NONPOINT SOURCE SUCCESS STORY

Minnesota

Stormwater and Invasive Aquatic Plant Control Improves Crystal Lake

Waterbody Improved

Crystal Lake serves as a recreational resource in a highly developed watershed. In 2002 Minnesota added the lake to the Clean Water Act (CWA) section 303(d) list of impaired waters for exceeding eutrophication criteria. A total maximum daily load (TMDL) study was conducted in 2011 and determined that the lake is impaired predominantly from internal phosphorus loading sources (decaying curlyleaf pondweed and sediment release). After implementing many best management practices (BMPs), including harvesting of curlyleaf pondweed, stormwater outfall cleanout, stormwater pond cleanouts and installation of a large regional stormwater system in upstream Keller Lake Park, the lake now meets water quality standards.

Problem

Crystal Lake (19-0027) is a 292-acre lake in the cities of Burnsville and Lakeville in Dakota County, Minnesota. The lake is within the North Central Hardwood Forests (NCHF) ecoregion. It is defined as a deep lake with a mean depth of 10 feet and a maximum depth of 35 feet. The lake is a major recreational resource for the area and is in a highly developed watershed that spans 3,667 acres (including the lake surface area). Several other lakes are also within the Crystal Lake watershed, including Keller Lake (Figure 1). In 2002 Minnesota listed the lake as impaired for exceeding eutrophication criteria (Table 1).

A summary of 1998–2008 data developed during the TMDL showed averages of 41.8 micrograms per liter (µg/L) total phosphorus, 24.5 µg/L chlorophyll *a* and 1.7 meter Secchi disk depth for the growing season. The TMDL called for an overall loading reduction of 31 percent and identified internal loading to be the major source of excess phosphorus. The internal loading was determined to be primarily from decaying curlyleaf pondweed and sediment release.

Story Highlights

Actions that helped reduce phosphorus loading include both in-lake management and external loading controls by the cities of Burnsville, Lakeville, and Apple Valley, which are all part of the Black Dog Watershed Management Organization. As part of its restoration approach, the city of Burnsville hired a company to conduct annual mechanical harvesting of curly leaf

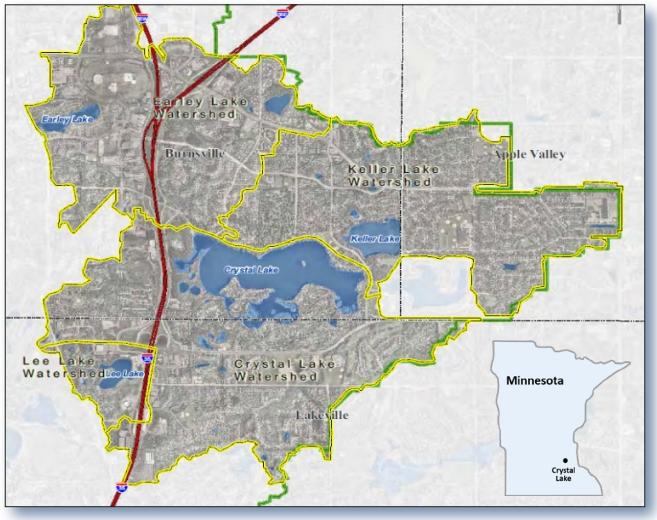

Figure 1. The Crystal Lake watershed is south of Minneapolis.

Table 1. A comparison of applicable lake eutrophication standards versus Crystal Lake datasets.

Eutrophication Water Quality Standards (NCHF Ecoregion)	TP	Chl a	Secchi Depth
	µg/L	µg/L	meters
Pre-2010: NCHF – Trophic State Thresholds for impairment	< 45	< 18	> 1.1
Post 2010: NCHF – Aquatic Rec. Use (Class 2B) – Deep Lake Criteria	< 40	< 14	> 1.4
Crystal Lake Datasets			
Pre-2002 Crystal Lake Data (used for original listing)	45	27.2	1.8
2006–2016 Crystal Lake Data (used for delisting)	32.8	20.6	1.7

pond weed across about 50 acres of the 290 acres of Crystal Lake over a 2-week period. If not cut back, the weed would die off in the peak of summer and release nutrients into the water, feeding algae blooms.

In the mid-2000s, the city of Burnsville constructed 17 rain gardens in an existing neighborhood within the Crystal Lake watershed as part of a paired watershed study (Figure 2). The study showed that the rain gardens reduced runoff volumes by approximately 90 percent, confirming that existing residential neighborhoods can be successfully retrofitted with rain gardens and provide high levels of runoff reduction and stormwater quality improvement.

Photo: MPCA

Figure 2. A rain garden installed in the Crystal Lake watershed in Burnsville.

As part of their Phase II National Pollutant Discharge Elimination System Stormwater permit requirements, local cities implemented a number of stormwater improvement projects. The cities of Burnsville and Lakeville dredged some existing stormwater ponds near Crystal Lake to increase their effectiveness. The city of Apple Valley built a stormwater pond on Keller Lake that keeps an estimated 55 pounds of phosphorus out of the water every year. Keller Lake was shown to contribute 20–25 percent of the phosphorus in Crystal Lake. To help mitigate that significant contribution, the city of Burnsville built an underground wet vault system to treat stormwater before it discharges into Keller Lake (Figure 3). The Keller Lake (Crystal Beach Park) Storm Water Quality Improvement Project received a $398,000 Clean Water Fund (CWF) grant in 2016 from the Minnesota Board of Soil and Water Resources. The city of Burnsville leveraged other funding in the amount of $482,000. This project reduced the phosphorus load by 78 pounds per year (lbs/yr), meeting the TMDL reduction.

Figure 3. An underground stormwater treatment system reduces contaminated water entering Keller Lake (not visible). Crystal Lake is in the background.

Results

Review of recent data (2006–2016) indicates growing season averages of 32.8 µg/L total phosphorus, 20.6 µg/L chlorophyll *a* and 1.7 m Secchi disk depth (see Table 1). With phosphorus meeting the standard and at least one of the response variables (chlorophyll *a* or Secchi disk) meeting its criteria, the lake was approved for removal from the state's 2018 list of impaired waters. In-lake water quality monitoring will continue on this lake to evaluate trends over time and to inform the need for modifying in-lake management. Also, opportunities for additional stormwater treatment will continue to be explored.

Partners and Funding

Crystal Lake cleanup projects relied on multiple players in addition to those already mentioned (Minnesota Board of Soil and Water Resources and the cities of Burnsville, Apple Valley and Lakeville). The Black Dog Watershed Management Organization helped to conduct water quality monitoring, organize projects, and apply for grants to benefit Crystal Lake. Other local governmental organizations provided programs and funding to benefit these lakes. The Dakota County Soil and Water Conservation District offers a Landscaping for Clean Water Grant program that makes it easy for Dakota County residents to plan and install native gardens, rain gardens, and native shoreline plantings. The city of Burnsville also offers grants for residents of up to $1,000 for projects on private property that enhance water quality, including shoreline restorations, rain gardens and native plantings.

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For additional information contact:

Chris Zadak
Minnesota Pollution Control Agency
651-757-2837 • chris.zadak@state.mn.us