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KENTUCKY OPERATORS TAKE THE LEAD IN REDUCING NUTRIENTS

Model results provide a framework for better performance

When the Kentucky Division of Compliance Assistance said the EPA wanted to help the Lawrenceburg Sewage Treatment Plant (STP) reduce nutrient pollution while saving energy, Superintendent Mitch Hudson was a little skeptical. "We had already had two energy audits, mainly looking at equipment upgrades. Most of those recommendations were either impossible from an operational standpoint or came with a 20-year payback. We maybe had low expectations, but we decided to give it a fair shake."

In 2017, Hudson and the chief operator, Jason Ransdell, participated in a pilot partnership targeting low- or no-cost operational changes to improve nutrient removal and save energy.

Hudson and Ransdell worked with the project team to model Lawrenceburg's 3.3 MGD Orbal ditch process with a free tool called Bio-Tiger, developed by Dr. Larry Moore at the University of Memphis. The Bio-Tiger model uses readily available treatment parameters and equipment information to develop a steady-state model and estimate potential energy savings. The model showed that aerators in the ditch supplied about 20% excess oxygen and inhibited denitrification. Hudson and Ransdell experimented with idling one 75-horsepower and two 25-horsepower aerators up to 24 hours/day to lower the dissolved oxygen (DO) concentration in the basin.

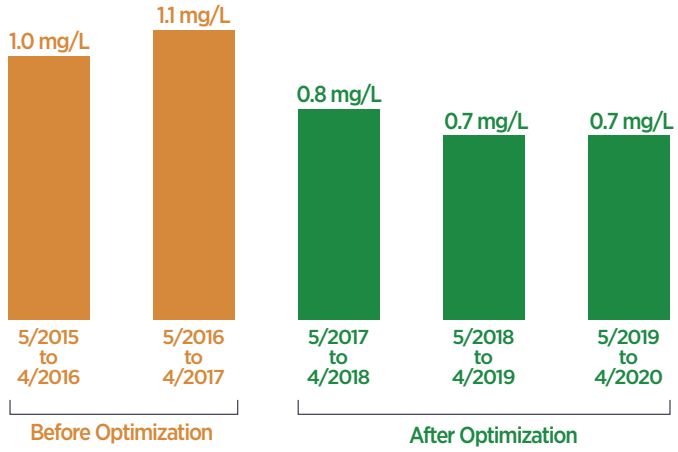
It was not a new idea, Ransdell says, but the discussion helped move things forward. "There are those ideas where you wonder 'what would happen if…' but are hesitant to try. Being able to talk to someone like Dr. Moore who has that depth of knowledge gave us some leeway to experiment."

Two years later, that experiment has paid big dividends. Effluent total nitrogen (TN) concentrations are down 63%. The three aerators remain mostly turned off, even with a 25% increase in BOD loading. This saved about $25,000/year. Lawrenceburg also discharges 39% less phosphorus and alum demand dropped with the new protocol, saving Lawrenceburg $4,500/year.

Lawrenceburg STP

Parameter	Before Optimization	August 2018–July 2019
Effluent TN (mg/L)	11	4
Effluent NH_3 (mg/L)	0.2	0.4
Effluent TP (mg/L)	1.1	0.67

Changes in average effluent total phosphorus at the Lawrenceburg POTW after optimizations



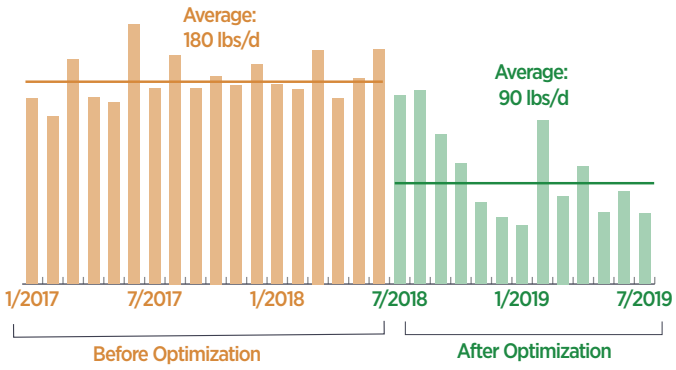
The changes were simple, but Hudson says, "You need to have the 'want-to' kind of attitude. This work represents you." The "want-to" attitude is in abundance at plants around Kentucky. At Princeton STP's 1.57 MGD oxidation ditch plant, the Bio-Tiger model showed potential to improve denitrification. William Brown, the chief operator, shut off all rotors in all three ditches for eight hours each night and ran one of two rotors in each ditch the rest of the day. Effluent TN has decreased 55%, while effluent total phosphorus (TP) has decreased by 9% without additional chemicals. Princeton has also reduced electricity usage by 13%.

Brown says the project has changed the culture at the plant. "I've turned into my dad, running around and shutting off lights," he says. He credits his superintendent, James Noel, for trusting him to get the job done. "He's given me the latitude to make changes and run the diagnostics I need to get the best from the plant."

Princeton STP

Parameter	Before Optimization	August 2018–July 2019
Effluent TN (mg/L)	22	9.7
Effluent NH_3 (mg/L)	0.4	0.3
Effluent TP (mg/L)	0.76	0.69

Changes in average effluent total nitrogen amount at the Princeton POTW after optimizations



In Greenville, superintendent Gary Russ and his team eliminate excess aeration and create anoxic conditions in their 1.3 MGD activated sludge system for a short time each day. Operators shut down the blowers from 6 a.m. to 9 a.m. every weekday for denitrification. The plant operates at high MLSS concentrations in winter, and there were some initial concerns that suspended solids would settle and clog the flexible membrane diffusers, but Russ says it hasn't been a problem.

Since the new aeration schedule began in August 2018, effluent TN concentrations have dropped 33% and electrical usage is down 13%. The average monthly electric bill has decreased from about $4,700 to $3,850.

Greenville STP

Parameter	Before Optimization	August 2018–July 2019
Effluent TN (mg/L)	15	10
Effluent NH_3 (mg/L)	0.3	0.3

Optimization Opportunities and Benefits

While every facility is unique, these three plants aren't unusual in design. Many others may have similar opportunities to save energy and improve nutrient removal. Any facility with excess treatment capacity, high effluent nitrates, and an aeration system that can operate intermittently or at reduced power might be a candidate for optimizing treatment processes.

These three plants might see future growth that would require their aerators to run more, which could reduce the long-term benefits of these optimization efforts. For now, though, their operators are using their ingenuity to pursue what is possible—and reaping the rewards.

Summary of Results

STP	Annual Energy Cost Savings	TN Reduced By	TP Reduced By
Lawrenceburg	**$25,000**	63%	39%
Princeton	**$23,000**	55%	33%
Greenville	**$10,000**	33%	N/A

Acknowledgements

This factsheet was prepared in collaboration with EPA's Brendan Held and is an adaptation of the article "Pilot Partnership for Optimization Pays Off" published by Clean Water Professionals of Kentucky and Tennessee in the December 2019 issue of *Streamlines.*

For more information, visit epa.gov/eg/national-study-nutrient-removal-and-secondary-technologies