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Crystal Lake Nutrient TMDL
Five Year Review

Prepared for:

Shingle Creek
Watershed Management Commission

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Executive Summary

This report is a review of progress toward meeting the load reductions identified in the Crystal Lake Nutrient TMDL (Wenck 2008). It includes an assessment of actions that have been implemented and the water quality trends that have been observed. Finally, this report describes the actions planned for the next 5 years of the implementation plan and sets forth how progress toward the TMDL will be measured.

Crystal Lake was formally designated an Impaired Water for excess nutrients in 2002. A TMDL and Implementation Plan were approved in 2008 and 2009, respectively. The TMDL determined that a phosphorus load reduction of 69% is necessary to ensure the lake meets water quality standards for nutrients. The TMDL requires a 90% reduction in load from internal sources, and a 59% reduction from the watershed.

The Implementation Plan identified priority actions and strategies for the first five years of implementation. Some of these have been completed or are in planning. Other actions such as implementing load reduction and infiltration strategies as opportunities arise are ongoing.

Annual monitoring of lake water quality on Crystal Lake has been conducted intermittently over the past 20 years, primarily through the Metropolitan Council's Citizen Assisted Monitoring Program (CAMP). In preparation for this Five Year Review, more intensive monitoring, sediment core sampling, and aquatic vegetation monitoring were completed.

Priorities for the next five years will be:

- Continue to implement BMPs as opportunities arise.
- Target the flocculation plant treatment to hypolimnetic withdrawals to maximize annual load reduction.
- Work with the DNR to get an updated fish survey, and as water clarity improves, to develop a vegetation management plan to address any invasive aquatic vegetation should it occur.

1.0 TMDL Overview

1.1 BACKGROUND

Crystal Lake is located in the City of Robbinsdale in Hennepin County (Figure 1-1). Crystal Lake is a highly used recreational water body with an active fishery as well as other aesthetic values. Crystal Lake has an approximate surface area of 89 acres, with a maximum depth of 39 feet and an average depth of 10 feet. The drainage area to the lake is 1,237 acres of fully developed urban and suburban land. The drainage area is split between the City of Robbinsdale and the City of Minneapolis. Crystal Lake does not have a natural outlet; a pumping station is used under high water conditions to discharge into the City of Minneapolis storm sewer system. The storm sewer discharges into Shingle Creek, which ultimately discharges to the Mississippi River.

The Crystal Lake Nutrient Total Maximum Daily Load (TMDL) addressed a nutrient impairment in Crystal Lake in the City of Robbinsdale (Wenck 2008). The TMDL and associated Implementation Plan (Wenck 2009) were approved in 2009 and implementation actions have been underway since that time. The total phosphorus (TP) load reductions calculated in the TMDL are shown in Table 1-1.

Table 1-1. TP annual load reductions as presented in the Crystal Lake TMDL.

		Avg lbs/yr	TMDL* lb/yr	Reduction lbs/yr
Wasteload	Watershed	430	174	256
Load	Atmospheric	22	22	0
	Internal	284	29	255
	TOTAL Load	736	225	511
				Overall Reduction: 69%

*TMDL is for the average precipitation year

1.2 IMPLEMENTATION PLAN

1.2.1 Principles

The TMDL Implementation Plan enumerated the principles guiding development and implementation of the load reduction plan. These principles, in no order, included:

- **Restoring biological integrity** and communities including fish, plants, and zooplankton;
- **Controlling internal load** and reducing the internal phosphorus loading in the lakes;
- **Retrofitting existing BMPs** and taking advantage of highway and redevelopment projects to add or upsize BMPs;
- **Fostering stewardship** and providing education and training opportunities to city staff to better understand how their areas of responsibility relate to the protection and water quality in the lakes;
- **Communicating with the public** and providing general and specialized information for everyone within the community.

