Clear waters in crisis

MSU researchers, Higgins Lake community partner to protect lake from septic tank contamination

By Bethany Mauger

Charlene Cornell remembers Higgins Lake's pristine, clear waters of her childhood.

The vacation home that she now calls her primary residence has been in her family for over 100 years. As a child, she could walk hundreds of yards in the waist-deep shallow water and feel the smooth pebbles beneath her toes. Now a retiree, the water in front of her house is matted with weeds.

Homeowners around the Roscommon County lake have noticed subtle changes to their shores throughout the last few decades. Rocks are crusted with brown algae. Fish that were once plentiful are now more difficult to catch. Swimmers are sometimes covered in an itchy rash after leaving the waters.

Studies confirmed what they already suspected, including an MSU study detailing the water chemistry's "dramatic" changes from 1995-2014. The culprit? Septic tanks.

Higgins Lake is lined with houses, most of which rely on septic systems for their wastewater treatment. MSU and United States Geological Survey (USGS) researchers say those tanks are to blame for nutrients such as nitrogen and phosphorous seeping into the waters used for boating, fishing and swimming.

Cornell and other concerned citizens say their best chance at protecting the lake's future is a modern sewage treatment plant. They've created a special assessment district, identified a site and even secured $1 million in federal funding to go toward the project. MSU Water Alliance researchers, including Alliance Director Joan Rose, are joining forces with the community to document the sewer system in action. Once the system is installed, they'll test samples over the course of five years and collect data.

The project isn't a done deal, and even when the contract is signed, homeowners don't expect the sewage treatment plant to be operational for at least five years. Meanwhile, the Water Alliance is seeking funding to support the data sampling, said Rose, also MSU Homer Nowlin Endowed Chair in Water Research and one of the world's foremost water experts. Once the project is set in motion, Rose is confident that Higgins Lake will see a positive impact to its water quality.

“Our data will document the improvement in water quality and the health of the lake,” Rose said. “This is going to provide a roadmap to communities that want to replicate this effort.”

A lake at risk

Higgins Lake dates back to the Ice Age, when the 7 mile-long, 4 mile-wide lake was carved by a glacier. It’s known for its shallow nearshore shelf and 130-foot deepwater basin that’s perfect for fishing. National Geographic once rated Higgins Lake as the sixth most beautiful lake in the world. Each year, about 100,000 people flock to the Northern Michigan icon.

Higgins Lake is known as an oligotrophic lake, meaning its nutrient levels are too low for much aquatic plant and algae growth. That’s why the lake’s water is so clear.

The area surrounding Higgins Lake is densely populated by cottages, even beyond the shoreline. Despite this, the area isn’t served by a municipal sewer system. Instead, these homes rely on onsite wastewater treatment systems, or septic systems, to treat their sewage, as is common in rural areas.

Septic systems work by collecting waste in an underground storage tank. The solids settle to the bottom, while the liquid wastewater, known as effluent, exits into a drainage field. As the effluent percolates through the soil, the viruses and bacteria are naturally treated and removed.

“Soil for the most part does an effective job on bacteria and viruses,” said Steve King, director of environmental health at the Central Michigan District Health Department. “With nutrients, especially nitrates, you have to have conditions that are exactly right to pull all that nitrogen out of the wastewater stream.”

The reality is, septic systems weren’t designed to remove nutrients such as phosphorous and nitrogen, said Anthony Kendall, MSU assistant professor in Earth and Environmental Sciences. The only way phosphorous can be eliminated is if it permanently attaches to soil or sand and remains in the sediment instead of moving into the groundwater. While that does happen at first, soil has a limited storage capacity. The longer a septic system is used, the more phosphorous moves into the water.

Study shows septic impact

Kendall was a co-author of a 2014 report continuing the USGS’s work on documenting Higgins Lake’s water quality. To gather data, they collected samples from both surface water and groundwater at 21 sites around the perimeter of Higgins Lake.

