of samples recovered on the rake or observed in the water would be identified to species level if possible. At each sample point the sample point number, the sample depth, the plant taxa observed, and the estimated abundance of each taxon would be recorded. The abundance of each species would be estimated using the following ranking system (See Figure 8-1):



- Rank 1 = < 1/3 of the rake head,
- Rank 2 = > 1/3 and < 2/3 of the rake head,
- Rank 3 = Plants filling >2/3 of the rake head,
- Rank 4 = Plants over the top of the rake

Figure 8-1 Macrophyte Monitoring Abundance Ranking

Surveyors would not have to sample in depths that are more than one inter-point distance deeper than the deepest vegetation, but they would sample at least one interval deeper than where vegetation was found.

A voucher specimen of each taxon identified would be collected, pressed and labeled with a standard herbarium label.

The following data would be reported to the MDNR:

- Frequency of occurrence of each species found in the survey and the combined frequency of: native submersed aquatic plants, all submersed aquatic plants, and all species found. Frequency of occurrence is calculated as the number of points in which a taxon (or combined taxa) occurred divided by the total number of points sampled (sample points that were deeper than the maximum depth where plants were found are excluded).

- Average number of submersed native species at each sample point and the standard error

- Average number of all submersed species at each sample point and the standard error
- Observed maximum depth of vegetation growth.

8.3.1.3 Biomass Monitoring

The MDNR requires, collection of biomass samples from 35 sample locations, during each sample event, to determine treatment effectiveness and the effect of treatment on the native plant community. Sample locations in the pre-treatment survey would be limited to locations containing Curlyleaf pondweed. The purpose of limiting pre-treatment sample locations to locations containing Curlyleaf pondweed would be to insure that the data adequately show treatment effectiveness. Biomass samples collected during the two post-treatment surveys would be collected from the same sample locations sampled during the pre-treatment survey. The pre-treatment and post treatment data would be compared to determine the reduction in Curlyleaf pondweed biomass and the increase in native plant biomass following treatment.

Samples would be collected using a rake attached to a pole. At each sample point, the rake would be lowered from the boat perpendicular to the bottom and then raised up to the water surface while slowly being twisted in a clockwise direction. Plant species from each sample would be separated into species and oven-dried to a constant weight.

8.3.1.4 Turion Monitoring

The MDNR also requires collection of turion samples from 35 sample locations in October to determine the potential for new Curlyleaf pondweed growth during the subsequent year. Sample stations would be the 35 biomass sample stations. Samples would be processed and the number of turions at each sample location would be determined.

8.3.1.5 Herbicide Residue Monitoring

Herbicide residue monitoring would determine herbicide concentration in the water column during a 21 day period after treatment. For management of Curlyleaf pondweed, a 48 hour contact time of Endothall at a concentration of 1.0 mg/L would be required for effective treatment. Herbicide residue monitoring at one and two days after treatment would measure herbicide concentration in the water column and determine whether the required contact time had been attained. Herbicide residue monitoring would also show the degradation rate of the herbicide. Knowing the degradation rate of the herbicide would be necessary to verify that the herbicide degraded prior to the growth of native vegetation and, hence, did not adversely impact the lake's native community. Endothall is expected to degrade into carbon dioxide and water within 21 days after treatment.

Herbicide residue samples would be collected from 2 locations within Lake Owasso. The stations would be located at the south end of the lake as well as in the northern portion of the lake near the outflow. Samples would be collected at 1, 2, 7, 14, and 21 days after treatment. Sample collection would be at mid-depth.

