LYKENS WATER AUTHORITY

LYKENS WASTEWATER TREATMENT FACILITY

BOROUGH OF LYKENS, DAUPHIN COUNTY

NPDES PERMIT # PA0043575

WASTEWATER TREATMENT EVALUATION

Bureau of Clean Water
Rachel Carson State Office Building
PO Box 8774
400 Market Street
Harrisburg, PA 17105-8774

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WASTEWATER TECHNICAL ASSISTANCE PROGRAM

2025

Disclaimers:
This report is meant to share findings and suggestions from DEP staff. It should not replace the advice of licensed engineers. Any brand names mentioned are only examples, not endorsements. The goal of DEP's Wastewater Optimization Program is to improve water quality by helping facilities with training, monitoring, and troubleshooting.

Executive Summary:

From April through June of 2025, staff from the Pennsylvania Department of Environmental Protection (DEP) and the Lykens Water Authority (Authority) collaborated on a project to evaluate and improve wastewater treatment at the Authority's treatment facility (Lykens) located on Arlington Street in the Borough of Lykens. The Aqua-Aerobics Sequencing Batch Reactor (SBR) treatment facility was constructed in 1997 with a minor instrumentation and control upgrade in 2012. Over time, the facility experienced effluent residual chlorine and coliform bacteria exceedances, staffing shortages, and some ongoing maintenance issues. Staff at the DEP South Central Regional Office recommended this evaluation.

DEP staff visited the site one or two days per week to check continuous-monitoring probes, perform routine process monitoring and nutrient tests, and to maintain their equipment. Activities and observations were discussed with senior facility staff and their contract operator.

The scope of work did not include the sludge press, sludge management, or biosolids disposal practices beyond the need to maintain continuous aeration of the digesters. Earlier DEP inspection reports noted that sludge production and disposal were under-reported during previous years.

Recommendations:

Based on observations, data, and records review, the DEP wastewater technical assistance program staff have recommended the following maintenance and repair actions for consideration:

- Repair or replace broken anoxic mixers in one SBR and both digesters.
- Clean dissolved oxygen (D.O.) residual probes in the SBRs on a weekly basis to remove slime growth that interferes with probe performance. This is especially critical because the SBRs are designed to operate on D.O. residual.
- Schedule down-time for each SBR when practical and clean out accumulated grit and detritus in the tanks as determined necessary. Perform any repairs to surface finishes on corroded steel.
- Keep the aeration (and mixers) always running in the two aerobic digesters except when thickening sludge and decanting supernatant water. Perform required maintenance on digester motors and air compressors.
- Clean out solids from the Chlorine Contact Tanks on a more frequent basis. There should be few or no solids settled in these tanks. If the amount of solids settled is unclear a sludge judge can be used to measure thickness of solids accumulation.
- Continue improving general housekeeping in enclosed spaces. Keep spaces free and clear of trip, slip, fall and other safety hazards.
- Proceed with repair or replacement of steel doors that do not close properly: this includes the door to the gas chlorinator and, more generally, to the rear door of the digester blower room and motor control center (first floor) and to the motor control center for the SBRs and screening system. Replace broken hardware and maintain these buildings as secure spaces.
- Pursue staff training for licensure and continuing education for license retention.

To improve process monitoring and control, the DEP wastewater technical assistance program staff have recommended the following sampling and laboratory practices:

- With new staff on board at the facility, train all staff in the basics of laboratory process monitoring.
- Employ the process monitoring tests recommended in the plant's Operations and Maintenance Manual. When the facility experiences treatment problems, testing should be done more often.
- Log all test results, from start to finish, on paper in a ledger or copy book, showing calculations where needed. Do not rely solely on a computer-based record, as data may be easily lost.
- Update any existing written Standard Operating Procedures, assuring they are easily understood.
- Conduct settled sludge volume tests on each SBR every two or three days and record the 30- and 60-minute SSV times. Observe the recorded data from day-to-day and season-to-season to look for trends that may show upcoming changes in the activated sludge.
- Use test data to find out if the plant is performing to its designed Mean Cell Residence Time or its Food-to-Mass Ratio. Settleometer testing itself does not typically provide enough information to identify operation efficiency.
- SBR operation requires that the process monitoring test results be standardized to the same point in the biomass from day to day. For Lykens, total suspended solids samples should be standardized to the bottom depth level of each SBR, as shown in Mr. Miller's instructions. Similarly, samples used for settled sludge volume are best taken during the "react" phase, when the activated sludge has been consuming wastewater while being aerated.
- Test aerobic digesters for sludge settling, for total solids, and (when aeration is operating) dissolved oxygen residual. This testing is useful for operating the digesters and the sludge press.
- If possible, obtain a portable D.O. meter and probe and regularly test each process unit for oxygen, keeping a record of the results for comparison and to observe for trends.