After collecting data for a year and a half, researchers found that levels of phosphorous and other nutrients had dramatically increased. In fact, they’d risen to the point that Higgins

Lake had become mesotrophic, meaning it had moderate amounts of nutrients that support aquatic plant and algae growth. That's why residents are seeing more weeds and algae near the shore.

The connection to septic tanks was clear, Kendall said. When they looked at samples around the lake's perimeter, nutrient levels were lower at sites near Camp Curnalia. This subdivision of homes on very small lots was moved to a sewer system in 2009. Kendall said the low nutrient levels in that area are an obvious indication that the sewer system is doing its job. Elsewhere, however, septic systems are responsible for the phosphorous that's causing more weeds and algae.

"Any lake with a significant number of people should have to have a sewer," Kendall said. "We can't expect to have people poop in the lake and not have a problem. And really, that is what we are doing when we live on lakes with septic systems."

Where there are septic systems, there's risk for bacterial contamination as well. In 2015, Rose and Kendall conducted a study tying septic systems to the presence of human fecal markers in watersheds across Michigan. That means that E. coli and other pathogens can find their way into the groundwater and, eventually, the lake.

Nutrients causing plant explosion

For now, Higgins' Lake's biggest problem is nutrients in the water. While nutrients such as phosphorous don't cause diseases, they can change a lake's ecology. Weeds that were once rare can grow rapidly, making the lake inhospitable to other desirable species. Aquatic plant growth can also impact the lake's water clarity that's so prized by visitors and residents alike.

Fred Swinehart, chairman of the Higgins Lake Property Owners Association environmental committee, has come to his family cottage every summer since he was in diapers. Today, he's a full-time resident. While water quality has been an issue since the 1970s, he said he's noticed the most drastic changes over the last 15 years.

Weeds crept into the shoreline in front of Swinehart's house, making the water murky. Then, last spring, giant floating blobs of furry-looking algae appeared next to his dock. In all his years at the lake, he'd never seen anything like it.

The problem isn't as evident to tourists, who spend most of their time on beaches or drive boats to the lake's deep center. Brad Gibson, a Higgins Lake homeowner who served 20 years on the property owner's association, said he hears from visitors all the time that there's nothing wrong with the lake.

“It’s still spectacularly beautiful,” Gibson said. “But if you just drop your boat in the middle of the lake, that’s all you see. Living there, you see that the near shore is totally degraded.”

Why the explosion?

While septic tanks have been used for decades around Higgins Lake, multiple factors have contributed to the increasing problems. One issue is small lot sizes and a high concentration of homes. On a one-acre lot, King said nutrients are typically detected in groundwater even within a few feet of a drain field.

The problem is some areas of Higgins Lake are densely populated, with homes on lots of a quarter of an acre or smaller. Complicating the matter is the presence of groundwater wells. On a small lot, it’s difficult to keep septic tanks at a proper distance from where human waste is stored.

Already, King’s office found one in 10 wells in the area contained nitrate levels beyond federal standards. That’s an indicator that septic systems are contaminating drinking water.

“You need to make sure there’s enough space between your septic and your groundwater well, otherwise you’re going to be slurping in septic water, which is completely gross,” Kendall said.

In the past, most people visited their family lake cottages a few times a year. Today, more people live in those cottages full time as they retire or work remotely. When they’re not there, they’re renting their cottages to tourists on Airbnb or VRBO, often packing in more people than the septic system was built to handle.

Another issue is a lack of maintenance or failure to replace failing septic systems. Michigan is the only state in the country without a statewide sanitary code requiring septic system inspections. While municipalities can create their own inspection ordinances, only 11 of Michigan’s 83 counties have one.

King estimates that 40 percent of the homes near Higgins Lake have no record of a septic system permit. That means no one knows what’s underground on 40 percent of Higgins Lake properties, or if there’s a septic tank there at all.

Even if all septic tanks were updated and perfectly maintained, it still wouldn’t be enough to keep nutrients out of Higgins Lake, Kendall said.

