PHOSPHORUS

ASK an EXPERT
ABOUT THE MINNESOTA RIVER

What is Phosphorus?

Phosphorus is an important nutrient for plant growth. Total phosphorous is the measure of the total concentration of phosphorus present in a water sample. Excess phosphorus in the river is a concern because it can stimulate the growth of algea. Excessive algae growth, death, and decay can severely deplete oxygen supply in the river, endangering fish and other forms of aquatic life. Low dissolved oxygen rates are of concern particularly during low-flow times or in slow-flowing areas such as reservoirs and the lower reaches of the Minnesota River. Large total phosphorus loads can have major impacts on downstream receiving waters such as Lake Pepin. Point-source phosphorus comes mainly from municipal and industrial discharge to surface waters. Nonpoint-source phosphorus comes from runoff from urban areas, construction sites, agricultural lands, manure transported in runoff from feedlots and agricultural fields, and human waste from noncompliant septic systems.

Phosphorus

Phosphorus-enriched streams are commonplace in the Minnesota River Basin. Elevated phosphorus levels stimulate algal growth and often lead to undesirable conditions. An overabundance of algae and sediment contributes to increased turbidity and reduced light penetration. Water clarity is greatly reduced under these conditions. When the algal cells die, their decomposition consumes large amounts of dissolved oxygen. Lower dissolved oxygen can impair the stream's ability to support aquatic life. Some outbreaks of highly elevated algal growth, termed algal blooms, release toxins into the water. Instances of this have occurred within the Minnesota River Basin and resulted in the death of animals (including pets) that ingested these toxins.

Phosphorus concentrations show substantial variation across the Basin. During 2000 to 2008, the average phosphorus concentration in the Minnesota River mainstem reach from Judson to Fort Snelling was 0.31 mg/L. Studies indicate that a reduction in undesirable algal growth cannot be expected unless mainstem phosphorus concentrations are brought below a threshold value of 0.26 mg/L. Several Minnesota River tributaries have phosphorus concentrations substantially greater than the threshold value (see map). These highly-enriched tributary streams deliver phosphorus loads that enrich the mainstem and slow the recovery of the Minnesota River. Phosphorus arises from both point (e.g. municipal and industrial discharges) and non-point sources (e.g. runoff from agricultural lands and urban areas).

Watonwan River algal bloom.

Blue Earth River algal bloom.

Lake Pepin algal bloom. The lake is accumulating phosphorus at 15 times the natural rate.

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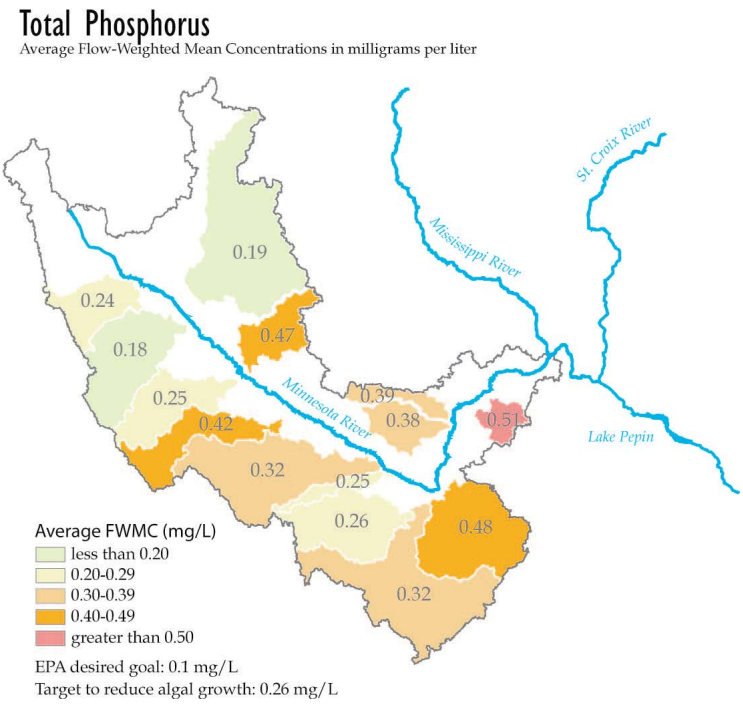
Phosphorus

Phosphorus is a chemical commonly found in soil, rocks and plants. It is an essential nutrient for plant growth and therefore is an important fertilizer in agricultural production and widely applied across the Minnesota River Basin (see map below). However, phosphorus is also an important contaminant of surface water since even low concentrations can lead to algal blooms (eutrophication). Elevated phosphorus levels is the primary cause of algal growth which is a leading contributor to low dissolved oxygen concentrations in the lower twenty-two mile reach of the Minnesota River during low flow conditions. Further downstream, elevated phosphorus levels can contribute to eutrophication of Lake Pepin. At a national scale, eutrophication is responsible for the hypoxic zone (area of low oxygen) in the Gulf of Mexico (see "Downstream Impacts: Nitrates and the Dead Zone" section for more information).



Sources of Phosphorus

The MPCA approximated primary sources of phosphorus to the Lower Minnesota River as part of Lower Minnesota River Dissolved Oxygen TMDL. Primary sources of Phosphorus included: Wastewater Treatment Facilities 65 percent, Urban stormwater 16 percent, Agriculture 14 percent, direct discharges of sewage 4 percent (MPCA, 2006). For all surface waters in the state, MPCA estimates that 26.4 percent of the total P delivered are attributed to surface runoff from cropland and pastureland during average flow conditions. Agricultural tile drainage, feedlots, and atmospheric deposition accounted for 1.8, 1.0, and 13.1% of the total P contributions during the average flow years, respectively. Furthermore, the study attributes 4.8 percent of the total P in the statewide surface waters to urban runoff during average flow years (Barr Engineering, 2004).

