Kansas Department of Health and Environment
Wastewater Referral Program

KDHE – KRWA Referral Program Addresses Wastewater Effluent Violations at City of Lecompton

Small Wastewater System Case Study

★ Lecompton

This photo shows one of the three, two horsepower aerators on Cell 2 of the city of Lecompton's wastewater lagoon.

City of Lecompton, Kansas

Wastewater systems across the nation need to comply with the regulations concerning discharges. This case study discusses the work by the Kansas Rural Water Association on a referral from the Kansas Department of Health and Environment for the city of Lecompton.

Lecompton is a small community located in Douglas County in northeast Kansas on the south bank of the Kansas River. Lecompton's population is 655 people. The city has a rich history dating back to the Civil War and before. This small city has two excellent museums. They are the Territorial Capital Museum (Lane University) and Constitution Hall which is the oldest wood-frame, civilian structure still standing on its original location in Kansas.

The city was referred to the Kansas Rural Water Association in February 2016 due to numerous effluent violations. The Association provides technical assistance to referrals from the agency under a contract funded by KDHE. The violations at Lecompton were mainly for exceeding effluent limits for Biochemical Oxygen Demand (BOD) and *E. coli*. During 2015, two violations occurred for each parameter. Previous to that time, the lagoon had an excellent monitoring record and consistently met all limits. The city's National Pollutant Discharge Elimination System (NPDES) Permit M-KS33-OO01 requires monthly monitoring for BOD, Total Suspended Solids (TSS), ammonia, *E. coli*, pH and Total Phosphorous. The city has effluent limits for BOD of 30 mg/l (monthly average), for TSS of 80 mg/l (monthly average) and *E. coli*. The *E. coli* limit varies depending on time of year. The *E. coli* limit is 262 colonies/100 ml during April through October and 2,358 colonies/100 ml during November through March.

This example of technical assistance was provided by the Kansas Rural Water Association under a referral process and contract funded through the Kansas Department of Health and Environment.

The city is served by a three-cell aerated lagoon that has been in service since the late 1970s. The total surface area for all three cells is 1.6 acres. Cell 1 is 0.4 acres and is ten (10) feet deep with two five-horsepower surface aerators. Cell 2 is 0.9 acres and is five (5) feet deep with three, two-horsepower surface aerators. Cell 3 is 0.3 acres and five (5) feet deep; this cell is not aerated. The lagoon was designed to handle an influent flow of 71,300 gallons per day (gpd), which is based on a maximum population served of 1188 people contributing 60 gallons/person/day. The system discharges directly to the Kansas River.

KRWA's initial investigation focused on controlling the excessive growth of duckweed on the lagoon. Various approved herbicides were used with varying results. Duckweed control was considered critical to good treatment to ensure facultative bacteria in all cells had sufficient levels of dissolved oxygen to breakdown incoming sewage. In lagoons, the major source of oxygen is from algae going through the process of photosynthesis. If the duckweed blanket is heavy enough, it can block sunlight which is essential if photosynthesis is to occur. This lack of sunlight can result in low levels of dissolved oxygen. Solar radiation also helps with the control of pathogens such as *E. coli*. Again, if duckweed growth is blocking sunlight, pathogen control can be adversely affected.

In October 2016, KRWA Wastewater Tech Charlie Schwindamann met with City Superintendent Rance Roberts to measure sludge depths in each of the lagoon cells. Since this lagoon had been in operation over 35 years, there was concern that sludge depths might be excessive. A small boat with trolling motor was used to access each cell. A sludge judge was used to measure sludge depths. Cell 1 was found to have almost four feet of sludge of which half was heavy sludge (usually inorganic material that will not decompose). That amount represented approximately 40 percent of lost capacity. Cell 2 had approximately 20 inches of sludge of which half was heavy sludge. This represents about 25 percent loss of capacity. And Cell 3 had six inches of sludge that was not considered to be a problem. Based on these sludge measurements, KRWA recommended that sludge removal was warranted and that the council consider removal during the next couple of years. KRWA also provided a cost estimate for removal of $59,000 for Cell 1 and $29,000 for Cell 2.

During 2017 and early 2018, the city's lagoon continued to have compliance problems even with effective duckweed control. In May 2018, Cell 2 experienced a very severe bloom of filamentous algae covering the entire surface

The 0.9-acre primary cell (Cell 1) of Lecompton's lagoon is equipped with two, five horsepower surface aerators to keep dissolved oxygen at satisfactory levels. This cell had four feet of sludge on the bottom that was eventually removed and land-applied.

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972.

