Pond Systems Nutrient Removal

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Organization Background

Minnesota Rural Water Association (MRWA) was founded in 1978. They are a non-profit association governed by a board of directors. They are staffed with full-time personnel trained to offer professional on-site technical assistance and training to water and wastewater system personnel in managerial, financial, and operation and maintenance of systems, as well as in source water protection. MRWA has partnered with the Minnesota Pollution Control Agency (MPCA) and MnTAP to find and implement wastewater treatment optimization strategies with Minnesota wastewater treatment ponds.

"Working at MnTAP has been a wonderful experience that has allowed me to take initiative on an interesting and important project. During the summer I learned a lot about how wastewater pond systems operate, and it was satisfying turning my findings into fleshed-out recommendations that will improve Minnesota's nutrient outflow." ~ AI

Project Background

MnTAP is partnered with the Minnesota Rural Water Association (MRWA) and the Minnesota Pollution Control Agency (MPCA), with funding through a grant by the LCCMR Legislative-Citizen Commission on Minnesota Resources (LCCMR). The goal of this partnership is to work with cities to reduce the phosphorus and nitrogen effluent in their wastewater treatment ponds (WWTPs). The project involves analyzing the pond systems and suggesting operational changes, as well as finding source reduction opportunities within the sources of inflow. The project's scope focused on the waste water ponds of the cities of Sandstone, Onamia, and Grand Meadow.

Incentives To Change

Nutrients discharged from facultative ponds are released into the ecosystem of local water bodies. If this nutrient loading is large, the local waters experience extreme algae growth in a response to the overabundance of their nutrient food source. The oxygen demand of the algae will lead to low dissolved oxygen within the water. This harms local aquatic animals and plants, putting the whole system at an imbalance. These waters have odor issues, taste strange, and are aesthetically displeasing. It also raises the cost of treating the water and converting it into acceptable drinking water.

For the reasons listed above, the MPCA has started setting phosphorus discharge limits for facultative ponds. Only around 37% of Minnesota's facultative ponds meet the new effluent limit.

> "I enjoyed working with the MnTAP interns on the Wastewater Optimization Project."
>
> *~ Tim Hagemeier*
> *Minnesota Rural Water Association*

Solutions

Use Alum for Chemical Phosphorus Removal

The three pond systems assessed this summer were not using chemical treatment to aid with phosphorus removal. Aluminum sulfate (alum) and ferric chloride (ferric) are common phosphorus removal chemicals. The chemicals can be distributed into the secondary pond from a small boat, or with more complex mixing systems.

Onamia and Grand Meadow: Adopt Waterfowl Prevention Techniques

Geese are attracted to the ponds in both Onamia and Grand Meadow, contributing fecal matter to the system. The solutions identified to prevent this loading is the use of wolf decoys along with an anti-bird odor chemicals to deter the geese. This recommendation could reduce 150 lb and 130 lbs of phosphorus per year from the respective effluent streams.

Improve the Flow Scheme of the System

The flow scheme of all the pond systems could be improved to increase hydraulic retention time (HRT) and hold water at higher depths on average. By holding water at higher depths, there is more room for bacteria and algae to grow to assist with the treatment process. This goal of higher depths is implemented in the first primary pond, which is kept near maximum depth as often as possible. HRT improvement alone could reduce phosphorus effluent annually by 100 lbs, 70 lbs, and 35 lbs for Sandstone, Onamia, and Grand Meadow respectively. Since the scheme utilizes gravity flow, there is no need for pumping between ponds, saving Sandstone $4,800 per year in energy.

Onamia and Grand Meadow: Identify and Reduce Inflow and Infiltration (I&I) Coming from Storm Water

There is evidence that storm water is making its way to the pond system in Onamia and Sandstone. Although the water introduced through I&I should not contain phosphorus, it would reduce the pond system's retention time and phosphorus treatment effectiveness. Performing flow monitoring, manhole inspections, dye testing, property inspections, televising of sewers, and/or smoke testing can help to identify sources of I&I.

This would prevent up to 27 million gallons (Onamia) and 28 million gallons (Grand Meadow) of water per year from being unnecessarily treated as wastewater. Assuming 70% of I&I can be identified and treated, this would increase the hydraulic retention time of the systems to reduce the annual phosphorus effluent by 130 lbs and 90 lbs respectively.

Recommendation	Annual Reduction	Annual Savings	Status
Sandstone: Alum Phosphorus Removal	3,600 lb phosphorus	N/A	Recommended
Sandstone: Modify Flow Scheme	100 lb phosphorus 60,000 kWh	$4,800	Implementing
Onamia: Alum Phosphorus Removal	760 lb phosphorus	N/A	Recommended
Onamia: Modify Flow Scheme	70 lb phosphorus	N/A	Implementing
Onamia: Waterfowl Prevention	150 lb phosphorus	N/A	Implementing
Onamia: I&I Identification and Reduction	180 lb phosphorus	N/A	Recommended
Grand Meadow: Modify Flow Scheme	35 lb phosphorus	N/A	Implementing
Grand Meadow: Alum Phosphorus Removal	1,000 lb phosphorus	N/A	Recommended
Grand Meadow: Waterfowl Prevention	130 lb phosphorus	N/A	Implementing
Grand Meadow: I&I Identification and Reduction	120 lb phosphorus	N/A	Planning

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