Farm Scale Study

A farm survey conducted in Seven Mile Creek Watershed in 2002 serves as an example of phosphorus use in the basin. Eighteen farms were interviewed totaling 11,000 acres of farmland. The cropland was dominated by a field corn and soybean rotation (93% of all acres). Commercial Phosphorus (P) applications accounted for 75 percent of the total P applied for corn acres with the balance of P contributed from manure (mostly hog). Average commercial fertilizer rate of phosphate across all field corn acres was 36 pounds per acre. A total of 263,000 pounds of P were applied on inventoried fields (MDA 2002).

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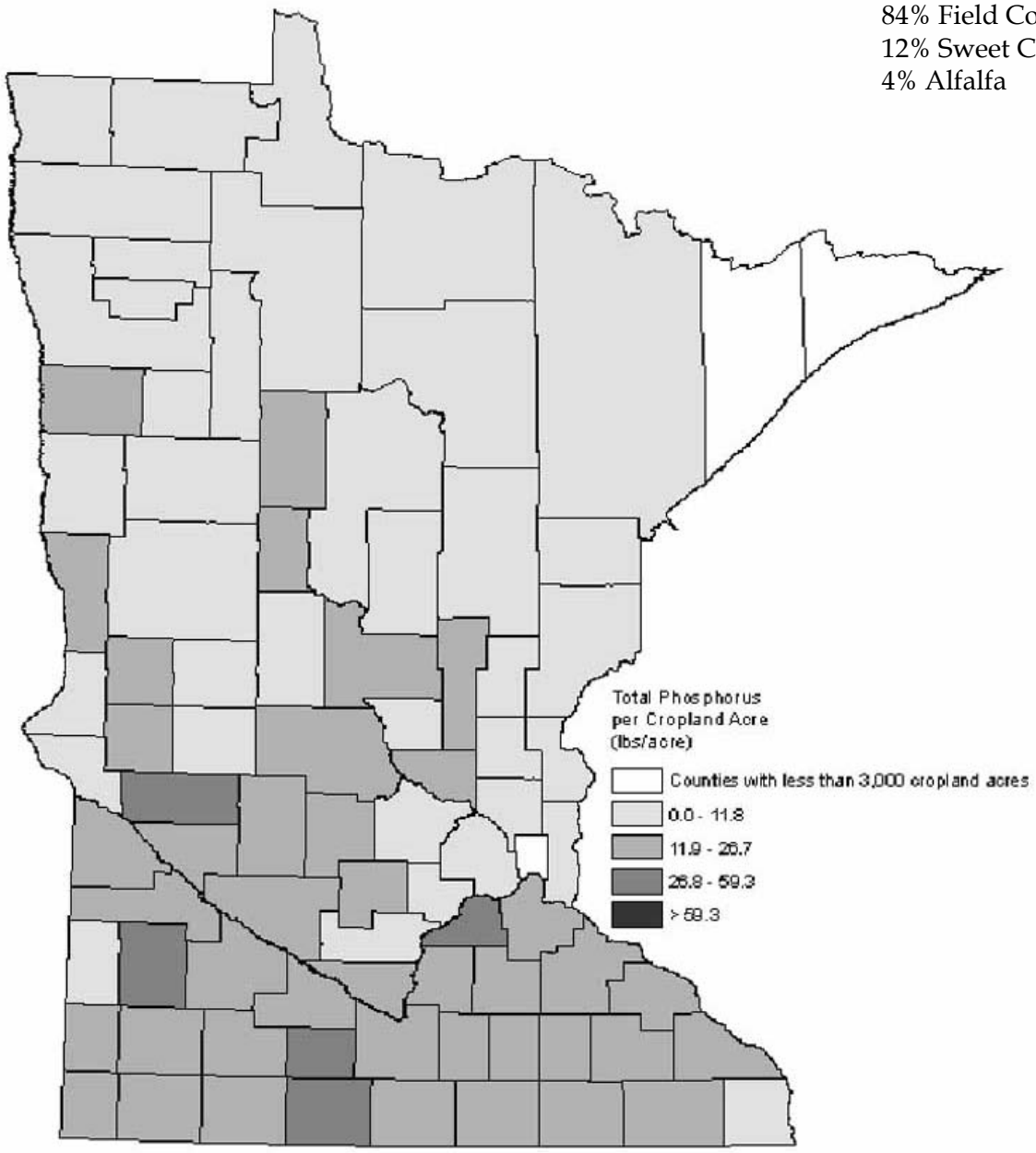
Phosphorus Applied

Destination of commercial phosphate used on field corn acres

84% Field Corn
12% Sweet Corn
4% Alfalfa



The map above depicts phosphorus input estimates based on 2002 Census data for county fertilizer sales and "fertilizer replacement" values from manure contributions. Inputs are averaged across all cropland acres within each county (Birr et al, 2008).The Minnesota River Basin stands out as a region with higher phosphorus inputs.

"Ask an Expert about the Minnesota River" project profiles scientists and citizens answering questions about the health of the Minnesota River. More answers to questions about the Minnesota River can be found at: mrbdc.mnsu.edu/learn

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