

Kentucky Wastewater Treatment Plant Optimization

Paulette Akers and Bryan Parker
April 2025

BACKGROUND

- Kentucky joined the Hypoxia Task Force in 2012
- Found out about the Tennessee optimization program in 2014 during a R4 Water Directors meeting
- Tennessee invited us to participate in their program and we started a pilot in 2015
- 3 years of pilot with 3 facilities each year.
- Audit performed by EPA R4 and Dr. Larry Moore, under an EPA contract



SUCCESS STORIES



Case Study: Princeton, KY



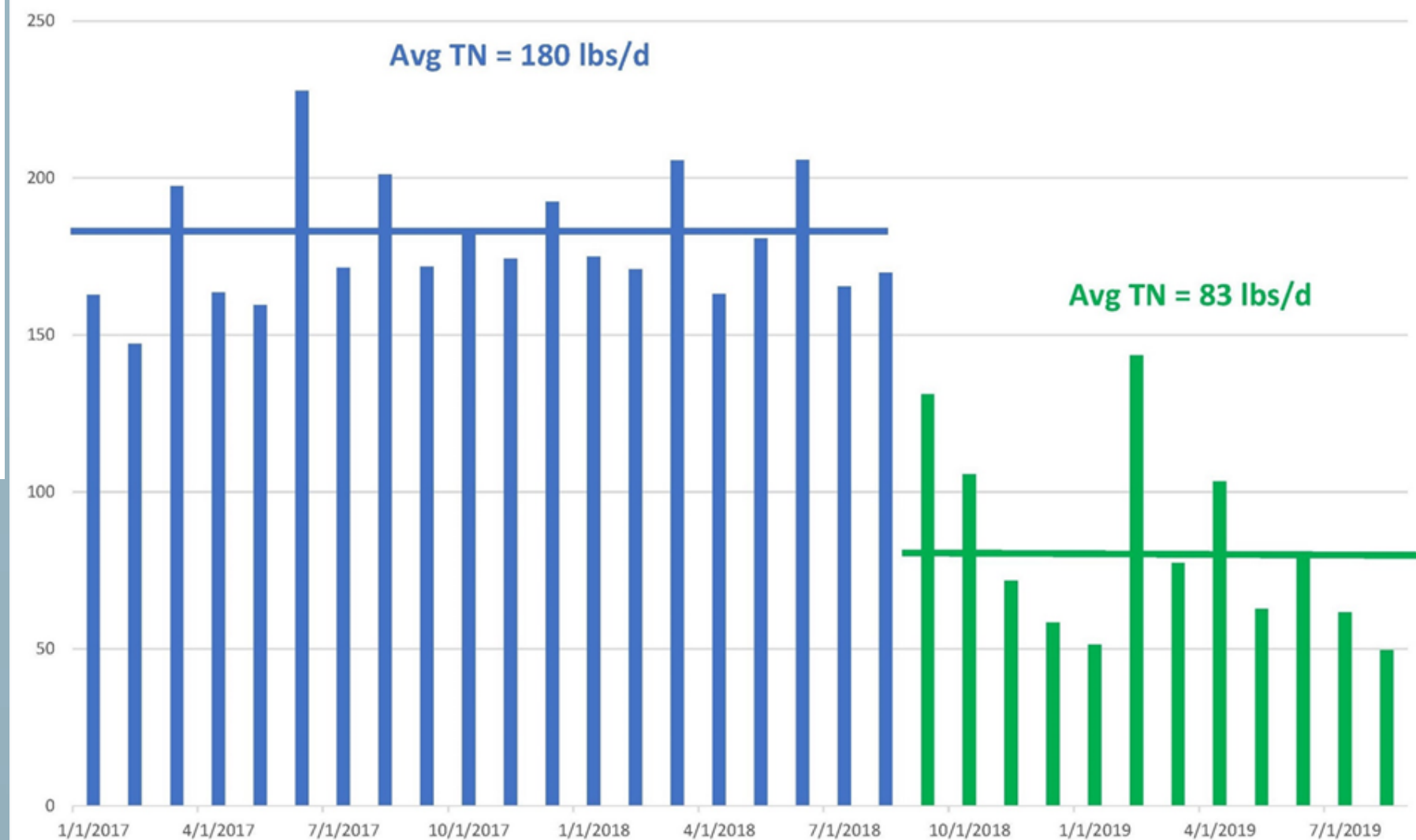
In 2015, the Kentucky Energy and Environment Cabinet (EEC) and EPA Region IV assembled a team of universities, associations, and government agencies to conduct nutrient and energy efficiency assessments for wastewater treatment plants (WWTP). EPA Region IV program funding provided these assessments at no cost to participating facilities. Each year from 2016 to 2018, three new facilities participated in the Program, receiving free nutrient and energy assessments along with recommendations on optimizing nutrient treatment. In 2017, the Princeton WWTP took part in the pilot program, using an Excel-based tool called Bio-Tiger to identify optimization opportunities.

