

Low Pressure, High Profile

Milestone Pressure Sewer Installation Completed in Twin Lakes, Ind.

By Joseph Harmes

Designing and constructing the largest low pressure sewer system in the Western Hemisphere was far from the original intent of the small Twin Lakes Regional Sewer District (TLRSD) in north-central Indiana.

"What was originally envisioned was to provide safe, reliable, cost-effective, sanitary sewer service to the residents of the district," says Mike Darter, general manager of TLRSD, which began planning a wastewater disposal infrastructure in the 1990s to remedy decades of failing septic systems contaminating its waterways with *E. coli*.

At stake was the area's quality of life, safety and economy, much of it derived from Lake Freeman and Lake Shaffer which together generate more than \$70 million annually for a tourism industry which faced posting "Swim at your own risk" signs on the shorelines.

The Twin Lakes Regional Sewer District was formed by the White County (pop. 25,000) Board of Commissioners in 1973 and in the next two decades grew into a 33-square-mile service area including a portion of the Tippecanoe River flowing through Monticello (pop. 5,400), the county seat. Two dams were built in the 1920s creating the more commercial Lake Shafer to the north of town and the mostly residential Lake Freeman in the south.

Almost immediately, the sister lakes attracted visitors from the surrounding area and cities like Indianapolis and Chicago for fishing, boating, camping and golf in the summer and, to a lesser extent, cross country skiing, snowmobiling and ice skating in the winter. The number of vacation cottages, fishing camps, motels and campgrounds grew from a few hundred to thousands, all discharging wastewater through fragile or inadequate septic systems or more primitive techniques.

"Septic wastewater disposal systems have been in use since most homes have been built around Indiana's lakes," said a 1999 report by Purdue University in cooperation with county health departments and the Indiana State Department of Health. "In addition, many septic systems are very old and have surpassed their maximum useful life span."

The study further noted that "approximately 50 percent of the soils in Indiana are not suited for septic systems. Some have high water tables, some are too sandy and permeable and others are too steep or rocky."

This was aggravated by a flush-and-forget mentality of many property owners, the report added, who "do not adequately maintain their septic waste disposal systems."

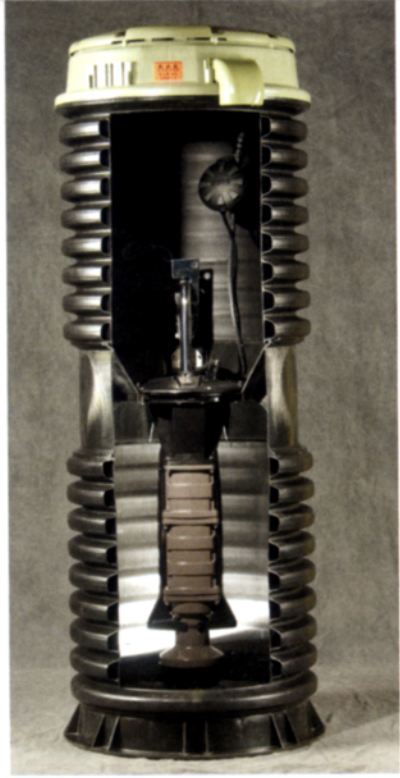
The study found "fecal contamination" at public bathing beaches and cited "leaking septic tanks" as one of the primary causes, along with run-off from livestock operations. A different report warned: "Untreated sewage from failed septic systems can contain a number of diseases that are a concern to people including hepatitis, giardiasis and salmonellosis."

The reports were merely sanitized depictions of what residents were living with amidst the Twin Lakes.

"It was not uncommon to find structures that would discharge the sanitary waste directly to the lakes and river or to a drainage tile flowing into them," says Darter, who also cites "a small town that was on the verge of being condemned because of sewage on top of the ground."

"Failing septic tanks were leaching into the lakes," says Patrick Stalker, a senior projects manager with Layne Heavy Civil, Inc. "It was visibly evident in several areas, including standing sewage in drainage ditches."

"The TLRSD has no public water supply so every home has its own well," says Joe Tierney, P.E. and vice president of GRW Engineers in Indianapolis. "In many cases, the wells were only a few



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feet away from the septic systems' leach fields. The high-density development around the lake did not allow appropriate separation distances between the wells and the septic system."

