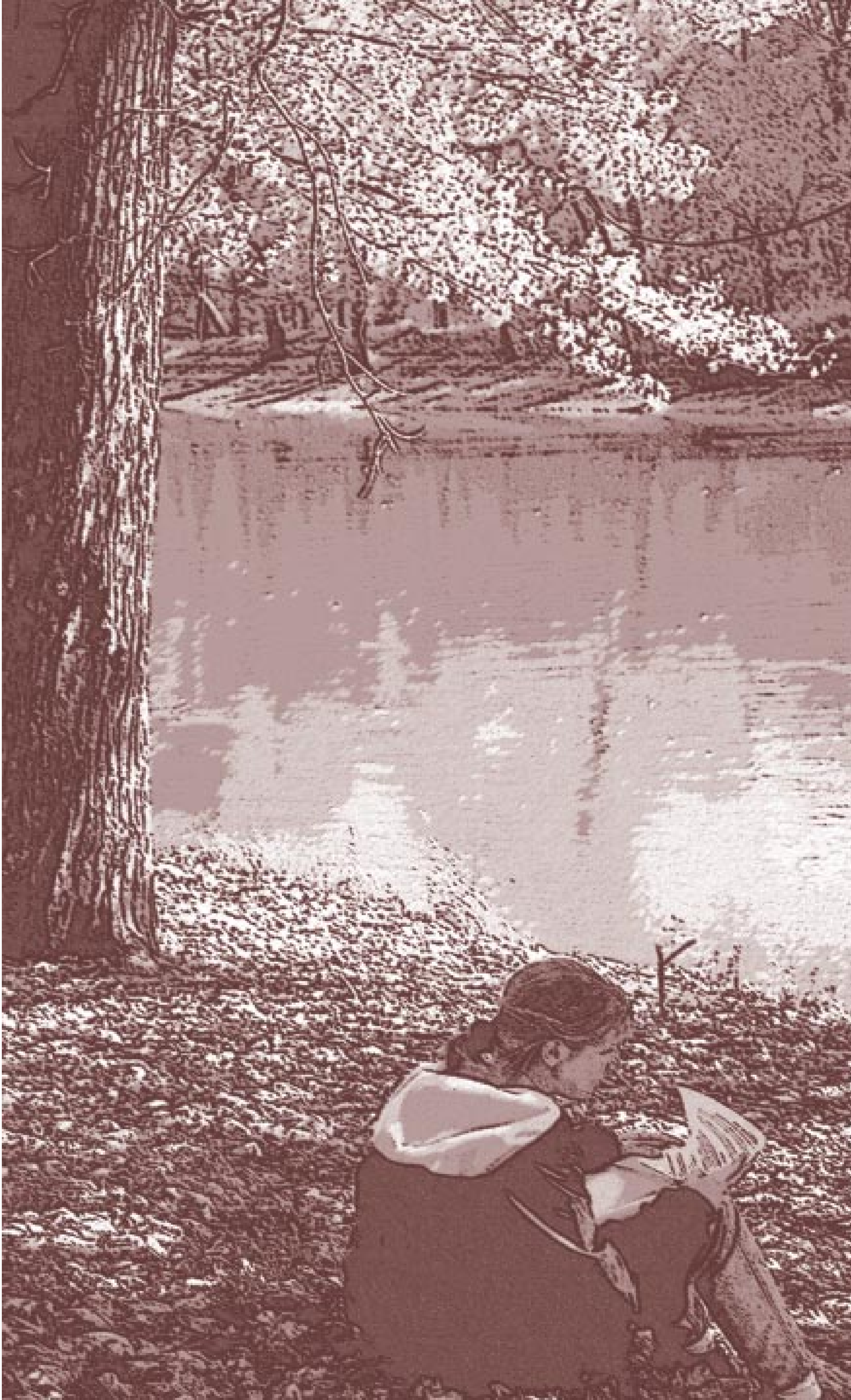