Princeton's 1.57 MGD facility, the Bio-Tiger model showed there was potential to improve denitrification. Instead of continual rotations, the facility shut off all rotors in the three oxidation ditches for 8 hours/night and ran one of two 40-HP rotors in each ditch during the remainder of the day. Effluent total nitrogen decreased ~56%, while effluent total phosphorus decreased by ~9% without using additional chemicals. Electricity usage also decreased



Princeton Wastewater Treatment Plant

Princeton WWTP Effluent Total Nitrogen



SUCCESS STORIES

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.

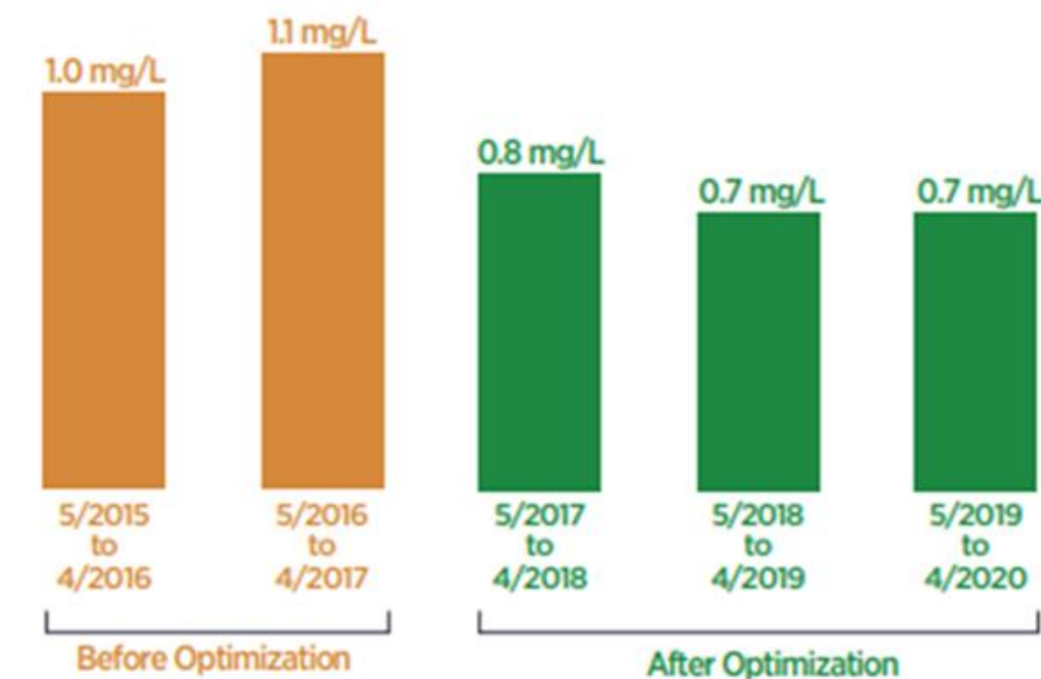
Hudson and Ransdell worked with the project team to model Lawrenceburg's 3.3 MGD Orbal ditch process with a free tool called Bio-Tiger, developed by Dr. Larry Moore at the University of Memphis. The Bio-Tiger model uses readily available treatment parameters and equipment information to develop a steady-state 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

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



SUCCESS STORIES

The Improvements Just Keep Coming at the Glasgow Wastewater Treatment Plant

Equipment, process and efficiency improvements are a way of life at the award-winning Glasgow (Kentucky) Wastewater Treatment Plant.

📄 Appeared in print as *"It Just Keeps Getting Better"*

✍ By Jim Force

🕒 February 2019

📌 Cover Story



Adam Headrick (left) and Tyler Bragg, Class IV operators, look with pride upon the final product.



The improvements just keep coming at the Glasgow (Kentucky) Wastewater Treatment Plant.