Wastewater Treatment Evaluation:

Lykens Borough is a small community situated along U.S. Route 209 in Dauphin County, approximately twenty-six miles northeast of Harrisburg. It has a year-round population of about 1,830 persons in about 965 housing units. The Lykens Water Authority oversees both the safe drinking water system and the sewage treatment plant. It also provides some services to neighboring Wiconisco Township, which maintains its own lagoon-type sewage treatment system.

The original treatment plant was built in 1967 and substantially renovated in 1997. Treatment technology is the Aqua-Aerobics Five-phase Sequencing Batch Reactor (SBR) operating two basins using activated sludge and coarse aeration. Lykens is rated for 0.41 million gallons per day (MGD) and a loading of 684 pounds per day. The hydraulic capacity when the SBR is operated in storm mode is 1.575 MGD.[1]

The SBR cycle structure is designed for automatic operation using a timed interval mode or by using a dissolved oxygen residual mode that adjusts D.O. in the SBRs in a way that provides best aerobic treatment to destroy carbon- and ammonia-based wastes while not allowing excessive D.O. to interfere with a nitrate-removing phase that prevents nitrate from concentrating in the treated effluent.

SBR CYCLE STRUCTURE	
PHASE	TIME (min)
Mix Fill	16
React Fill	74
React	16
Settle	30
Decant	44
TOTAL	180

Phases where aeration occurs 90 min

Figure 1: 5-phase SBR treatment cycle

The timed interval allows the operator to set up to five periods of aeration and non-aerated mixing that together equal one treatment cycle. The timer settings can vary between each of the two SBRs so that they don't become synchronized to discharge treated effluent at the same time, which could overwhelm the disinfection process later.

In January, DEP staff visited the facility and met with its contract operator and borough employees. Representatives of DEP's regional field operations office also visited. During this meeting, wastewater technical assistance program staff from DEP's Bureau of Clean Water discussed their program of using continuous monitoring probes and other process monitoring tests for compliance assistance and process optimization. Then, on April 8 and 9, they deployed equipment to the facility. The equipment included several continuous-monitoring probes set to record data at fifteen-minute intervals and a portable process monitoring laboratory. This equipment is summarized in Attachment B. Data collection was automated on-site and remotely, allowing the participants to observe real-time events. DEP staff also visited the site weekly to perform probe maintenance and conduct process control tests, including nutrient tests, to monitor treatment and to maintain equipment calibrations. The program is not set up to monitor effluent fecal coliform bacteria that has been a concern and source of frequent permit exceedances. Data collection continued through late-June in anticipation of facility repairs to critical equipment; however, those repairs were only partially completed.

[1] Here, it is assumed that the 684 lb./day of organic material is significantly diluted by the high volume of stormwater, allowing for the roughly threefold maximum hydraulic flow rate.

The Lykens Water Authority contracted with Miller Enivronmental of Reading, Berks County, to operate the wastewater facility using borough employees as laborers. Following a period of turnover, the Authority hired dedicated staff as wastewater treatment and drinking water filtration plant operators, along with two more workers as laborers. The need for staff training was identified by DEP regional inspectors as borough staff learn to operate the plant.

Photo 1: View of Lykens SBR at the start of decant phase.

Continuous immersion probes were used for data collection only. When installed as a permanent improvement, these probes usually regulate a process, such as Lykens's use of dissolved oxygen residual probes to regulate the amount of aeration the activated sludge receives during the react fill and react (aerated) cycles. DEP's probe data was stored and displayed locally on a notebook computer available for the operators to view. Attached cellular devices allowed DEP's staff to remotely check for changes in characteristics while away from the plant during the remainder of the week.

Graphing this data allows plant operators to visualize some changes in treatment, and observing graphical trends allows them to make treatment adjustments well in advance of many types of plant upsets. Most treatment process manufacturers now recommend using probes to monitor and control wastewater treatment. It provides some level of assurance against problems that occur when the operator cannot be physically present on site.