8.3.1.6 Analysis and Reporting

Monitoring data would be analyzed and reported annually to the MDNR. The analysis and report would determine the degree of Curlyleaf pondweed control attained and confirm the positive or neutral effect of the herbicide treatment on the native plant community. The analysis would include the preparation of maps showing Curlyleaf pondweed coverage prior to and following each herbicide treatment. Analysis of the native plant community would include both an analysis of individual species and a community wide analysis. Specific analyses to be performed include frequency of occurrence and density (low, average, high) of individual species, diversity of the plant community, floristic quality index of the plant community (would determine the average quality of the plants comprising the community), percent open area, and percent similarity of the plant communities between sample events within each year and between years. Plant biomass would be compared between sample events to evaluate the decline in Curlyleaf pondweed and to evaluate the response of the native plant community to the treatment. Turion numbers would be evaluated to confirm an anticipated decrease in turions from the treatments. Herbicide residual monitoring data would be analyzed to confirm the correct application of the herbicide and to evaluate the herbicide degradation rate to confirm that the herbicide caused no harm to the native plant community. The data analysis and report would be submitted to the Minnesota DNR annually to confirm compliance with permit requirements.

8.3.1.7 Monitoring Cost Estimate

The estimated cost to complete the monitoring program, including aquatic plant, biomass, turion, and herbicide residue, is $183,700. The aquatic plant monitoring cost assumes the MDNR would require an aquatic plant survey of 150 sample points and biomass and turion sampling at 35 sample points. If the MDNR would require either more or fewer sample points, the cost would change accordingly.

8.3.2 Future In-Lake BMP: Alum Treatment

The recommended BMP to address internal loads in Lake Owasso is the management of Curlyleaf pondweed. The Curlyleaf pondweed management plan, if implemented, will occur over a four-year period. However, if water quality in Lake Owasso has not improved after the management of Curlyleaf pondweed to the desired levels (or does not meet the GLWMO goals and the MPCA deep lake criteria), an alum treatment of the lake should be reevaluated and considered. Modeling indicates that an alum treatment in Lake Owasso would improve the overall water quality in the lake, although not to the levels expected by the Curlyleaf pondweed management.

The estimated cost of a whole-lake alum treatment based on an alum dosing rate estimated by the results of the sediment core analysis is $198,000.

8.4 Nonstructural BMP Recommendations

It is quite difficult to effectively model the effects of nonstructural BMPs on lake water quality, but studies have shown that they are effective at reducing phosphorus loads. The results of this study have shown that existing wetlands and ponds will be effective at removing large diameter particles and the associated phosphorus from stormwater runoff after completion of proposed development. However, dissolved phosphorus and phosphorus associated with extremely small particles may not be effectively removed. Therefore, source control (reduction of particles and phosphorus deposited on site) will be important in the lakes watersheds in the future as development continues.

Examples of effective nonstructural BMPs that would be appropriate for the Lake Owasso watersheds include:

1. An evaluation of road salting practices in the Lake Owasso watershed is recommended. Also, storage of road salt in this area should be evaluated to determine whether unintended runoff from storage areas is occurring.
2. Continue the existing street sweeping program, including an early spring sweeping, a late fall sweeping, and additional sweepings as needed.
3. Continue public education programs to inform the residents of the Lake Owasso watershed of ways to reduce phosphorus loading through proper handling of yard fertilizers and wastes, pet wastes, soaps and detergents.
4. Encourage industrial/commercial areas to institute good housekeeping practices, including appropriate disposal of yard wastes, appropriate disposal of trash and debris, appropriate storage and handling of soil and gravel stockpiles.
5. Discourage the feeding of waterfowl at shoreline areas around Lake Owasso and upstream ponding areas. Waterfowl feces can add a significant amount of dissolved phosphorus to a lake or pond. Lake shorelines provide essential nesting and feeding habitat for some waterfowl. However, the habit of leaving bread scraps and other food for waterfowl encourages a large number to congregate and nest.
6. Encourage vegetated buffers between yards and the shore of Lake Owasso and upstream ponding areas. Vegetated buffers are effective at trapping suspended solids and nutrients

from runoff. Requiring/encouraging vegetated buffers between yards and the lake will reduce the amount of phosphorus from yard runoff, and will prevent shoreline erosion. Vegetated buffers also discourage waterfowl from nesting and feeding on yards adjacent to the lake.