Built in 1962 as a trickling filter plant with upflow sand filters and anaerobic digesters, the plant was upgraded four times, most recently in 2014. Today, it operates as a 4.0 mgd SCADA-controlled extended aeration facility with new headworks, circular clarifiers, biosolids press and peracetic acid instead of chlorine for disinfection.

The improvements haven't gone unnoticed. For outstanding performance, Glasgow won the 2017 Kentucky Water & Wastewater Operators Association Plant of the Year award. Last year, the Glasgow Water Co. received the Kentucky Excellence in Energy Leadership Award sponsored by the Kentucky Energy and Environment Cabinet.


PERMITTING

- Kentucky has a narrative nutrient criteria (401 KAR 10:031 Section 1)
- Most major POTWs (designed flows >1 MGD) have had monitoring requirements, but not nutrient limits
- All majors will have nutrient optimization language if they don't already have limits
- A reasonable potential analysis may impose nutrient requirements
- Permits for new or expanded discharges may impose phosphorous limits

OPTIMIZATION IN NEW PERMITS

- 5-year permit cycle
- When applying for next permit, must complete Nutrient Reduction Evaluation Form
- Nutrient Optimization Audit provides info for the Evaluation Form
- Can be done by DOW staff or by facility engineers, but they must review their processes
- Encouraging facility to get audit done early because recommendations can save money
- DOW staff available to do nutrient optimization visits on any major facility, not just permit required

NUTRIENT REDUCTION EVALUATION FORM

NUTRIENT REDUCTION EVALUATION FORM Kentucky Pollutant Discharge Elimination System					 Division of Water	
Facility Name:			Permit Number:			
(Read accompanying instructions carefully before completing this form) This form was created to assist facilities in performing a nutrient reduction evaluation.						
REQUIRED FORM INPUT: (Sections I, II, and III)						
Section I. Treatment Information						
Type of Treatment:		Activated Sludge-Oxidation Ditch <input type="checkbox"/> Lagoon System <input type="checkbox"/> Activated Sludge-Sequential Batch Reactor <input type="checkbox"/> Other <input type="checkbox"/> _____ Activated Sludge-Other <input type="checkbox"/>				
Section II. Average Monthly Concentration of Total Phosphorus and Total Nitrogen						
Include monthly data for the most recent five calendar years.						
Month	Year	Average Monthly Effluent Flow (MGD)	Average Monthly Concentration of Total Phosphorus		Average Monthly Concentration of Total Nitrogen	
			Influent (mg/l)	Final Effluent (mg/l)	Influent (mg/l)	Final Effluent (mg/l)

NUTRIENT REDUCTION EVALUATION FORM

REQUIRED FORM OUTPUT: (Sections IV and V)

Section IV. Identification of potential measures to reduce nutrient effluent discharge.

Identify potential measures (separated into: Source Reduction Measures, Operational Improvement Measures, Unit Process Configuration Improvement Measures and Additional Treatment Measures) to achieve the target effluent discharge values for TP and TN. The target TP value is ≤ 1.0 mg/l avg. monthly concentration. The target TN value is ≤ 10 mg/l avg. monthly concentration. In addition, identify the associated estimated capital and annual operating and maintenance costs and reasoning for the annual cost (electric cost, time, chemical cost, etc.)

Source Reduction Measures:

Identify Measure:	Capital Cost:	Annual O&M Cost:	Reasoning:

Operational Improvement Measures:

Identify Measure:	Capital Cost:	Annual O&M Cost:

Section V. Identification of selected measures to reduce nutrient effluent discharge.

From the potential measures identified in Section IV, identify the measure(s) selected by the permittee to achieve the target nutrient effluent discharge values.

If the targets cannot be met:

- Identify any difficulties or problems believed to interfere with the facility’s ability to achieve the target nutrient effluent discharge values, and
- Identify the measures that can be taken and the target nutrient effluent discharge value for these measures.

For each measure selected identify the estimated timeframe necessary to fully implement the measure.

