

PHOSPH US

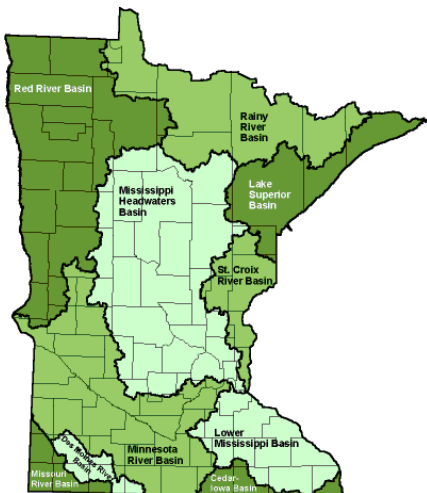
What IS phosphorus?

- Atomic element P, but not found in its pure form in nature.
 - Crucial nutrient for plant growth.
 - Often below detection in natural waters. Its minimal amount makes it the nutrient that limits primary production.
 - Inorganic form: phosphate.
- Organic forms: dissolved or particulate.

Sources of phosphorus in MN rivers

- Agricultural Systems: drainage waters, eroded soil, animal excretion.
 - Leaches to soil
 - Erosion: grassland to arable land from overcultivation or overgrazing.
- Runoff from: construction sites, lawns, phosphorus mines
- Untreated wastewater.

Minnesota River Basins
produced by Minnesota Planning



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Effects of Phosphorus on Water Systems

- Eutrophication: decreased DO with an increase in BOD.
- Decrease in water and habitat quality = limits to biodiversity.
- Increases invasives.
- Increases toxicity of water.



Phosphorous Treatment

- Chemical removal
 1. Add calcium, iron, or aluminum salts
 2. Combine with phosphate to form a precipitate.
 3. Clarify or filter precipitate.
 4. Dispose of sludge.
- Biological removal
 1. Bacteria (PAOs) placed in anaerobic environment.
 2. Organic matter ferments to create fatty acids (VFAs).
 3. Bacteria consume VFAs by metabolizing and *releasing* phosphates; but accumulate organic compounds for later use.
 4. In aerobic phase--PAOs multiply and absorb the phosphorus they depleted during anaerobic phase + oxidize carbon for energy to continue absorbing and storing phosphorus.
 5. Some sludge recycled; some sludge is disposed of.

Phosphorus Prevention

- MN has a lawn phosphorus ban = GOOD!
- Agricultural solutions: erosion prevention because that is how phosphorus enters water systems.
 - Buffers
 - Grass waterways
 - Conservation tillage techniques
 - Contour strips/terraces on hillsides

Comparison of the THREE RIVERS

- More than 160 municipal and industrial point-sources have operated in the St. Croix River basin since 1905.
- The St. Croix River basin is currently undergoing an effort to make a 20% reduction in phosphorus input.
- By 2020 the projected phosphorus input is 550 tons per year.
- The Minnesota River currently inputs 4,000 pounds of phosphorus per year.
- Most phosphorus inputted to the Minnesota River basin is due to wastewater treatment plants.
- The Mississippi River loads 3,810 metric tons of phosphorus per year.

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