

CASE STUDY: Detroit Lakes, Minnesota Water Reclamation Facility



Application:	Aerobic Sludge Digestion
Design Flow (ADF):	1.86 ADF
Mixing Efficiency:	≈ 0.25 HP/1000 FT ³
Compressors:	Two (2) 25 HP (one duty, one standby)
Blowers:	Three (3) 60 HP (two duty, one standby)
Design Engineer:	SEH, Inc.

BioCycle-D Process Helps WRF Meet Stringent Phosphorus Limits and Save Energy

In 2013, Detroit Lakes Public Utilities began planning for a \$30-million improvement project, taking their water reclamation facility (WRF) from a seasonal effluent phosphorus limit of 1 mg/L to a stringent effluent phosphorus limit of 0.066 mg/L. The planning team considered many different options, including different facility locations, different discharge locations, and seasonal versus year-round discharges.

The team chose to maintain the existing discharge location, and they began construction of an upgraded facility on the existing site in 2018. The upgraded facility replaced an outdated trickling filter process utilizing anaerobic digestion with a **new membrane bioreactor (MBR) process utilizing aerobic sludge digestion producing Class B sludge for land application.**

In the updated MBR facility, solids are wasted off the return activated sludge (RAS) line to a membrane thickening tank. Following thickening, solids are pumped to two aerobic digesters. The anaerobic digesters were converted to aerobic digesters to minimize the rerelease of phosphorus. **EnviroMix's BioCycle-D Optimized Aerobic Digestion Process** was selected for the aerobic digesters, **delivering 77% energy savings** compared to conventional aerobic digestion, optimizing the process for phosphorus removal, and producing Class B sludge.



Detroit Lakes WRF's aerobic digesters



ENERGY EFFICIENCY

77% power savings versus traditional diffused air mixing design approach



STRAIGHTFORWARD OPERATION

Automatically adjusts cycle operating based on loading conditions

Minimal, localized maintenance



PROCESS OPTIMIZATION

Precise process control improves volatile solids destruction and phosphorus removal



UNPARALLELED FLEXIBILITY

Bottom-up mixing supplements aeration

Headers conform to the slope of the tank floor, eliminating "dead spots"



BioCycle-D utilizes compressors to mix the digesters with less than 15% of the horsepower required by the conventional aerated mixing approach.



Headers and nozzles easily integrate with the aeration grid and conform to the steep slope of the tank's cone-shaped floor.

The driving factors for Detroit Lakes' selection of an MBR and BioCycle-D Optimized Aerobic Digestion Process were the site constraints and the low effluent phosphorus limit of 0.066 mg/L. This low concentration limit was driven by a Total Maximum Daily Load study for the nearby St. Clair Lake. The WRF needed to reduce the mass phosphorus load down to 198 kg/yr — a 94% reduction of the previous permitted discharge. The BioCycle-D process was able to be retrofit into the existing anaerobic digester tanks, and the unique operation of the process ensured that phosphorus remained in the sludge.

BioCycle-D operates on the principle of alternating aerobic and anoxic conditions to optimize digestion. The alternating cycles, combined with a sludge processing mode, ensure phosphorus remains sequestered in the sludge and not in the supernatant returned to the head of the plant. Furthermore, the BioCycle-D process decouples aeration from mixing — in other words, the function of mixing is no longer provided by the diffused aeration system as it would in a conventional system, allowing for much smaller blowers and significant turndown capability.

BioCycle-D delivers the Detroit Lakes WRF:

- Optimized aerobic digestion with **class B biosolids for land application**.
- **Annual power cost savings of over \$100,000 at design loading, based on \$0.10 per kWh.**
- Requirement of three 60 HP duty blowers, as opposed to three 125 HP duty blowers with the conventional approach.
- Ability to **mix tanks with cone bottoms that are 8 feet deep** — a major barrier for alternative mixing systems.

Due to local industry process changes, the WRF is receiving approx. 30% more solids loading than anticipated. To accommodate this increased loading, EnviroMix process engineers worked with facility staff to modify the digester operation from parallel to series operation. Even in these challenging circumstances, **the plant is extremely pleased with the phosphorus capture capability in the digesters, which reduces the loading back to the head of the plant.** Over a 10-month period between 2020 and 2021, the effluent averaged 0.057 mg/L total phosphorus.

“I like the fact that BioCycle-D helps tie up the phosphorus in the sludge. And it's a great digestive product with good volatile solids destruction... Farmers love the biosolids the process produces.”

— Rob Bredeson, Water/Wastewater Supervisor



Contact sales@enviro-mix.com today to discuss the ways EnviroMix can optimize your mixing and process solutions. Or check out [this video](#) about the project!