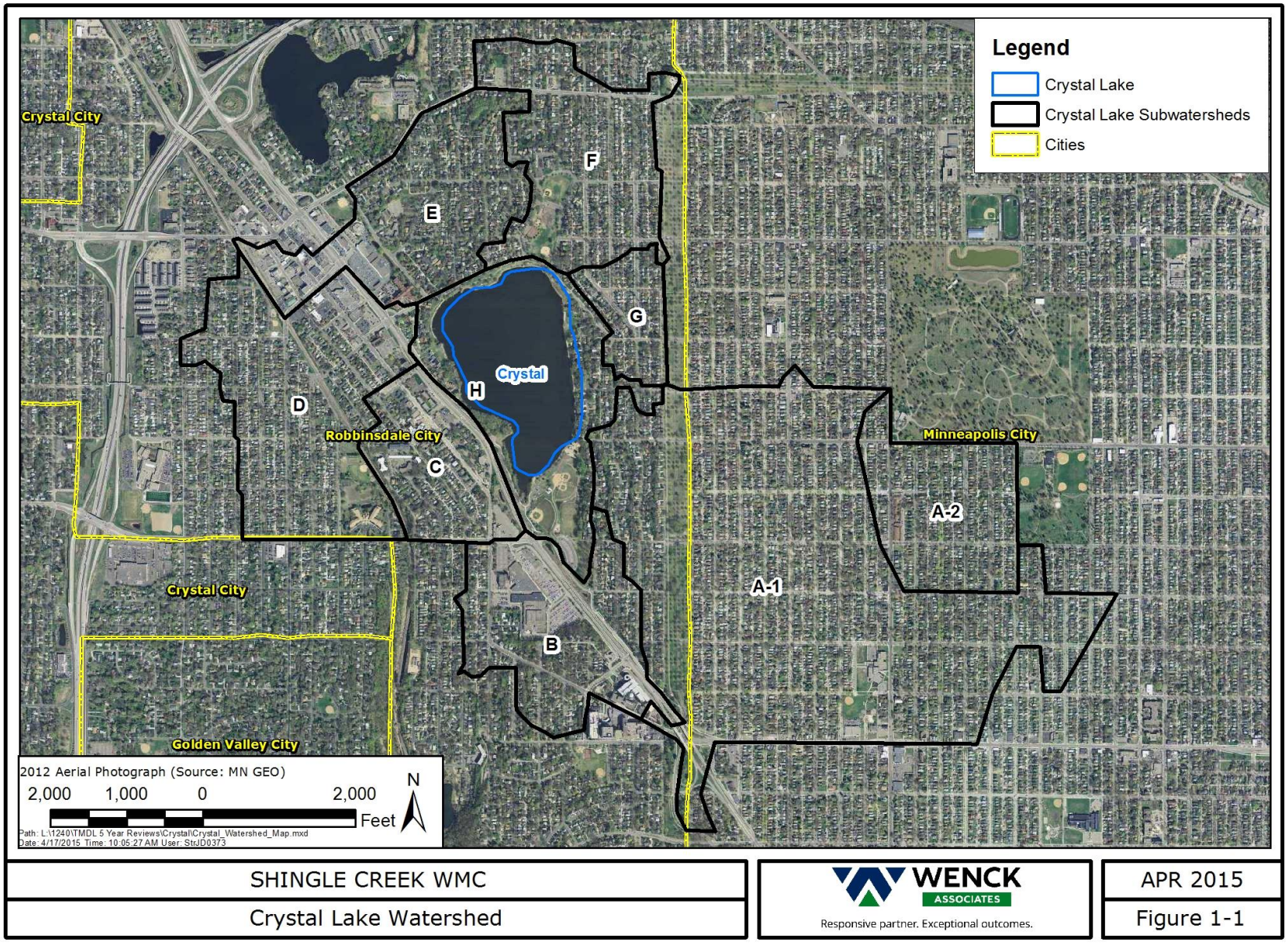


Figure 1-1. Crystal Lake subwatersheds.

1.2.2 Approach

The impairment to Crystal Lake developed over time as the watersheds draining to it urbanized. As the watershed developed, the native prairie and savanna was cleared and farmed. Over the past century the farms and remaining undeveloped land were converted to urban and suburban uses, increasing the volume of runoff and the amount of pollutants conveyed to the lake. Just as the resulting degradation in water quality took many years, it is recognized that improvement will also take many years.

The Implementation Plan took into account both short-term and long-term projects. The short-term projects that could be accomplished in a 10-20 year timeframe focused on retrofitting existing development with new BMPs and maximizing the efficiency of in-place BMPs. The long-term practices aimed to establish policies and practices that lower phosphorus loading through retrofitting BMPs, redevelopment, or new construction.

1.2.3 Priorities

Implementation priorities for Crystal Lake were identified in the form of BMP strategies. Following are the BMP strategies that were highest priority during the first five years of the TMDL. Their 2015 status is shown in *italics*. More detail on completed strategies is discussed later in this report.

- Continue monitoring the lake. *Crystal Lake water quality monitoring was conducted through the Citizen Assisted Lake Monitoring Program (CAMP) in 2008, 2010, and 2014. Water quality monitoring was conducted by the Shingle Creek WMC in 2013.*
- Continuously update the watershed SWMM and P8 models. *Ongoing activity.*
- Evaluate ways to refine street sweeping practices to maximize pollutant removal. *Not yet completed.*
- Evaluate a possible ordinance amendment to require street sweeping in parking lots. *Not yet completed.*
- Conduct aquatic vegetation, fish, phytoplankton, and zooplankton surveys. *Aquatic vegetation surveys performed by Shingle Creek WMC in 2013. No DNR fish surveys have been performed since the 2004 survey detailed in the TMDL.*
- Develop and implement an aquatic vegetation management plan. *Not yet completed.*
- Install gross pollutant traps upstream of storm sewer outfalls into the lake. *Ongoing.*
- Complete the shoreline restoration project in Hollingsworth Park. *The City worked with the DNR to complete a shoreline restoration on the highly sloped eastern lakeshore, but has not undertaken any additional shoreline restoration work.*
- Encourage lakeshore property owners to plant native buffers on their shoreline. *No targeted actions taken.*
- Implement an internal load reduction project. *A flocculation treatment facility to remove and treat water from the hypolimnion was installed on the southeast corner of the lake in 2013.*
- Implement BMP retrofits as opportunities such as street and utility reconstruction arise. *As detailed later in this report, additional BMPs were added as part of the reconstruction of Bottineau Boulevard (CSAH 81) by Hennepin County. Robbinsdale incorporated several BMPs into street reconstruction projects, and Minneapolis undertook the 37th Avenue Greenway project.*
- Implement BMP and restoration demonstration projects as opportunities arise. *As detailed later, in 2012 Robbinsdale received a grant to complete three BMP demonstration projects in this watershed.*

1.3 TMDL IMPLEMENTATION PLAN ACTIONS

1.3.1 Commission Actions

The Commission agreed to take the lead on general coordination, education, and ongoing monitoring. This information has been incorporated into the Commission's annual Water Quality Reports. Taking the lead, the SCWMC has conducted and will continue to facilitate the following activities. 2015 status is shown in *italics*:

- General Coordination. *All ongoing activities*
  - Coordinate water resource policy and the following general activities:
    - Assisting member cities with their implementation activities
    - Disseminating information on changing BMP technology and practices
    - Collecting annual implementation activity data
    - Recommending activities such as vegetation or fishery management
    - Periodically updating the Commission's Capital Implement Program (CIP)
    - Conducting public hearings on proposed projects
    - Sharing the cost of qualifying improvement projects
  - Annual monitoring and activities report
  - Establishment of performance standards
- Education. *All ongoing activities*
  - Public education and outreach
  - Promotion and encouragement of Public Official and Staff education
  - Presentations for lake associations, home ownership associations, block clubs, garden clubs, service organizations, senior associations, advisory commissions, City Councils, and other groups
  - Shoreline restoration, rain garden, and other BMP demonstration projects
- Monitoring
  - Monitor water quality in the lakes and annually publish results. *Completed and ongoing*.
  - Provide additional monitoring such as:
    - Aquatic vegetation surveys. *Completed in 2013.*
    - Sediment chemistry. *Completed in 2008.*
    - Zooplankton sampling and other biological assessments. *Not yet completed.*

1.3.2 Stakeholder Actions

The regulated stakeholders responsible for meeting the TMDL are the cities draining to Crystal Lake (Minneapolis and Robbinsdale) and Hennepin County. In addition, property owners in the watershed have a role to play in implementing BMPs on their private properties. The stakeholders agreed to consider the following activities in implementing the TMDL. Their 2015 status is shown in italics. More detail on completed strategies is discussed later in this report.