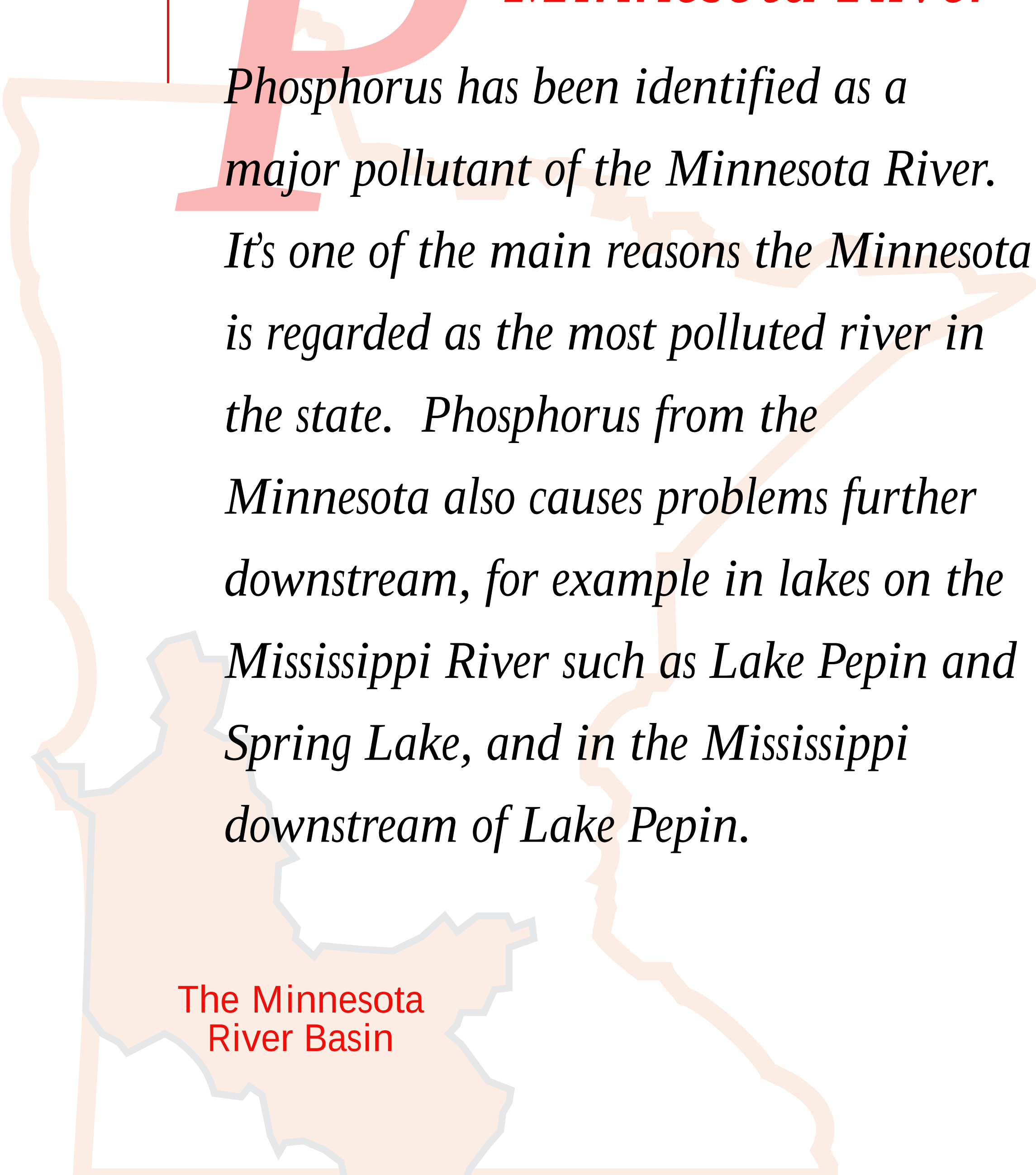


