



NONPOINT SOURCE SUCCESS STORY

Minnesota

Coordinated Efforts Improve Water Quality in Beaver, Keller, Carver and Battle Creek Lakes

Waterbodies Improved

Nutrients in stormwater runoff resulted in the eutrophication and impairment of four lakes in Minnesota's Ramsey-Washington Metro Watershed District (RWMWD). As a result, the Minnesota Pollution Control Agency (MPCA) added the lakes to its Clean Water Act (CWA) section 303(d) list of impaired waters—Beaver, Keller and Battle Creek lakes in 2002 and Carver Lake in 2008—for failure to attain their aquatic recreation designated uses. Implementing best management practices (BMPs) throughout the watershed decreased stormwater runoff and improved water quality in the four lakes, allowing Minnesota to remove them from its list of impaired waters in 2014.

Problem

The RWMWD is in the eastern Twin Cities Metro Area in Minnesota (Figure 1). The majority of the watershed is developed, with industrial, commercial and residential land uses present. The watershed district contains 12 cities, 18 lakes, five streams and numerous wetlands. The Beaver, Carver, Keller and Battle Creek lakes together drain more than 12 square miles of land within this watershed district. All four lakes are regularly used for recreational activities such as canoeing and fishing.

Minnesota water quality standards for aquatic life and recreation for shallow lakes in the summertime (June–September) require that (1) the average total phosphorus (TP) concentrations are equal to or less than (\leq) 60 micrograms per liter ($\mu\text{g/L}$), (2) chlorophyll-*a* (chl-*a*) concentrations are $\leq 20 \mu\text{g/L}$, and (3) Secchi disc (SD) transparency is at least 1.0 meter (3.3 feet). For deep lakes, the standards are more stringent, requiring that the summertime average TP concentrations are $\leq 40 \mu\text{g/L}$, chl-*a* concentration are $\leq 14 \mu\text{g/L}$, and SD transparency is at least 1.4 meters (4.6 feet).

Data collected about every other week during the growing season beginning in the 1970s (in Beaver, Keller and Battle Creek lakes) and 1980s (in Carver Lake) indicated that the lakes were not meeting these standards. Battle Creek Lake exceeded standards for TP, while Beaver, Carver, and Keller lakes failed to meet standards for TP, chl-*a* and SD from the late 1970s through the early 2000s. Based on these data, Beaver, Keller and Battle Creek lakes

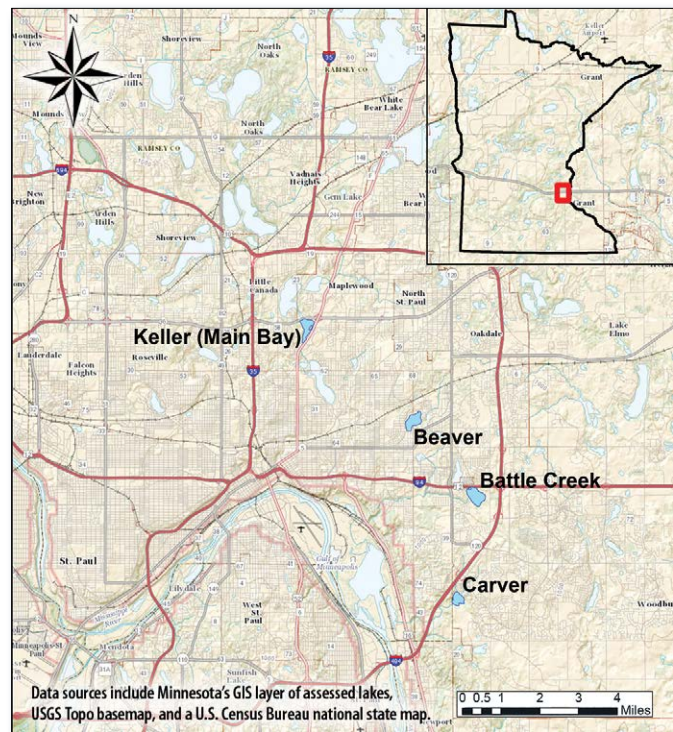


Figure 1. The four restored lakes (Beaver, Carver, Keller and Battle Creek lakes) are on the eastern side of St. Paul in southeastern Minnesota's Twin Cities Metro Area.

(shallow lakes) were listed as impaired for failing to attain their aquatic recreation designated uses in 2002 and Carver Lake (a deep lake) was listed in 2008. Carver Lake was listed in 2008 rather than 2002 because consistent summer TP, SD and chl-*a* water quality data were not available.

Project Highlights

Numerous lake management plans were implemented which directed and focused the restoration efforts for these lakes. These plans culminated in a 2007 RWMWD Watershed Management Plan. Specific plan elements included implementing BMPs, stricter stormwater treatment standards, and the Volume Reduction Strategy that the RWMWD adopted in 2006 (Table 1).