ENERGY OPTIMIZATION

- Contract with Kentucky Rural Water to conduct energy audits for major facilities
 - Under 10k population served in their regular NRWFW grant
 - Over 10k population served with the DOW contract
- Outreach to facilities about reading their utility bill



BY THE NUMBERS



- About 100 major facilities
- Have talked directly to 22 facilities
 - 16 have permit requirement
- 7 audits completed
- 9 audits scheduled
- 6 declined or deferred

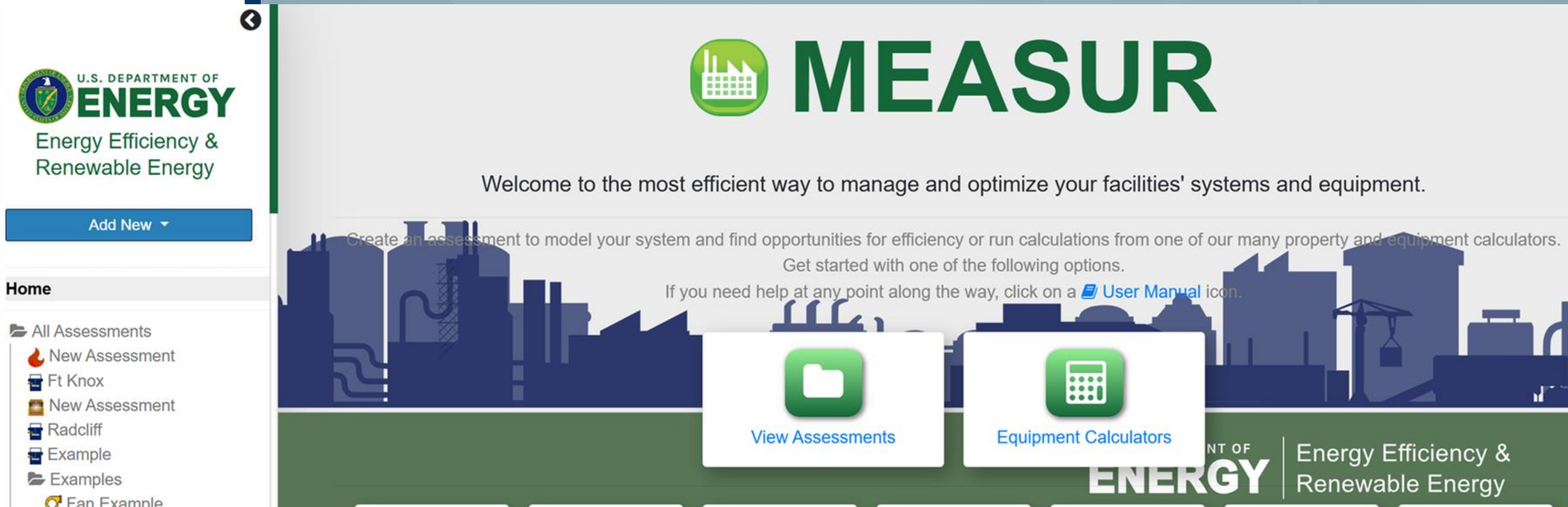


ABOUT
17 %

Participating in the
first 6 months!



TOOLS



The screenshot shows the MEASUR web application interface. On the left is a sidebar with the U.S. Department of Energy logo and a list of assessment options. The main content area features the MEASUR logo, a welcome message, and instructions on how to use the tool. Two large buttons, 'View Assessments' and 'Equipment Calculators', are prominently displayed. The background of the main area shows a stylized industrial facility.

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

MEASUR

Welcome to the most efficient way to manage and optimize your facilities' systems and equipment.

Create an assessment to model your system and find opportunities for efficiency or run calculations from one of our many property and equipment calculators.
Get started with one of the following options.
If you need help at any point along the way, click on a [User Manual](#) icon.

View Assessments

Equipment Calculators

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Home

- All Assessments
 - New Assessment
 - Ft Knox
 - New Assessment
 - Radcliff
 - Example
 - Examples
 - Fan Example

<https://measur.ornl.gov/landing-screen>

DIVISION OF WATER WEBPAGE

Donate to the Team Kentucky Storm Relief Fund at [TeamKYStormReliefFund.ky.gov](https://www.teamky.org/TeamKYStormReliefFund)

Search

Kentucky Energy and Environment Cabinet



About

Careers

Calendar

Open Records

Contact



Environmental Protection

Natural Resources

Energy

Nature Preserves

Administrative Hearings

Building a Better KY

Air

Compliance Assistance

Enforcement

Waste

Water

Brownfields

Resources

eSearch

Economic Development

WWTP OPTIMIZATION

[Home](#) / [Environmental Protection](#) / [Water](#) / [Planning and Protection](#) / WWTP Optimization

Kentucky has developed a wastewater treatment plant optimization program. This will help facilities lower their nutrient levels in their effluent and may also help lower their utility bills. Programs like these are going on in other states around the US including Tennessee and Minnesota. Find out more about what optimization is: [🔗 Optimize Your Wastewater Treatment Plant](#).