Phosphorus in the Minnesota River

Phosphorus has been identified as a major pollutant of the Minnesota River. It's one of the main reasons the Minnesota is regarded as the most polluted river in the state. Phosphorus from the Minnesota also causes problems further downstream, for example in lakes on the Mississippi River such as Lake Pepin and Spring Lake, and in the Mississippi downstream of Lake Pepin.



Reduced diversity of aquatic life is one possible result of high phosphorus levels.

Phosphorus is a nutrient for plant growth. Excess levels of this nutrient can cause algae to bloom in lakes and rivers, which has direct and secondary impacts on water quality.

One direct impact of too much algae is a reduction in transparency, or clarity, of the water in the river's main stem and its tributaries. This inhibits the growth of rooted vegetation on the river bottom which, in turn, reduces the quality of habitat and thus the diversity of aquatic life in the river.

A critical secondary impact of excessive algae growth is the depletion of dissolved oxygen in the water. As the large quantities of algae die off, sink to the river bed and decay, the bacteria which break down this biomass consume large quantities of the available oxygen in the water. In the Minnesota, the situation is bad enough that oxygen levels sometimes fall below what is needed to sustain a balanced community of fish and other aquatic organisms. The potential for this problem is especially present during times of low flow.

Phosphorus becomes more available as a food source to algae in still or slow-moving water. Thus it is most associated with water-quality problems in lakes and reservoirs. In rivers, its effect is most pronounced in back-channel areas, especially during periods of drought or low flow.

How bad is it?

Monitoring data show that the Minnesota River is severely affected by phosphorus. Average concentrations of phosphorus range from 300 to 325 parts per billion downstream of Courtland. These levels are well above those that are known to cause severe problems in lakes. Moreover, the concentration of chlorophyll in the lower Minnesota at

Jordan has established a world record for streams of similar size in temperate climates. Chlorophyll, a pigment produced by algae, is a good indicator for estimating the amount of algae in a lake or stream, and thus the impact of phosphorus. Finally, median concentrations of phosphorus in river-bed sediments are considerably higher in the lower Minnesota River than in the Mississippi River upstream of Lake Pepin.

Sources of phosphorus

Phosphorus comes from natural sources and human activities. All plants contain phosphorus. As plants die and decompose, phosphorus is released. Human activities that generate phosphorus are often categorized as either "point" or "nonpoint" sources. Point-source phosphorus comes mainly from municipal and industrial discharges to surface waters, whereas nonpoint-source phosphorus comes from agricultural fields, urban runoff, construction sites, feedlots, and on-site septic systems.

Point and nonpoint sources of phosphorus affect the river in somewhat different ways. With the exception of stabilization ponds used mainly by smaller communities, point sources tend to discharge continuously throughout the year. By contrast, most nonpoint-source pollution, with the exception of on-site septic systems, is generated by precipitation that triggers surface runoff. Thus there is a strong tendency for nonpoint-source pollution loading to coincide with normal or high river flows, while point-source loads dominate during low flow when nonpoint-source loads are minimal.

Excess phosphorus in the Minnesota River causes algae to bloom.

The total phosphorus "load" in the Minnesota River, and the relative proportions of point- and nonpoint-source contributions to it, vary greatly with the river's flow (see charts on opposite page).

What's being done about it?

One environmental goal for the Minnesota River is to reduce the growth of algae. The Minnesota River Basin Joint Powers Board has endorsed an interim objective of reducing phosphorus loadings to the river by 40 percent, a level which would significantly contribute toward this goal. Once the 40 percent reduction has been achieved, the need for further phosphorus reductions can be evaluated. To be successful, phosphorus reduction will need to occur in both the point and nonpoint-source arenas.