“The reality is, septic systems contribute most of the nutrients in the system, and they’re not designed to remove it,” Kendall said. “And if the nutrients aren’t already in the lake, they’re on their way. More and more, we’re starting to feel the impacts.”

A modern solution

MSU experts say a sewer system is the answer to Higgins Lake's water problems. Many residents agree. Over the last few years, some homeowners from Gerrish Township and Lyon Township, where the lake is located, have rallied to move forward with a Septic Tank Effluent Pumping (STEP) system.

The system was recommended by an engineer after exploring alternatives. The way it works is each home would still have a septic tank that collected solids. The effluent, however, would be pumped to a central wastewater treatment plant. Then, the septic tanks would be pumped every seven years so that the sludge could be taken to a treatment plant.

To move forward, the two townships formed the Gerrish-Lyon Utility Authority (GLUA). Homeowners in both townships also approved a special assessment district. These are formed under Public Act 188, where a majority of property owners agree to levy a property tax in exchange for a specific service, like road improvements.

The project carries a hefty price tag of $115 million. Swinehart said they plan to seek grant money, and already, the GLUA has received $1 million in federal funding. Homeowners could also apply for state homeowner assistance programs.

King said property owners would pay off the cost of the system over multiple decades. He also pointed out that anyone who owns a septic system is responsible for replacing it every so often. Depending on the size, that could cost anywhere from $10,000 to $15,000. Moving to a modern sewer would be a comparable cost, he said.

While it's a massive undertaking, it's not impossible. Other lake communities, including Houghton Lake, have moved from septic tanks to sewage treatment plants. Camp Curnalia, which is located along Higgins Lake, has also already moved to a sewer. Kendall said these steps are needed as lake communities grow and develop.

"When we develop an area, we have a bigger impact," Kendall said. "We need to design a waste treatment system that matches the impact that we have, not something left over from this bygone era of the family cabin that you visited two, three or four times a year. That is a very, very different place than the lake is today."

Water Alliance getting involved

The proposed project has divided the community. Houses around the lake are marked with signs either supporting or opposing the project. Many neighbors, especially those in homes on back lots not directly located along the shoreline, have raised concerns about the cost, as well as whether septic systems are really to blame for the water quality. Others question whether the STEP system will be effective.

That’s why testing the water is so important, Rose said. She and the Water Alliance are partnering with Grand Valley State University on a proposal to collect samples four times a year for five years. The plan would include sampling after peak usage days such as Memorial Day, the Fourth of July and Labor Day, as well as high precipitation events. The samples would be tested for microbes as well as nutrients.

The data they collect will document the lake’s improvement year after year, settling once and for all whether the STEP system improves water quality. It will also show how quickly the lake turns around once it’s no longer subjected to runoff from septic tanks. Another goal is for researchers to help equip locals to become citizen scientists and assess the lake themselves, as well as working with local high school students in a STEM science program.

It's the perfect Water Alliance project because it encompasses all three of the Alliance’s missions – research, education and engagement. It also addresses problems that can only be solved with an interdisciplinary team.

“This project represents our mission here at MSU as a land grant university,” Rose said. “We want to do good science, and we want to engage and educate our community.”

Preserving the lake’s future

Many steps remain before a sewer system is installed. There are legal hoops to jump through, contracts to be signed and bids to be collected. Realistically, it will be years before Swinehart and other concerned citizens see their dream become a reality.

In the meantime, Swinehart and his fellow residents will keep working. They’ll keep holding meetings and educating their neighbors because they want their grandchildren to enjoy Higgins Lake. They want them to have the same memories that they were privileged to have.

Keeping these lakes clean must be a priority for Michigan, Kendall said. If we want to enjoy them for recreation, we must do everything we can to minimize the human impact, he said.

“Our lakes are a treasure, and we should treat them that way, rather than just treat them as the ultimate receiving ground for our waste,” Kendall said.