The TLRSD functioned mostly as a paper entity until 1994 when it was reactivated. In a 1995 planning report, "the County Sanitarian noted the most significant problem is the inability to properly correct failures of on-site septic systems because of small lot sizes," says Darter. "Also, very few on-site systems discharged to an absorption field and the use of on-site aerated septic systems that discharged directly to the lakes was a common practice," he adds.

"The small lot sizes did not allow extra space to actually install a properly-sized septic system," says Tierney. "Many systems consisted of 55-gallon drums as holding tanks and leaching tanks. In a majority of the cases the leach fields for lake-front homes were within a few feet of the shoreline."

Given the state of disrepair, "the E. coli counts in the lakes were always well above the 1,000 to 10,000 range during the recreational period of April through October, with the full body contact limit of 235," Darter says.

But even failing septic systems can have their defenders. Some even "tried to attribute the high coliform to the native Canadian goose population," says Tierney.

The TLRSD began to research economically viable and environmentally friendly methods to sewer the sprawling district. Among the options: traditional gravity installations, vacuum assist, low pressure sewers (LPS) and gravity/LPS hybrids. A stand-alone LPS, designers concluded, checked all the boxes needed to sewer every structure within a half-mile of 100 combined miles of shoreline.

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“There could of have been some gravity service areas, but the depth and dewatering would have been very costly and resulted in multiple lift stations (which in the U.S. can run about \$350,000 to \$500,000 each) pumping long distances,” says Stalker, an estimator and senior project manager for several stages of the project.

The LPS configured 219 miles of horizontal directional drilled pipe for LPS mains and an additional 67 miles of pressure sewer lines with two sewage booster packages, five Gorman-Rupp self-priming lift stations, four wastewater treatment plants and 5,071 grinder pumps to serve more than 8,000 locations (present size).

In a highly competitive bidding process, TLRSD’s planners chose grinder pump manufacturer Environment One Corp. (E/One) because of its reputation for durability and its proven record of successful installations around lakes with conditions similar to the Twin Lakes. Other E/One water-front LPS jobs include Martha’s Vineyard, Baja California (Mexico) and Hawaii.

Low pressure sewer systems begin at a grinder pump which accepts wastewater and grinds its contents into fine slurry and transports it through small diameter (2- to 4-in.) PVC pipes buried just beneath the frost line to roadside force mains or treatment facility.

Unlike conventional gravity central sewers, which use 24-in. pipe and require deep excavation, an LPS system is not destructive to the landscape’s natural or built features and requires less maintenance.

“Because of the size of the lots, the nature of construction, the width of roads and lanes, narrow easements, easements filled with other utilities, the terrain — by far and away directional drilling of LPS was the only way to sewer this area. It provided a timely installation with minimal disturbance to the property owners,” says Darter.

A grinder pump manufactured by E/One is a self-contained unit — barely bigger than a washing machine — with an integral dry (wet optional) well, a one horsepower motor, controls and level-sensing. It is automatically activated and runs for very short periods. Electrical consumption of the grinder pump is low — a household that uses 250 gallons of water per day should consume less than 10 kwhr per month to run the pump.

E/One has manufactured more than 500,000 grinder pumps at its Niskayuna, N.Y., headquarters. Its pumps comprise the largest installed base of pressure sewers in the world, and E/One alone provides LPS service to more than one million people worldwide.

With LPS, the wastewater discharged from the grinder pumps can be propelled uphill from the homes, through diverse ground challenges and even around contours. It is effective for distances at more than a mile from force mains or water treatment facility.

Although elevations in the area are relatively flat, they drop severely near the lakes and river. In some places, Darter says, “the static lift to get from the lake front to the flat upper area was 60 ft or more. This made selecting a grinder pump that could consistently perform under very challenging hydraulic



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E/One, job engineers determined, was the only manufacturer offering a proven semi-positive displacement type grinder pump able to perform under the higher head demands present in this project.

The E/One grinder pump addresses this with a progressing cavity pump, rather than a centrifugal pump, which produces a nearly constant discharge rate over a wide range of head conditions, including negative head conditions.