Point sources

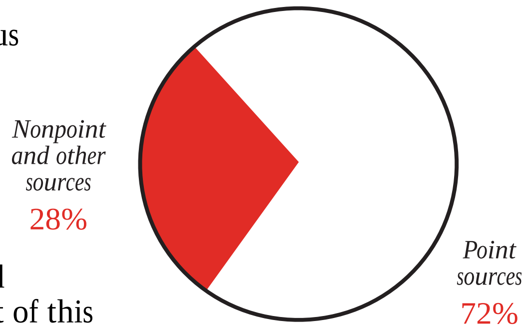
Compared to pollution from nonpoint sources, point-source pollution in the Minnesota originates from a small number of large contributors. There are 282 municipal and industrial dischargers in the Minnesota River basin. In 1996, 10 of these accounted for about 60 percent of the Minnesota's total phosphorus load from point sources. Most point sources have made significant progress in reducing the pollutants they discharge to the Minnesota River and its tributaries. However, few have taken measures specifically to reduce their phosphorus load, because phosphorus pollution in rivers has only recently become a priority issue. Such measures would include

Point-source phosphorus comes mainly from municipal and industrial wastewater discharges.

Phosphorus proportions at high, low, and average flows

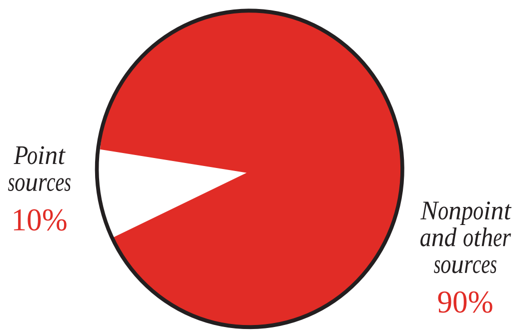
- *Low Flow:* In the low-flow year of 1989, the total annual load of phosphorus measured at Jordan was 396 tons (i.e., the river carried that much phosphorus past the measuring point during that year). Point sources contributed approximately 72 percent of this total, an estimated 284 tons. The remainder was contributed by nonpoint sources, natural background, and phosphorus released from river sediments.

Relative proportions of
total phosphorus load at low flow

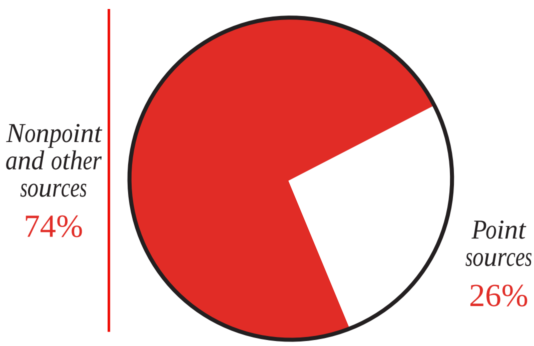


- *High Flow:* In the high-flow year of 1991, the total annual phosphorus load measured at Jordan was 2,976 tons. Point sources contributed approximately 10 percent of the total, an estimated 284 tons.

Relative proportions of
total phosphorus load at high flow



Relative proportions of
total phosphorus at long-term average flow



- *Long-Term Average Flow:* On average, from 1979 to 1993, the total annual load of phosphorus at Jordan was 1,080 tons. Point sources contributed approximately 26 percent of the total, an estimated 284 tons. The remaining 74 percent was contributed by nonpoint sources, background, and sediments.

treatment of wastewater with phosphorus-binding chemicals such as alum and ferric chloride, or biological phosphorus-removal processes.

The three items below summarize a strategy which the MPCA, together with municipal and industrial dischargers, is pursuing to further decrease point-source phosphorus released into the river. Each strategy is based on a specific provision of the state's water-quality rules.