Operational Control:

It is very important for treatment plant staff to become familiar with the treatment system and the SBR technology employed. To help them with this, the designer and manufacturer provided a detailed Operations and Maintenance Manual. This book contains most all the information on:

- recommended process monitoring tests and performance ranges,
- how to interpret test results,
- how and when to service and maintain equipment,
- what service parts should be stocked in reserve should they be needed,
- and much more.

DEP technical assistance staff had also recommended that Lykens's newer employees attend a wastewater operations course. Since ongoing training is part of the requirements of license retention, it is recommended that plant staff regularly complete training.

Preliminary Treatment Issues:

Preliminary treatment is best described as things done to prepare the wastewater for treatment. It usually involves three activities: Pumping, Grit Removal, and Screening/Trash Removal. At the start of the evaluation in April, Lykens's headworks screening system by Hycor was shut down and waiting for replacement parts. This unit removes rags and solid garbage from the wastewater before activated sludge treatment. Consequently, trash and rags were accumulating in all downstream processes:

- Trash, detritus, rags, and children's toys floating atop the SBRs if the air was off
- "Flushable" wipes floating on the surface of the Chlorine Contact Tank
- Rags and detritus visible in the two aerobic digesters when the aeration was shut off

Photo 2: Flotsam in SBR

Photo 3: Hycor Preliminary Treatment Unit

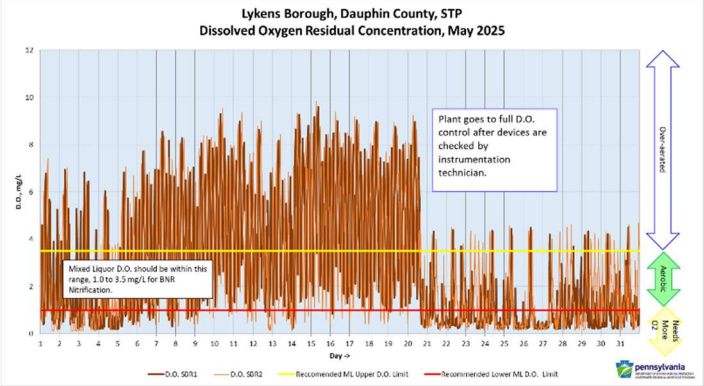
The Hycor room above the SBR motor control center (MCC) and blower room displayed evidence of flooding that hadn't been cleaned up when flooding happened sometime prior to assembly of the current operations team.

Plant staff replaced damaged control electronics, and the Hycor returned to service. Decreased rags and trash were observed once this work had been completed.

Photo 4: Zoogleal growth on probe tip

During the evaluation, staff discovered that the SBRs had been operating in extended storm mode for an unknown, long period of time. The system typically operates on timed cycles or using D.O. probes, but the D.O. probes were found to be overgrown with slime bacteria that reduces the range of D.O. detection. If the programming detects malfunction of the D.O. signal, the operation switches to timed mode. Should the timers be insufficiently set, the programming may have switched to storm mode, which allows for higher water level in the SBR tanks but reduces the aeration and potentially treatment efficiency to prevent activated sludge from washing away.

DEP staff cleaned the Lykens D.O. probes using the same mild dish detergent and soft-cotton wipes they use on their own equipment. D.O. values rebounded to match those of DEP's equipment. A week later, staff examined the automated pressure level transducers also located at the SBRs. They found a similar situation with slime growth on the detectors, along with large, heavy and obscuring masses of rags and plastic debris washed into the SBRs when the headworks screening system was out of service. While the slime growth would not affect the pressure transducers the same way it affected the D.O. probes, the accumulation of rags and detritus may have led to premature failure of one of the transducers, preventing designed level control for that SBR.



Miller Environmental had its instrumentation contractor replace the bad transducer, and the contractor also discovered problems with the SBR programming and restored the operation to D.O. control mode described earlier. The graph of dissolved oxygen during May shows SBR operational change from unregulated D.O. to controlled blower operation after May 20. Excessive D.O. levels often lead to elevated utility costs.

Effluent Disinfection and Monitoring

At the start of the evaluation, DEP staff noticed floating wipes, rags, and plastic in the chlorine contact tanks. Using a core-sampler, they also noted that solids from three-inches up to five-inches thick covered parts of the floors of these tanks. Aeration to both the digesters and to the chlorine contact tanks was regularly turned off. These accumulated settled solids exerted a chorine demand on the disinfection system. Because of it, there was usually insufficient chlorine residual to truly disinfect the volume of water treated, resulting in fecal coliform violations. While it is possible to drain and clean the chlorine contact tank channels, there is no sump in either tank to permit efficient removal of all the settled solids.