- External Load Reduction
  - Crystal Lake Improvement Project. *Completed*.
  - Retrofit BMPs
    - New or enhanced stormwater ponding. *See Table 2.1.*
    - Infiltration devices and reforestation. *See Table 2.1*
    - In-line or off-line treatment manufactured devices. *See Table 2.1.*
    - Rain gardens and biofiltration. *See Table 2.1.*
  - Increase infiltration in watershed. *See Table 2.1.*

- Shoreline restoration and management. *Not yet completed.*
- Street sweeping. *Ongoing.*

- Internal Load Reduction
  - Internal load reduction project. Flocculation treatment facility constructed in 2013 and operated during the 2013 and 2015 growing seasons (*see section 2.1.4*)
- Biologic Integrity
  - Aquatic plant management. *Not yet completed*
  - Fish population management. *Not yet completed*
- Tracking and Reporting
  - Integration of BMPs into stakeholders' SWPPs. *Completed on an ongoing basis.*

2.0 Progress Review

2.1 TMDL IMPLEMENTATION ACTIONS

2.1.1 Shingle Creek Watershed Management Commission

The Commission has completed a number of actions in implementation of this TMDL. Some of these are specific to the Crystal Lake TMDL, and some are general actions across the watershed that will also benefit Crystal Lake.

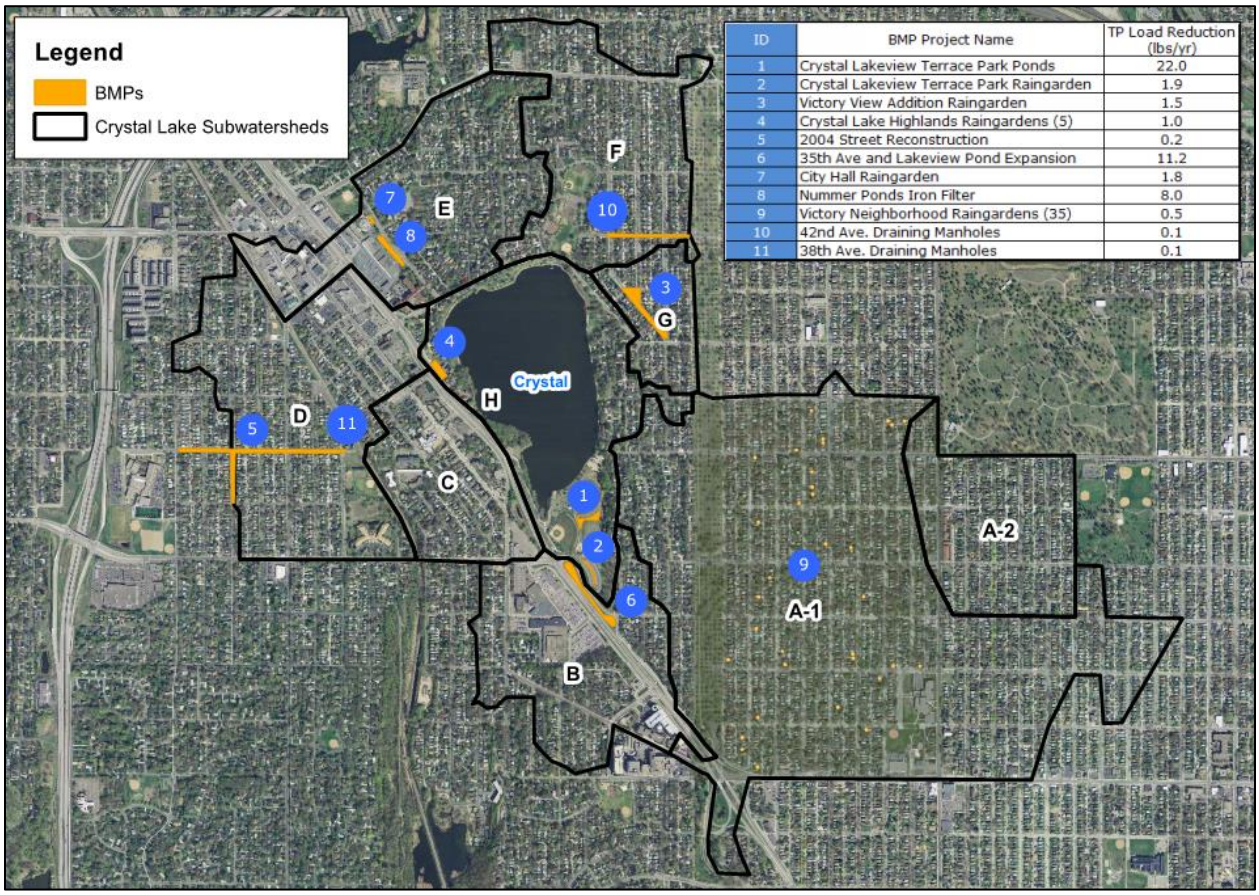
- As will be discussed later in this document, the Commission sponsors ongoing citizen volunteer water quality monitoring on lakes throughout the watershed, including Crystal Lake, and has undertaken more intensive water quality, sediment core, and aquatic vegetation monitoring.
- Since the TMDL and Implementation Plan were completed, the Commission has updated its watershed management plan and development rules to be even more stringent. The development and redevelopment water quality and infiltration requirements now apply to non-single family residential parcels down to one-half acre in size. The previous threshold was five acres. The Crystal Lake subwatershed contains numerous commercial and industrial parcels smaller than five acres. As these develop or redevelop, they will now be required to implement load-reduction Best Management Practices (BMPs).
- The Commission and the member cities have received several grants to assist in implementing BMPs in this subwatershed. These include:
    - $50,000 from Metro Conservation Districts and $5,000 from Hennepin County's NRICH program to undertake three BMP retrofit projects: a large bioinfiltration basin at Robbinsdale City Hall; retrofitting an existing pond with an iron-enhanced filter bench; and constructing a capture and reuse facility to harvest stormwater to use on a community garden.
    - $82,500 from the MPCA's Section 319 program to apply a whole-lake alum treatment to the lake. The City decided to implement hypolimnetic withdrawal instead.
    - $282,000 to complete the Paired Intersection Study, which investigated how using porous asphalt pavement on city streets could reduce the need to apply road salt, and could increase infiltration of runoff.
    - The Victory and Cleveland Neighborhoods of Minneapolis have received Conservation Corps of Minnesota funding in the form of crew days to help residents dig and plant rain gardens to capture roof and impervious surface runoff.