1. Discharges directly to or affecting a lake or reservoir are given a phosphorus effluent limitation of one milligram per liter (mg/l).
2. Wastewater treatment projects that propose new or expanded discharges and are identified as "significant" under agency rules require a "nondegradation review" to determine their impact on water quality. This helps to ensure that opportunities for reducing phosphorus are fully explored. The MPCA then considers what additional control measures beyond minimum treatment requirements can reasonably be taken to minimize water-quality impacts.
3. Point sources need to remove nutrients to the fullest practicable extent where nutrients are considered to be detrimental to designated water uses. Major wastewater treatment plants are encouraged to initiate a phosphorus management planning process that includes monitoring, an evaluation of phosphorus reduction alternatives, and the development of a phosphorus management program to protect downstream waters.

Significant phosphorus reductions already are being implemented. The Metropolitan Council's Blue Lake and Seneca wastewater treatment plants on the Minnesota are voluntarily removing phosphorus. In January, 1997 the Rahr Malting Company was issued the first discharge permit on the Minnesota River to contain specific phosphorus limits. In December, 1997 the city of Mankato became the first municipal discharger on the river with phosphorus limits. The city's phosphorus reduction plan goes beyond the limits required in its discharge permit.

Nonpoint sources

Nonpoint-source pollution originates from literally thousands of sources across the basin. State and federal agencies are working with citizen groups, local government, the Joint Powers Board, and other organizations to reduce nonpoint-source pollution in the Minnesota

Conservation tillage helps to reduce the amount of sediment-attached phosphorus that washes into streams.

River. The list below summarizes some of the efforts being used to improve water quality.

1. New or expanding feedlots are required to obtain a certificate demonstrating they are in compliance with water-quality rules for feedlots. This involves both MPCA and county feedlot officers. There are other non-regulatory efforts directed at manure management as well as educational activities such as field days and demonstrations.

2. The MPCA's program for individual sewage treatment systems governs treatment of sewage from individual homes and businesses (e.g., septic systems). Regulation also involves county governments. Several agencies, including the MPCA, fund septic-system upgrades through a state revolving loan fund.

3. Agricultural producers are encouraged to use conservation tillage on their fields. The adoption of conservation tillage is approaching 50 percent on a countywide basis in the basin, according to a survey conducted by the Minnesota Board of Water and Soil Resources. Many producers have also enrolled land in state and federal land retirement programs (e.g., Conservation Reserve Program and Reinvest in Minnesota). In addition, many of those farming highly erodible land have adopted conservation plans under the 1985 Farm Bill's Conservation Compliance provisions. Such measures help to hold more soil in the field and reduce the amount that enters a stream as polluted sediment. Since phosphorus often is attached to sediment particles, limiting the amount of sediment that enters streams also helps in reducing phosphorus pollution. Progress is being made to reduce sediment in the Minnesota River. Research data from the Mankato

monitoring station show sediment concentrations at typical river flows were approximately 25 percent lower in the decade 1986-1995 compared to the 1970s.

4. The University of Minnesota Extension Service published a set of “best management practice” recommendations for phosphorus management in 1997. BMPs are on-land methods of reducing runoff. Since many agricultural fields test very high in phosphorus, fertilizer application rates can be reduced without affecting yields in many cases. Additionally, subsurface placement of phosphorus is a very effective method of reducing phosphorus runoff. The U’s extension service is helping to publicize these and other beneficial practices.

5. Local governments are working with citizens to better utilize their Comprehensive Local Water Plans and to obtain funding to improve water quality. Setting local goals and developing a resource-improvement philosophy for tributaries will help to achieve downstream water-quality improvements as well.

For more information

To get involved in activities related to the Minnesota River, contact either:

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(612) 297-3825

Stephen Hansen
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Joint Powers Board
125 Charles Avenue
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(612) 361-6590

Check the MPCA’s site on the worldwide web, at www.pca.state.mn.us.

Minnesota River Basin

The Minnesota River flows 335 miles through some of the state's richest agricultural land from its source in Big Stone Lake on the Minnesota/South Dakota border to its confluence with the Mississippi at Fort Snelling. The river's basin drains 16,700 square miles, including all or parts of 37 counties, with a population of about 700,000. The Minnesota River is the state's largest tributary to the Mississippi.