“Installing LPS uphill can be challenging, but we did installations where we set the unit in the very backyard of a property at the bottom of a steep slope, so steep that you had to literally zig zag up the hill with the equipment so it didn’t flip backwards on us,” says James Rothenberger, vice president of Rothenberger Company, Inc. of Concord, Mich. “I think an E/One would pump sewage to the top of the Statue of Liberty!”

Even with a shovel-ready blueprint in hand, TLRSD had to navigate the politics of funding and septic tank abandonment in dozens of public meetings.

“It takes a lot of public relations by the sewer districts on the front end” to launch any project, observes Rothenberger.

First, says Darter, there was “owner perception: ‘I’m not having any problem flushing, I don’t need sewer’ and saying their septic systems were working just fine.” But officials mandated that “where your property line is within 300 ft of the new public sewer, the property owner is required to connect to the public sewer when so informed of its availability,” Darter adds.

“There was a significant amount of resistance to the overall sewer projects but much of it was to the forced connection and the cost and the monthly bill,” says Tierney, who was involved with two stages of the project. “Most people in this country take reliable sewer and water service for granted and expect it to be

there and cost little or nothing. [Here], it went from nothing to \$50 to \$65 per month and in some projects there was an initial connection fee that ranged from \$1,000 per home for one project area to \$2,500 per home in another," he adds.

The concept of LPS, which has been refined and effectively used for more than 45 years, played little role in the debate.

"You have some resistance everywhere you go, more from the fact they didn't have a sewer bill before the project than the technology used. I think some of the grinder pump/LPS bashing is really about the bill they are now getting," says Stalker, who installed several thousand of the project's grinder pumps.

"I attended at least four public meetings that had hundreds of people turn out at each one," says Tierney, "and there were some legitimate questions as to what the grinder pumps were all about but we did not receive very much in terms of challenges to LPS. In fact, I would say that most were in favor of the lower-cost technology," Tierney adds.

To finance the \$65 million enterprise, Darter says, "90 percent was funded by USDA-RD via loan (\$44,144,500) and grant (\$14,616,500). One project was financed with a revenue bond in the amount of \$6.25 million."

Construction commenced in 2000 and would last more than a dozen years to sewer in six stages. Engineers integrated almost a dozen grinder pump models, each with a specific

design purpose. Multiplex housing serviced by one pump. Indoor pumps for lakeside homes where land was unavailable. Others adapted to flood plains.

In many instances, E/One's grinder pumps could be located in the footprint of an abandoned septic tank.

Other equipment and technology was key to the project. Gorman-Rupp Co. developed specialty-pumping stations including a highly specialized sewage booster package dubbed the "sewster" station, says Bob Jordan, municipal sales manager for Indianapolis-based *covalen*, a manufacturer's rep which also is the nation's largest distributor of low pressure sewer solutions.

Gorman-Rupp and *covalen* also provided five highly engineered sewage lift stations utilizing self-priming above ground pumps for collection and transportation to the treatment plants, says Jordan who worked with all project phases.

A technique integral to success was horizontal directional drilling where the drill head can be guided from above ground both horizontally and side-to-side for depth.

"As the head is pushed forward a tracing scope follows it from above," says Tierney. "The tracing head is operated by someone who communicates with the person running the drill rig. This allows them to drill around the curve in a road, for example."



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"In many of the individual installation scenarios it was the only technology that would work. Many of the lake-front houses were on near vertical slopes and extremely challenging to complete the install," says Tierney.

"I think the use of trenchless technology to install the piping network was by far the best construction method and caused the least property damage and daily disruptions to the community. The LPS and the horizontal directional drilling process were so minimally invasive that when the actual construction was ongoing most people didn't even notice until their pump was installed," Tierney adds.

"We had to horizontally bore under the Tippecanoe River five different times along with dozens of state highway and county roadway crossings," says Rothenberger who oversaw the installation of 210,000 lf of HDPE force main ranging from 1-1/4 in. to 10 in. in diameter.

"Find me a project on a large river or lake where you can install 40 miles of open cut gravity sewer to over 1,100 locations without once having to set up an overnight detour for traffic," he adds. "We literally never had to do that once with our method."