2.1.2 Stakeholder Actions

The Cities of Robbinsdale and Minneapolis, and Hennepin County have implemented several load reduction BMPs throughout the watershed to improve water quality. The BMPs that have been implemented since 2002 are listed in Table 2.1 along with each BMP's estimated phosphorus load reduction. Other than the Victory and Cleveland Neighborhoods rain gardens, this table does not include actions completed by individual property owners.

Table 2-1. BMPs implemented in the Crystal Lake watershed since 2004 and estimated phosphorus load reduction.

Activity Type	Sub-watershed	City	BMP Name	BMP Description	TP Load Reduction (lbs/yr)
External	A-1	Robbinsdale/ Minneapolis	Lakeview Terrace Park	Pond/wetland system	22.0
	H	Robbinsdale	Lakeview Terrace Park	Parking lot raingarden	1.9
	G	Robbinsdale	Victory View Addition	Raingarden	1.5
	H	Robbinsdale	Crystal Lake Highlands	Raingardens (5)	0.0
	D	Robbinsdale	2004 Street Reconstruction	Draining manholes (10)	1.0
	B	Robbinsdale/ Hennepin Cty	35th Ave and Lakeview Pond Expansion	Construction of two ponds	0.2
	E	Robbinsdale	City Hall Raingarden	Raingarden	11.2
	E	Robbinsdale	Nummer Ponds Iron Filter	Installation of iron enhanced sand filter	5.3
	A-1	Minneapolis	Victory/Cleveland Neighborhood Raingardens	Raingardens of various sizes (35)	1.8
	F	Robbinsdale	42nd Avenue	Draining manholes	8.0
	D	Robbinsdale	38th Avenue	Draining manholes	0.5
	A-2	Minneapolis	37th Avenue Greenway	Filtration/infiltration basins and underground storage vaults along 5 blocks treating 20 acres	20.0
				Subtotal	**73.4**
Internal	Lake	Robbinsdale	Crystal Lake flocculation treatment facility	Hypolimnetic withdrawal and treatment	178.7
				Subtotal	**178.7**



ID	BMP Project Name	TP Load Reduction (lbs/yr)
1	Crystal Lakeview Terrace Park Ponds	22.0
2	Crystal Lakeview Terrace Park Raingarden	1.9
3	Victory View Addition Raingarden	1.5
4	Crystal Lake Highlands Raingardens (5)	1.0
5	2004 Street Reconstruction	0.2
6	35th Ave and Lakeview Pond Expansion	11.2
7	City Hall Raingarden	1.8
8	Nummer Ponds Iron Filter	8.0
9	Victory Neighborhood Raingardens (35)	0.5
10	42nd Ave. Draining Manholes	0.1
11	38th Ave. Draining Manholes	0.1

Figure 2-1. BMP locations in the Crystal Lake watershed.

2.1.3 Crystal Lake Subwatershed Assessment

In 2010 the Hennepin Conservation district in partnership with the Metro Conservation District and the Commission undertook a subwatershed assessment for that part of the Crystal Lake drainage area that is in the City of Robbinsdale. The goal of the study was to identify and prioritize retrofit treatment practices. Seventeen catchments and their existing stormwater management practices were analyzed for annual pollutant loading. Stormwater practice options were compared for each catchment, given their specific site constraints and characteristics. Potential BMPs in 10 of the 17 catchments were identified and modeled at various levels of treatment efficiencies. If all were implemented they would reduce the annual TP load from the watershed by an estimated 51 pounds per year.

2.1.4 Crystal Lake Flocculation Treatment Facility

A flocculation treatment facility was constructed on the southeast shore of Crystal Lake in 2012. The purpose of this facility is to withdraw and treat nutrient-rich hypolimnetic (deep-lake) water from Crystal Lake using aluminum sulfate (alum), and discharge the treated water back to the lake. This facility has a maximum daily flow rate of 0.720 million gallons per day (mgd) and is intended to operate seasonally between April and October. The facility began operation and treatment on May 6, 2013 and operated through October 20, 2013. The facility was not operational in 2014. The facility was operational again in 2015 and operated between April 27 and October 28.

During the 2013 operational period, the flocculation treatment facility treated approximately 105 million gallons (321 acre-ft) of lake water and removed approximately 208 pounds of TP. The facility withdrew lake water from both the hypolimnion (bottom layer) and epilimnion (top layer) in 2013 (Appendix A; Table 2-2; Figures 2-2 and 2-3). Crystal Lake is a deep lake that stratifies during the summer growing season. When stratification develops, water in the hypolimnion is cut off from the atmosphere. Low oxygen conditions begin to develop and dissolved phosphorus (ortho-P) is released from lake's sediments. Facility influent TP concentrations were approximately 20% higher and ortho-P concentrations were nearly double when water was withdrawn from the hypolimnion compared to the epilimnion during the 2013 operational period. When the facility pumped water from the hypolimnion, TP and ortho-P removal rates were higher (Table 2-2) and the facility operated more efficiently due to the higher phosphorus concentrations, mainly dissolved phosphorus, in the hypolimnion. Dissolved phosphorus removal is extremely important in lakes because it is the phosphorus form readily available to aquatic algae for uptake and, when it is delivered to the epilimnion, can lead to excessive algae blooms and poor water clarity. Treatment effectiveness decreased when water was pumped from the epilimnion due to high levels of particulate algae that adsorbed to the chemical reagent.