After the Hycor screening unit had been back in service, the incidents of rags appearing in the contact tanks stopped. Further, after discussions on efficient digester operation with plant staff, Miller Environmental saw to it that the aeration blowers for this part of the treatment plant (digesters and contact tanks) remained on most of the time, except during sludge decanting. This meant that at least one channel in each contact tank was aerated.

DEP's evaluation program does not have the resources to test for fecal coliforms in the effluent. So, while the effluent usually performed well for nutrient removal, it remained unknown most of the time if disinfection was working well enough. Intuitively, staff understood that the accumulated solids in the tanks would interfere with chlorine disinfection. Recorded effluent TRC test results of 0.01 mg/L through 0.20 mg/L in May suggested that the chlorine consumed was not going to guarantee complete disinfection. DEP staff recommend more frequent monitoring and cleaning of the chlorine contact tanks.

On June 17, inspection staff from the southcentral regional office returned to the plant to perform a routine inspection and wrote non-compliances for two long-standing maintenance issues:

- Effluent sampler was not connected for flow-proportioned sampling. The wire was on the ground and appeared to have once been cut through and repaired. Previous inspection reports noted this as a deficiency.
- One of the two SBR anoxic mixers was non-functional and had been during previous inspections.

As a follow-up, Miller Environmental notified us that the Authority had authorized repair or replacement of three mixers: one SBR, one each in both digesters. Reinstating flow-proportioned sampling was unknown at that time.

Photo 5: Disconnected Sampler Cable

Process Monitoring Lab Tests

Staff at Lykens perform some routine process monitoring tests prescribed by Mr. Miller. These include:

- Settled sludge volume (SSV), which measures how well the activated sludge settles during SBR settling and decant phases and whether the solids will float
- Total Suspended Solids (TSS), a “gold standard” test for the concentration of activated sludge in the treatment units
- Total Solids (TS), another drying oven test used to measure the solids being sent to the sludge press for dewatering and disposal
- pH, Temperature, Dissolved Oxygen, and Total Residual Chlorine (TRC), the effluent water quality tests required every day by the facility’s operating permit.

Test results for a given day or week are reported electronically to Mr. Miller’s business address in Reading, and loose-leaf, paper records are maintained in monthly tables on site in 3-ring binders. Also written records of meter calibrations and electronically measured flow are maintained.

As part of its evaluation, DEP staff conducted process monitoring lab tests once per week. These tests included:

- Solids by volume, a 15-minute solids test that substitutes for the longer drying oven test.
- Settled sludge volume, SSV, with calculated sludge volume index, SVI.
- Microscope examination of mixed liquor to assess health and activity of microorganisms.
- Oxygen Uptake Rate, OUR, to assess health of the system and whether aeration is sufficient, or if organic overloads may exist.
- Water chemistry tests (colorimetric) the measure nitrogen and phosphorus in the raw and treated wastewaters, and tests for organic strength. Some of these test results are compared with the probe data to assure that probe calibrations are holding.
- pH, Temperature, dissolved oxygen residual, and oxidation/reduction potential, using portable meters and probes, to check reliability of installed probes.

Some of these tests are recommended by Aqua Aerobics in their Operations and Maintenance Manual as standard, routine tests to be performed at the plant regularly. At times when the plant is upset or if the biological treatment is failing, both the facility permit and the SBR manufacturer recommend increasing the frequency of these monitoring tests, until the problem is resolved.

Site Security and Safety:

Many small treatment plants may be remotely located and have special site safety and security needs. Lykens's plant, though, is very visible at the west end of town, and during the evaluation, some neighbors from nearby residences engaged staff in light conversation about the plant. It is likely that a few of these people keep an eye on the plant and would quickly alert to impulsive trespassers or casual thieves. But site security and safety should be among the many tasks of a plant operator.

By arrangement, the operators left a gate unlocked so DEP staff could enter and work; however, security has recently been a hot topic in the business, and it bears some discussion. During the evaluation, DEP staff

- found doors incapable of easily closing or missing original security hardware,
- observed that access codes for programmable equipment such as the main pumping station controls or the SBR human-machine interface (HMI) were too easily available, or the remote dialer bypassed to prevent nuisance alarms,
- occasionally found slip, trip, and fall hazards unmarked by signage or cones,
- equipment and hoses blocking walkways,
- old records blocking access to operating equipment.