Results

Project efforts helped decrease phosphorus loading to these lakes, which has led to improved water clarity and decreased chl-*a* concentrations. Recent monitoring data indicate that water quality has significantly improved in the four lakes (Figure 2). Due to year-to-year variation in the lakes, the 10-year averages (June–September) of TP, chl-*a* and SD were used to analyze recent water quality trends. This analysis revealed that Beaver Lake has consistently met the state's eutrophication standards since 2006, Keller Lake and Carver Lake have been meeting state standards since 2007, and Battle Creek Lake has met TP standards since 2010. As a result, all four lakes were removed from the impaired waters list in 2014.

Partners and Funding

Lake restoration efforts were supported by many partners and funding sources. Specific partners included the RWMWD, MPCA, Minnesota Board of Water and Soil Resources (BWSR), Minnesota Department of Natural Resources (DNR), Metropolitan Council, city of Woodbury, Ramsey County, city of Maplewood, Capitol Region Watershed District, city of Oakdale, Apostolic Bible Institute, Fortis Insurance and the Minnesota Department of Transportation.

Nonpoint source project funding included \$2.1 million of Capital Improvement Funds provided from 1987–2013, \$1.9 million in MPCA

Table 1. A Timeline of Practices and Policies that Improved Water Quality in the Four Lakes

Project (Date)	Project Description
Tanners Lake Water Quality Improvement Project (1997–1998)	Installed wetland enhancements, an extended detention system, a sand filter system and an alum treatment facility for the Tanners Lake watershed (discharges into Battle Creek Lake).
Tamarack Water Quality Treatment System Project (1999–2000)	Installed two treatment ponds to treat stormwater runoff entering the Tamarack Swamp wetland area (drains to Battle Creek Lake).
Valley Creek Road Stormwater Treatment Project (2002–2003)	Installed infiltration and filtration treatment cells to treat roadway and neighborhood stormwater runoff (discharges into Battle Creek Lake).
Apostolic Bible Institute Water Quality Pond Project (2002–2004)	Installed approximately 660 feet of storm sewer and manhole/catch basin units, one diversion structure, a water quality treatment pond and a pond outlet structure to treat stormwater entering Battle Creek Lake.
Carver Lake Porous Pavement Project (2005–2006)	Retrofitted two city cul-de-sacs with porous pavers to infiltrate stormwater runoff.
Stormwater Volume Reduction standard (2006)	A standard requiring that construction projects greater than 1.0 acre retain 90% of stormwater runoff from impervious surfaces.
BMP Incentive Program (2006–2014)	42 native habitat restoration projects, 5 filter strips/swales, 40 rain gardens, 1 filtration basin, 4 infiltration basins/trenches, 7 porous pavement projects, 3 green roofs, 1 wet pond and 8 cisterns/rain barrels.
Keller Lake Shoreline Restoration Project (2010–2011)	Restored approximately 2,000 feet of shoreline using techniques such as rip rap gabions and native vegetation.
Hwy. 36/61 Interchange Water Quality Improvement Project (2012–2013)	Retrofitted an existing interchange to incorporate an enhanced sand filter and constructed wetlands for stormwater treatment discharging to Keller Lake.

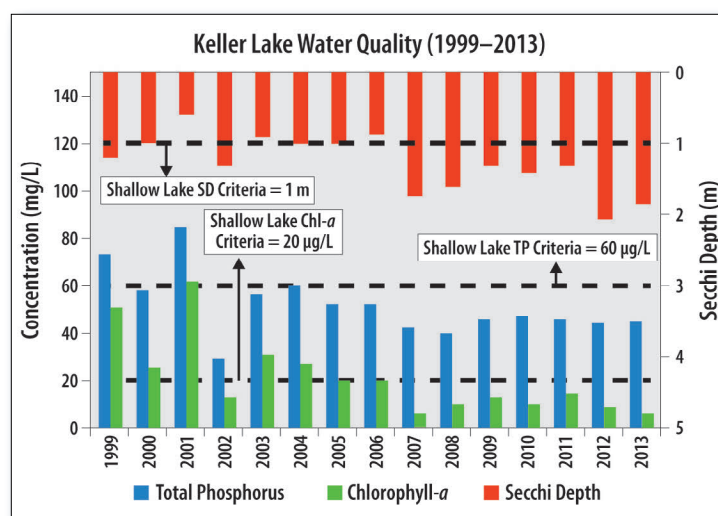


Figure 2. Decrease in total phosphorus (TP), chlorophyll-*a* (Chl-*a*) and Secchi depth (SD) concentrations (mean June–September) for Keller Lake from 1999–2013. The other three lakes show similar trends in these parameters.

state revolving fund loans, \$100,000 each from the city of Woodbury and BWSR, \$69,000 from the Metropolitan Council and \$70,000 from DNR. RWMWD served as the lead on these projects and the project manager was funded using CWA section 319 match funds.



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