The facility treated approximately 352 acre-ft of lake water and removed approximately 148 pounds of TP (Table 2-2) during the 2015 operational period. The facility once again alternated withdrawals from the hypolimnion and epilimnion, however significantly more water was pumped from the hypolimnion (226 acre-ft) compared to the epilimnion (103 acre-ft). It is important to point out that the average hypolimnion influent ortho-P concentration was nearly 7 times greater in 2013 (22 µg/L) compared to 2015 (141 µg/L). This implies there was very little accumulation of dissolved phosphorus in the hypolimnion in 2015 and phosphorus release from the lake sediments was low. In-lake monitoring shows 2013 and 2015 average surface water TP concentrations and other water quality parameters were similar (see section 2.2.2) suggesting a major reduction in hypolimnion ortho-P between 2013 and 2015 is unlikely. Wenck recommends that the City verify the facility's 2015 hypolimnion influent location and depth, and that the correct concentration data were used to calculate the facility's 2015 dissolved phosphorus removals.

Table 2-2. Facility treatment summary for the 2013 and 2015 operational periods.

Treatment Year	Influent Withdrawal Location	Days Pumped	Treated Volume [Acre-ft]	Influent TP [µg/L]	Effluent TP [µg/L]	Influent Ortho-P [µg/L]	Effluent Ortho-P [µg/L]	TP Removed [lbs]	TP Removed [lbs/day]	Ortho-P Removed [lbs]	Ortho-P Removed [lbs/day]
2013	Epilimnion	79	150	238	24	71	9	87	1.1	25	0.3
	Hypolimnion	89	172	298	55	141	9	121	1.4	62	0.7
	TOTAL	168	322	270	32	109	9	208	1.2	87	0.5
2015	Epilimnion	64	126	104	13	11	2	31	0.5	3	<0.1
	Hypolimnion	118	226	203	11	22	1	117	1.0	12	0.1
	TOTAL	182	352	167	12	18	2	148	0.8	15	0.1

2.2 WATER QUALITY TRENDS

2.2.1 Monitoring Program

Monitoring of lake water quality on Crystal Lake has been conducted periodically over the past 20 years. Much of the data was collected through the Metropolitan Council Environmental Services (MCES), City of Robbinsdale and CAMP volunteers. Surface samples were collected at least one time per month from May through October for total phosphorus (TP), Secchi depth and chlorophyll-a (chl-a). In addition, in 2013 the Commission conducted bi-weekly surface, bottom and water column monitoring (Appendix B). Sediment core samples were taken and analyzed in 2008 (Appendix C) and aquatic vegetation surveys were performed by the Commission in 2013 (Appendix B). Water quality data and trends for Crystal Lake are presented in the Commission's Annual Water Quality Report.

2.2.2 Trend Analysis

Water quality in Minnesota lakes is often evaluated using three associated parameters: total phosphorus (TP), chlorophyll-a (chl-a), and Secchi depth. TP is typically the nutrient that limits algal growth in Minnesota Lakes. However, there are cases where phosphorus is widely abundant and the lake becomes limited by nitrogen or light availability. Chlorophyll-a is the primary pigment in aquatic algae and has been shown to have a direct correlation with algal biomass. Since chlorophyll-a is a simple measurement, it is often used to evaluate algal abundance rather than expensive cell counts. Secchi depth is a physical measurement of water clarity, measured by lowering a black and white disk until it can no longer be seen from the surface. Measurements of these three parameters are interrelated and can be combined to describe water quality.

Minnesota has different water quality standards for lakes depending on their depth. Crystal Lake meets the definition of a Deep Lake (maximum depth >15 feet, less than 80 percent of lake area shallow enough for rooted plants). Figure 2-2 to 2-4 below show historic and current summer average TP, chlorophyll-a and Secchi depth for Crystal Lake. No clear TP trends were observed since 2000. TP was monitored for only two years in the 1990s, however current levels (since 2000) appear to be significantly less. Chlorophyll-a and transparency data show no clear trends as both show large variability from year to year. In some years, such as 2008, chlorophyll-a and transparency meet or are very close to state standards, while in other years neither parameter is close to meeting state standards. Monitoring will need to continue in Crystal Lake to continue to evaluate water quality trends and success of the watershed BMPs and flocculation treatment facility.