Under the CWA, EPA has implemented pollution control programs such as setting wastewater standards for industry. EPA has also developed national water quality criteria recommendations for pollutants in surface waters.

The CWA made it unlawful to discharge any pollutant from a point source into navigable waters, unless a permit was obtained:

- EPA's National Pollutant Discharge Elimination System (NPDES) permit program controls discharges.
- Point sources are discrete conveyances such as pipes or man-made ditches.
- Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need a NPDES permit;
- Industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.[1]

[1] US EPA. 2020. *Summary of The Clean Water Act* | US EPA. [online] https://www.epa.gov/laws-regulations/summary-clean-water-act [Accessed 10 September 2020].

area of the cell. Treatment was severely compromised. A sample of the algae was provided to KDHE biologists to confirm it was indeed of the filamentous type. This variety of algae presented in large, flat oval shaped masses that were very effective at blocking sunlight and adversely affecting treatment. Operating the aerators in Cell 2 did little to disperse the algae mats or provide sufficient levels of oxygen. KRWA and the city officials consulted with KDHE staff who recommended trying to control the filamentous algae using barley straw. References indicated that by adding barley straw to the lagoon and allowing it to decompose over time, hydrogen peroxide would be released. Hydrogen peroxide is toxic to algae.

This photo shows Cell 2 completely covered with filamentous algae mats. These mats block sunlight which is needed by algae to produce oxygen needed by bacteria to break down organic matter. Such a situation can adversely affect treatment and effluent quality. The mesh bag with float in the foreground is barley straw introduced to control the algae.

Originally, KRWA staff tried to locate a local source of barley straw. Local breweries were contacted only to find they shipped in their barley from across the U.S. KRWA also contacted the Kansas Department of Agriculture to possibly locate nearby farmers who grew barley; none could be located. Finally, City Clerk Lynley Sanford located a supplier of barley straw in New York who provided the straw mainly for algae control in ornamental ponds. An order was placed and straw bales arrived at Lecompton shortly thereafter. The bales of barley straw were then broken up and placed in mesh bags with floats attached. These were launched onto the surface of Cell 2 to hopefully control the filamentous algae. While it took almost two weeks to begin seeing signs that the barley straw was effective, the application eventually yielded good results. However, the major drawbacks of using barley straw is that it is rather expensive (including shipping from distance) and labor-intensive for setup and then replacing the decomposed straw every several weeks after introduction.

The appearance of large mats of filamentous algae on a lagoon is not a common occurrence. In July 2018, KRWA Consultant Jeff Lamfers attended a council meeting to discuss the issue of non-compliance of the lagoon. Lamfers addressed the control of both duckweed and filamentous algae, and also sludge removal. It was assumed that the filamentous algae mats especially resulted from the availability of concentrated nutrients like nitrogen and a rich source of organic matter. The likely source was the excessive amount of sludge decomposing on the bottom of Cell 1 releasing excess nitrogen that was then passed onto Cell 2 causing unusual and concentrated aquatic plant growth. Lamfers encouraged the city council to seriously consider desludging Cell 1 during the next couple of years in order to remove the nutrient source, eliminate the filamentous algae and hopefully return the lagoon to compliance. The council took KRWA's recommendation under advisement. It should be noted that sludge removal does not always return lagoons to compliance. But in the case of Lecompton's lagoon which is aerated and thus has a very short detention time, it was thought that sludge removal would be effective at returning the lagoon to compliance with all permit limits.

In September 2019, the city contracted with Hodges Farms and Dredging of Lebo, Kansas to remove sludge from Cell 1. During the removal process which required four days, all incoming raw flow was directed to Cell 2. Clearer water was also pumped off the surface of Cell 1 to Cell 2. Then the sludge slurry on the bottom of Cell 1 was pumped and loaded onto tanker trucks. The sludge was taken to nearby cropland and land applied. The sludge was surface-applied by the contractor and then disked in by the farmer in order to meet the Vector Attraction Reduction requirements of EPA's Part 503 Sludge Regulations. The total cost for sludge removal was $78,480.

As of September 2020, the city has a year's-worth of effluent data since sludge was removed from Cell 1. Visually, Cells 1 and 2, at least organically, appear to be more lightly loaded than in the past. Additionally, Cell 2 has less plant growth and has much clearer wastewater. The appearance of filamentous algae and/or excessive duckweed has all but ceased on Cell 2. Recently, excessive filamentous algae have appeared on the surface of Cell 3, which may require eventually removing sludge from Cell 2. But most importantly, effluent quality has improved significantly. Since sludge was removed, the city has only experienced two minor *E. coli* violations. Otherwise, all effluent limits have been met. Hopefully this trend continues.