

Volunteer Water-Quality Monitoring of Lake Pepin and Spring Lake:

A Citizen Lake-Monitoring Network on the Mississippi River

By

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ABSTRACT

Phosphorus levels in the Mississippi River became an issue after water-quality problems occurred in Lake Pepin during the summer drought of 1988. With very low river flows, the lake experienced severe nuisance algal blooms and localized fish kills. Excessive phosphorus was suspected as the cause. Questions arose about a possible connection between phosphorus discharges from Metropolitan Wastewater Treatment Plant (Metro Plant) and algal levels in Lake Pepin, about 50 miles downstream of the facility, and in Spring Lake, about 12 miles downstream.

Located on the Mississippi River in St. Paul, Minnesota, the Metro Plant is owned by the Metropolitan Council and operated by its Environmental Services Division (MCES). It is the largest treatment plant in Minnesota, processing about 225 million gallons of wastewater daily and serving over two million residents of the Twin Cities Metropolitan Area. Dis-

charge permits issued in 1990 and 1993 required MCES to study the effect of phosphorus loads on the water quality of the Mississippi River, Spring Lake, and Lake Pepin. MCES completed the river and lake studies with the assistance of other agencies, consultants, and partners.

As part of the Lake Pepin Phosphorus Study, 1994-98, the Minnesota-Wisconsin Boundary Area Commission (MWBAC) conducted a five-year volunteer lake-monitoring program for Lake Pepin and Spring Lake on the Upper Mississippi River. The objective was to provide information on lake-users' perceptions of water quality, coupled with water chemistry analyses, to help evaluate the water-quality goal for Lake Pepin, which was adopted by an interagency cooperative group studying eutrophication of the two lakes and river. The water-quality goal for Lake Pepin is a mean viable chlorophyll-*a* concentration of 30 micrograms per liter ($\mu\text{g/L}$) or less during the summer period (June-September) for river flows of 4,600-20,000 cubic feet per second (cfs).

Twenty-five volunteers, recruited rather than randomly selected, obtained water-quality data every other week from mid-May through September at thirteen sites in Lake Pepin and three sites in Spring Lake. During 47 sampling periods, volunteers subjectively rated the level of algae, recreational suitability, and level of suspended sediment in the lakes. The volunteers also measured Secchi depths and collected depth-integrated surface water samples. Water samples were analyzed at environmental laboratories for total phosphorus, total suspended solids, volatile suspended solids,



inorganic suspended solids, total chlorophyll-*a*, viable chlorophyll-*a*, and turbidity.

From June to September, 1994-98, 41% of river flows at Prescott, Wisconsin, fell between 4,600 and 20,000 cfs, the summer low-flow range associated with the water-quality goal for Lake Pepin. Most of these low flows occurred within the middle to upper end (10,000-20,000 cfs) of the range. Flows in the lower end (4,600-10,000 cfs) of the range were infrequent, occurring only 8% of the time. Low-flow conditions such as those during the 1988 drought, which produced severe water-quality impacts in Lake Pepin, did not occur during the study period.



Water-quality data collected by MWBAC volunteers corroborate the findings of recent scientific studies of Lake Pepin and Spring Lake. Volunteer water-quality data collected within the low-flow range of 4,600 to 20,000 cfs indicate that water quality in Lake Pepin was significantly more impaired in the upstream portion of the lake than in the downstream portion. Whole-lake mean viable chlorophyll-*a* concentrations within the low-flow range were less than 30 $\mu\text{g/L}$ in the summers of 1994 through 1997; however, the

mean summer concentration was higher than 30 $\mu\text{g/L}$ in 1998, the driest year of the study. Volunteer data also indicate that water quality was substantially more impaired in Spring Lake than in Lake Pepin.

Based on data obtained within the low-flow range, a good linear relationship exists between volunteers' ratings of physical condition (amount of algae present in lake water) and lab-measured viable chlorophyll-*a* when concentrations were less than 55 $\mu\text{g/L}$. A good linear relationship also exists between volunteer perception ratings of the amount of sediment in the water and total suspended solids concentrations. The results indicate that MWBAC volunteers could subjectively discriminate the amounts of algae and sediment present in the lakes within limited concentration ranges, including the range that encompasses the viable chlorophyll-*a* goal for Lake Pepin. Relationships between volunteer ratings of recreational suitability and the amounts of sediment and chlorophyll in the water are not as strong. The results indicate that perception ratings of recreational suitability are more complex and need further study.

Recommendations include continuing the volunteer lake-monitoring program (with some modifications), integrating the volunteer lake-monitoring program with other similar programs, and establishing procedures for an intensive "drought-oriented" monitoring program for use during extremely low-flow conditions, as occurred in 1988.