"The Twin Lakes system has a lot, not a little, of everything a low pressure system will have: Massive amounts pipe in varying sizes, complex pumping stations, incredibly tight spaces to install the E/One units and the sewer mains, abrupt changes in elevations, wet soils, hundreds of easements to work within, rock bores," Rothenberger says. "If you wanted to educate someone on collection systems and all the pieces of the puzzle, Twin Lakes pretty much has it all."

TLRSD also measured savings in the amount of time it took to complete some portions of the project. In only 14 months, says Rothenberger, his company put in approximately 40 miles of LPS to "everything from one-room cottages, campgrounds, restaurants and 5,000-sq-ft homes." His assignment also included force main work, 780 E/One grinder pumps (eight different models), 199 air release/flushing stations, 136 isolation valves on the sewer mains and 82,000 ft of electrical conduit to power the E/One units.

"It takes a contractor who has already installed several LPS systems and a workforce of people who are at the top of their field," says Rothenberger. "Prior to Twin Lakes we had already installed over 2,500 grinder units on different projects since 2004. Many of our guys have worked on each doing everything from drilling, digging, testing and restoration. They know what to expect."

"Once they get going and installing these things, get a method going, they just get right on with it," says Darter. "For this district, the best thing was low pressure sewer. You would not ever be able to put gravity sewer in this amount of area. You just couldn't. Today it would still look like a war zone if you tried it like that," he says of the environmental wreckage that deep trenching for a gravity system would have caused.

"The combination of E/One grinder pumps and directional boring enabled the project to be completed at an attractive budget," says covalen's Jordan.

After more than a dozen years of partial and now full implementation, three key conclusions regarding this LPS are evi-

dent: The system is reliable and cost-effective, hydraulically flexible and improves quality of life.

"It is tough to track time between service calls for individual pumps because not all customers are full-time residents," says Darter. "From a personal side, I am a full-time resident and my grinder was installed in March 2004 and the first service call I had was May 2014. Anticipated life before parts need replaced is seven years."

Darter cites TLRSD's stats covering about 5,000 grinder pumps from 2011-2013: "Average pumps pulled/year, 417; average repair hours/year, 721; average hours to rebuild/pump, 1.75 hrs; average cost of parts/year, \$163,705.00; average labor cost/year to rebuild, \$14,009.00; and, average cost for parts & labor/year, \$177,715.00. There are no costs or fees to the homeowner. All operation and maintenance costs are calculated into the monthly rate."

"I think the fear of maintenance is what keeps sewer districts from using LPS more often," says Rothenberger. "From what I have seen over the years is that there is very little maintenance to an LPS, particularly an E/One system. The technology and the materials used on an LPS have improved so dramatically that all those horror stories are a thing of the past."

A well-functioning sewer system also opens doors for economic development and new construction. As the City of Monticello website now emphasizes, "In economic development circles, experts will tell you infrastructure is key in landing new industries or businesses. When building a new facility or relocating one, developers first look at water and sewer accessibility and dependability."

"What I can see from traveling in the district," says Darter, "houses are being built on lots that were deemed too small for a septic system. Homes and cottages are being remodeled and enlarged since public sewer is available and couldn't before because of the (septic system) limitations. The value of land is going up because of the public sewer. I am starting to notice that more property owners are becoming full-time and making their lake home their primary residence."

"One thing that always strikes me is what people will learn to live with when they have a septic system at a cottage," says Rothenberger. "I have seen people having to have a porta John in the driveway for the summer because they can't use the bathroom. Or they can't do the dishes at the same time they take a shower. Or they can't take a shower at all. Once they have an LPS it's pretty neat to see people enjoy the lake and have more guests and grandkids and live like we are in the 21st century, not the 19th!"

"TLRSD has now been installing essentially the same project using the same pumps and pipe material for 14 years and they have a very good and long track record which supports LPS design concepts and construction methods," says Tierney. "I think the TLRSD system is an excellent example of how LPS can be installed in a minimally invasive manner in very physically challenging areas and provide reliable, cost-effective sewer service."

Joseph Harnes is a freelance writer covering the evolution and acceptance of low pressure sewer systems.