Some of this simply came down to past housekeeping versus employee turnover. DEP staff noted that housekeeping was improving as new employees settled into their responsibilities, and this may indicate a work ethic evolving as the crew becomes a team.

Actions that would improve site security and safety include:

- including regular check-ins by phone or in person when a staff member is working solo in another part of the facility.
- access to the main control building and to the SBR MCC and Blower building (first floor) should be secured by installing new doors or lockset hardware.
- use warning tape, cones, and other visual devices to mark places where hoses, cables, or other equipment lay across pathways longer than a day..
- observe for and eliminate slip-trip-fall hazards, especially in wet areas
- continue to improve housekeeping inside buildings and work spaces.
- secure any open electrical cabinets, stow items not in use

Closing Remarks:

For a period preceding this evaluation, the Authority experienced staff shortages that interfered with the operation and maintenance of the wastewater treatment plant. With the recent hiring of additional staff, there is now sufficient labor available to improve. DEP commends Lykens's staff for beginning to resolve maintenance backlogs that may have adversely affected operations and encourages them to keep it going. A combination of cooperative effort, continuing training, and investment will assure better effluent quality, reduce operational difficulties, and increase customer satisfaction.

ATTACHMENT A: EVALUATION TEAM

PA Department of Environmental Protection		
Erick Ammon, Water Program Specialist Wastewater Technical Assistance Program Bureau of Clean Water PA Dept. of Environmental Protection Rachel Carson State Office Building 400 Market St., POB 8774 Harrisburg, PA 17105-8774 Tel. 717-772-8911 Eml. eammon@pa.gov		Marc Neville, Water Program Specialist Wastewater Technical Assistance Program Bureau of Clean Water PA Dept. of Environmental Protection Rachel Carson State Office Building 400 Market St., POB 8774 Harrisburg, PA 17105-8774 Tel. 717-772-4019 Eml. mneville@pa.gov
Lykens Water Authority STP Operators		
Dean Miller, Operator-in-Charge Miller Environmental, Inc. Reading, PA 19602 Tel. (610) 376-9162 info@miller-env.com		Ty Buffington, Operator Lykens Borough STP Lykens Borough 200 Main Street, Suite C Lykens, PA 17048 Tel. (717) 453-7597 lykensborough@comcast.net
Nathan Pendal, Supervisor Lykens Borough STP Lykens Borough 200 Main Street, Suite C Lykens, PA 17048 Tel. (717) 453-7597 lykensborough@comcast.net		Austin Keisling & Jeremy Patrick Operators-in-Training Lykens Borough STP Lykens Borough 200 Main Street, Suite C Lykens, PA 17048 Tel. (717) 453-7597 lykensborough@comcast.net

ATTACHMENT B: PROCESS DIAGRAM & PROBE PLACEMENT SCHEMATIC

Probe Installation Map
Borough of Lykens STP, Dauphin County, Pennsylvania

Probes and Equipment Deployed:

(2) pH / Temperature Probes	(2) SC4500 Probe Controller	Digester Heating Block
(2) Dissolved Oxygen Probes	(11) Probe Mounts	Microscope
(2) Oxidation/Reduction Potential	eWON Telemetry Device	Wet-chemistry supplies
(2) Total Suspended Solids	(2) Cellular Modems	Air-blast Cleaning System
Ammonium-Nitrogen Probe	Wi-Fi Portable Modem	Digital Camera
Nitrate-Nitrogen Probe	Drone Computer for Data	Table and Chair
Total Organic Carbon Probe	TSS Lab Centrifuge	Cleaning Supplies
(2) SC1000 Probe Controller	Spectrophotometer	Misc. Tools, Parts, Supplies

Influent Pump Station w/UVAS Probe

UVAS Probe in wet well

Probes in SBR #2: pH, DO, ORP, TSS

Upper probe controller for SBRs

Lower probe controller & display

Effluent nitrate and ammonium probes

Effluent probe controller & telemetry

Portable process monitoring lab

Rags on SBR level pressure transducer

Broken probe mount due to turbulence.

Suspended solids in Chlorine Contact Tank

Flooding waterline in Hycor room