Nutrients from Kentucky are contributing to the dead zone in the Gulf of Mexico, also known as Gulf Hypoxia. Optimization is one way that Kentucky Division of Water is working with the EPA to decrease the amount of nutrients reaching the Gulf. Kentucky is working together with other states through the Mississippi River/Gulf of Mexico Hypoxia Task Force. Visit [🔗 Kentucky's Nutrient Reduction Strategy](#) page to find out other ways that Kentucky is working to reduce our nutrient impact.

Some wastewater facilities will be required to optimize in their discharge permit. If your facility has been notified through its KPDES permit that you must conduct a nutrient reduction optimization, you will be invited to attend a meeting to talk about optimization and what that means at your facility. You should complete a nutrient reduction evaluation during your next permit cycle so you will have time to weigh your options for how your facility would meet nutrient targets. It is a permit requirement to complete a nutrient reduction evaluation, but who completes that audit is flexible.

[Kentucky Nutrient Reduction Strategy](#) >

[Kentucky Wastewater Discharge Permits](#) >

[Kentucky Office of Energy Policy](#) >



<https://eec.ky.gov/Environmental-Protection/Water/Protection/Pages/WWTPOptimization.aspx#:~:text=Optimization%20is%20one%20way%20that,of%20Mexico%20Hypoxia%20Task%20Force>.

OPERATOR CERTIFICATION PROGRAM



Environmental Protection

Natural Resources

Energy

Nature Preserves

Administrative Hearings

Building a Better KY

Air

Compliance Assistance

Enforcement

Waste

Water

Brownfields

Resources

eSearch

Economic Development

KENTUCKY OPERATOR CERTIFICATION PROGRAM

Home / [Environmental Protection](#) / [Compliance Assistance](#) / Kentucky Operator Certification Program

The Certification and Licensing Branch is home to the solid waste, drinking water and wastewater certification programs. Through education and certification exams, these three programs help ensure that the people charged with dealing with community solid waste, drinking water and wastewater are knowledgeable and capable of handling the responsibilities required of those positions.

News and Events

New Hotline!

We're excited to introduce our new Operator Certification Program hotline, offering direct support at 502-564-3170 for all your certification-related inquiries. Our knowledgeable team is ready to help you with application queries, education & experience requirements, exam preparation, and more.

Facility Update

Operators and facilities can now embrace the convenience and efficiency of the new Facility Update [eForm 136](#). This streamlined tool is the go-to method for allowing operators and facilities to effortlessly communicate certified operator employment changes to their facilities, ensuring compliance and seamless communication with regulatory bodies. The Facility Update fact sheet and eForm 136 SOP can be found [here](#).

Operation Matters Blog

Stay informed with the latest news and events by subscribing to the Operation Matters blog [here](#). For the most current updates and in-depth analysis, join our community of readers today!



Solid Waste Operator/Manager Certification and Training	>
Drinking Water and Wastewater Certification and Training	>
Reciprocity & Equivalency	>

UPCOMING TRAININGS

Nutrient Reduction and Optimization Training

ON [MARCH 20, 2025](#) / BY [KYDEP](#) / IN [NEWS & EVENTS](#)

Date: April 3, 2025

Location: Lake Cumberland State Resort Park

Date: April 30, 2025

Location: DEP Training Center, Frankfort

Date: May 29, 2025

Location: KY Dam Village State Resort Park

The Kentucky Operator Certification Program and Division of Water invites you to participate in a one-day Nutrient Reduction and Optimization Training, an essential course for wastewater operators of major facilities. This training will provide valuable insights into Kentucky's Nutrient Reduction Strategy, which outlines ongoing and future efforts to reduce nitrogen and phosphorus levels in Kentucky waters that contribute to the production of Gulf hypoxia.

Course Fee: \$30



SIGN ME UP!

Join 375 other subscribers

KY OPERATOR CERTIFICATION PROGRAM



Kentucky
Operator Certification
Program
eec.ky.gov/ocp

QUESTIONS

PAULETTE AKERS

PAULETTE.AKERS@KY.GOV

BRYAN PARKER

BRYAN.PARKER@KY.GOV