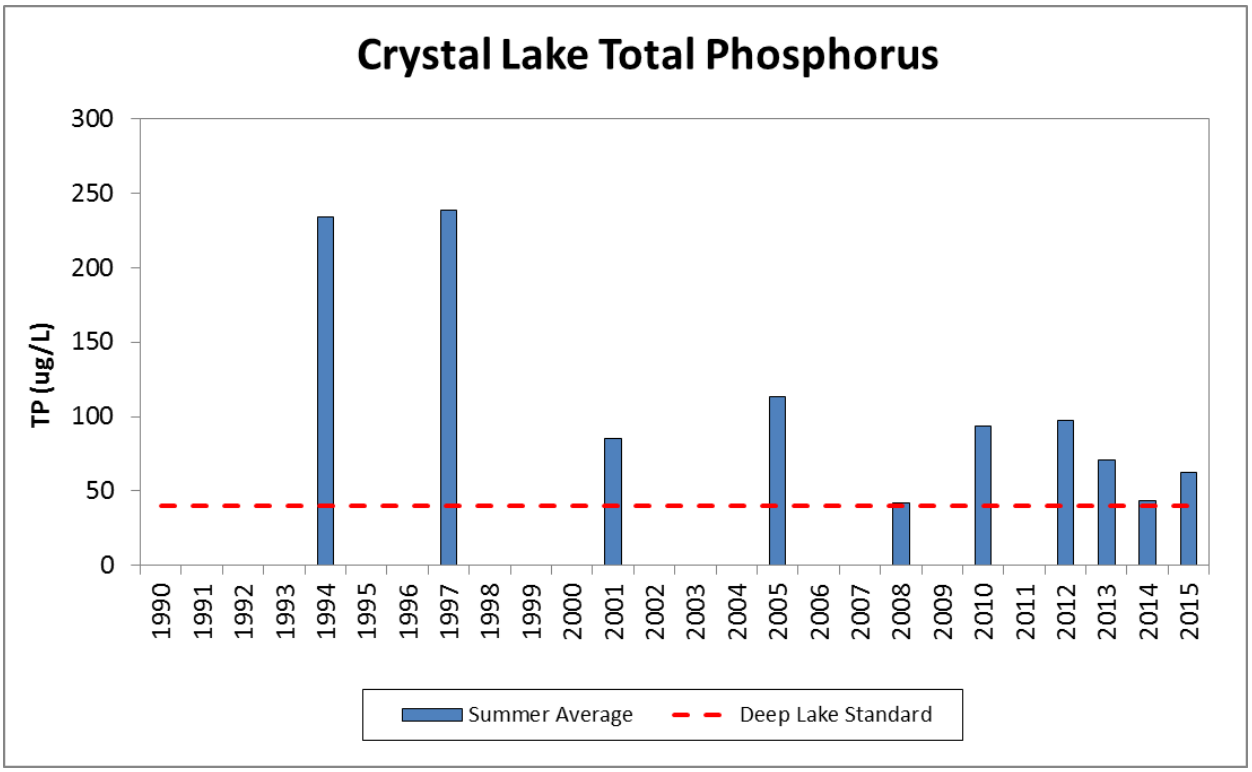


Figure 2-2. Crystal Lake summer average total phosphorus.
Note: 2012 and 2015 sample results supplied by the City of Robbinsdale

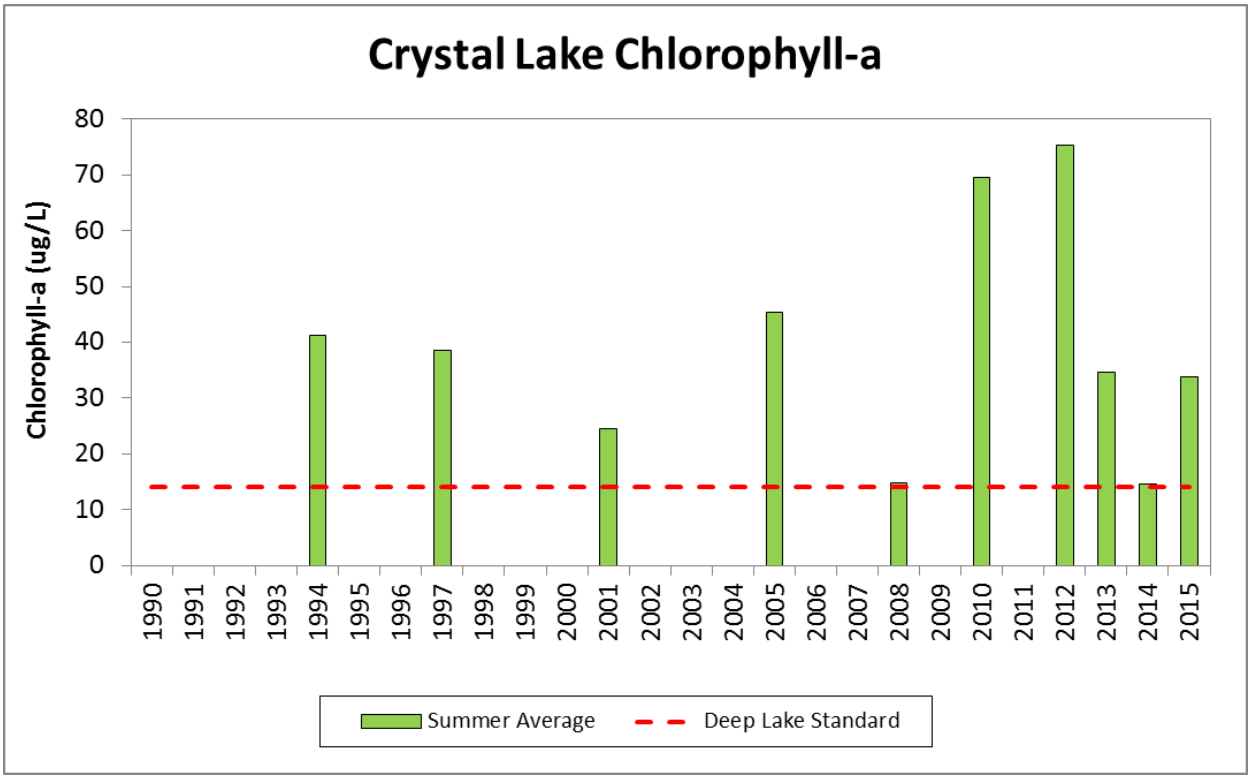


Figure 2-3. Crystal Lake summer average chlorophyll-a data.
Note: 2012 and 2015 sample results supplied by the City of Robbinsdale

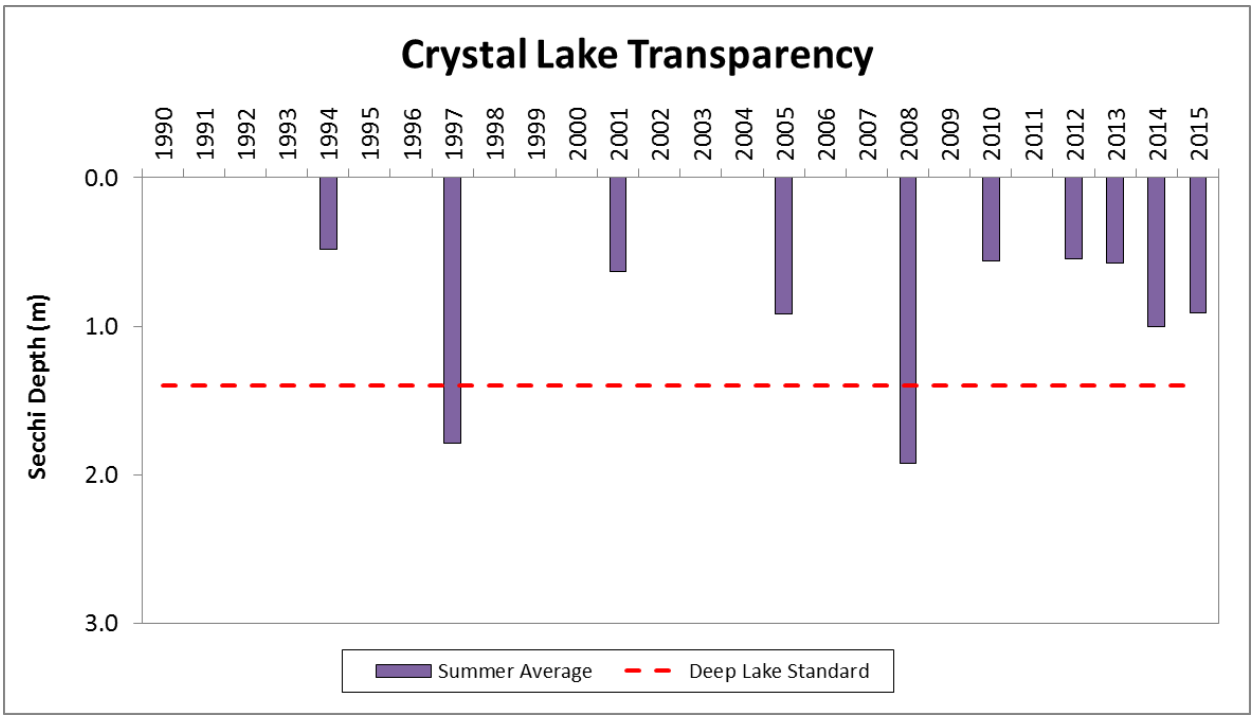


Figure 2-4. Crystal Lake summer average transparency data.
Note: 2012 and 2015 sample results supplied by the City of Robbinsdale

2.2.1 Summary of Progress

The lake model used 2001 and 2003 as base years for estimating the existing nutrient loading to Crystal Lake and the TMDL. BMPs completed since 2003 then would be considered for computing load reduction toward the TMDL. Since 2003 it is estimated that BMPs implemented in the watershed and lake have led to an annual TP reduction of about 251 pounds (Table 2-3). Figure 2-5 shows the estimated TP loading and reductions achieved for Crystal Lake since 2001. While the reductions shown in Table 2-1 and Figure 2-5 are significant, there are additional watershed (203 pounds) and internal (76 pounds) load reductions needed to reach the TMDL goal.

Table 2-3. Annual TP load reductions required and achieved for Crystal Lake.

		TMDL Required Reductions [lbs/yr]	Reductions to Date [lbs/yr]	% Achieved	Remaining Reductions [lbs/yr]
Wasteload	Watershed	256	73	28%	183
Load	Atmospheric	0	0	0	0
	Internal	255	178	70%	77
	TOTAL	511	251	49%	280

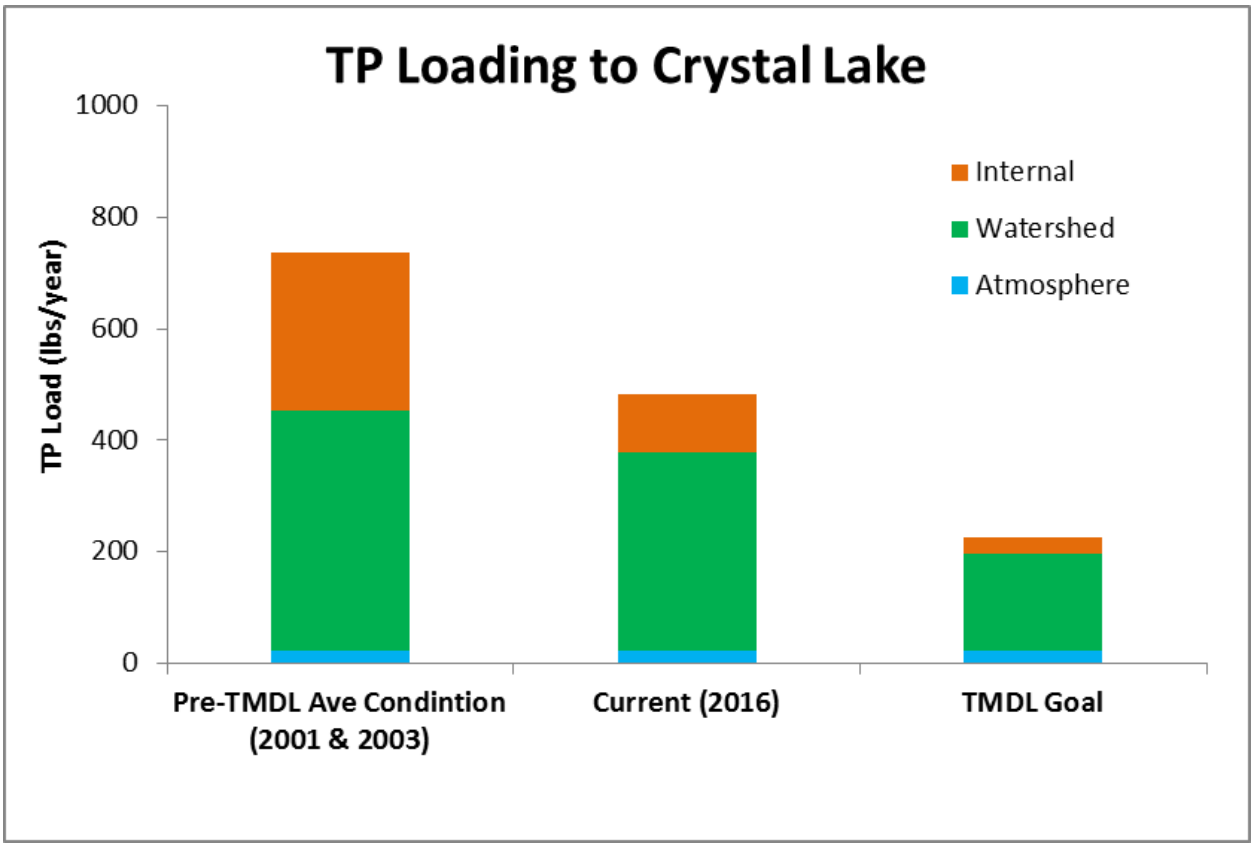


Figure 2-5. Crystal Lake TP loading and reductions.

3.0 Next 5 Year Actions

3.1 PRIORITIES

The Commission and its Technical Advisory Committee reviewed and discussed the data and potential future actions. Priorities for the next five years will be:

- Continue to reduce watershed load to Crystal Lake by adding new and enhancing existing treatment BMPs and by increasing infiltration and runoff.
- Reduce the effects of internal loading in the lake by continuing to operate the flocculation treatment facility to treat nutrient-rich hypolimnetic water.
- Develop and implement balanced short and long-term aquatic vegetation and fish management plans.

3.2 COMMISSION IMPLEMENTATION ACTIONS

3.2.1 Continue Monitoring and Reporting

The Commission will continue to rely on volunteers to conduct water quality monitoring on the four lakes every other year through the Citizen Assisted Monitoring Program (CAMP) program, supplemented by surface and water column sampling every five years. The lake was monitored through CAMP in 2014 and is scheduled for CAMP monitoring in 2016. The next detailed surface and water column sampling and aquatic vegetation survey is scheduled for 2018.

3.2.2 Education and Outreach

The Commission will provide focused education and outreach to the cities and property owners/residents in the drainage area. The Commission will continue to promote small BMPs such as rain gardens, pervious pavement, and use of native plants. With the West Metro Water Alliance (WMWA), the Commission will review and extend where possible the Watershed PREP program so that every fourth grade classroom in the subwatershed is visited at least twice.

3.2.3 Project Financial Assistance

The Commission's Cost Share Policy provides that member cities may submit capital improvement projects to the Commission's Capital Improvement Program (CIP), and the Commission will fund 25% of the cost of the project, with a maximum share of $250,000. The Commission has also been successful in obtaining grant funding for projects, and will continue to seek out sources of funding to assist the cities in completing projects. Both Minneapolis and Robbinsdale have undertaken projects with Commission cost-share. The Commission also operates a Cost Share program for small BMPs that is intended to provide assistance in completing projects identified in the subwatershed assessments described above.

3.2.4 Five Year Evaluation

The Commission will complete another Five Year Review in 2019-2020.

3.3 STAKEHOLDER ACTIONS

3.3.1 Opportunistic Projects

The cities and Hennepin County have been routinely including load reduction and infiltration BMPs into their highway and street reconstruction projects. Hennepin County added ponds and treatment devices into a recent CSAH 81 reconstruction project that not only treated runoff from the highway, but also from adjacent residential and commercial areas that discharged into their storm sewer systems. BMPs have also been added in public spaces, such as rain gardens at Robbinsdale City Hall, the 37th Avenue Greenway in Minneapolis, and in street right of way. The City and Commission will also investigate retrofit opportunities to partner with private property owners such as the Terrace Shopping Center.

3.3.2 Implement Subwatershed Assessment

The Crystal Lake Subwatershed Assessment Report identified several locations in the watershed where BMPs, mostly bioinfiltration basins and rain gardens, could be added as streets are reconstructed to achieve additional total phosphorus load reductions. The estimated cost of installing those BMPs was about $210,000, with a target of achieving a 10 percent load reduction or 51 pounds TP per year.

3.3.3 Street Sweeping

Continue to identify critical areas and sweep streets more frequently as necessary.

3.3.4 Shoreline Buffers and Restoration

Robbinsdale will continue to urge shoreline property owners to install and maintain shoreline buffers and to restore any unstable or eroded shorelines, and will undertake additional buffer and restoration projects on city-owned lakeshore property where feasible.

3.3.5 Aquatic Vegetation and Fish Management

Aquatic vegetation surveys performed by the Commission in 2013 indicated there is currently very little aquatic vegetation in Crystal Lake (Appendix X). Water quality in Crystal Lake is expected to improve as the aforementioned external and internal load reduction projects are implemented. Water clarity in Crystal Lake should increase as water quality improves, which will likely trigger growth of floating and submerged aquatic plants. The City of Robbinsdale will work with the DNR, Commission and the lake association to prepare and implement an aquatic vegetation management plan, including ongoing monitoring and treatment of invasive species such as curly-leaf pondweed and Eurasian water milfoil as necessary. The DNR last completed a fish survey in 2004, and the Commission will work with the DNR to obtain updated fish survey information.

3.3.6 Flocculation Treatment Facility

A review of the treatment facility operation data shows that dissolved phosphorus removal is much more efficient and effective when hypolimnetic water is being treated compared to water withdrawn from the epilimnion. Going forward, it is recommended that the City manage operations to maximize the amount of time the plant is withdrawing from the anoxic hypolimnion.

4.0 References

Wenck Associates, Inc. 2008. Crystal Lake Nutrient TMDL.
http://www.pca.state.mn.us/index.php/view-document.html?gid=7906

Wenck Associates, Inc. 2009. Crystal Lake Nutrient TMDL Implementation Plan.
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Appendix A

Appendix B

Appendix C