



Subterranean

Smaller is better. Homes in the Villages of Seven Lakes in Nova Scotia might never have been built, without the hidden infrastructure that kept blackwater manageable.

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Secrets

BY JOSEPH HARMES

To keep home prices affordable, excavation minimal, and sewage manageable, the developer used “grind and pump” technology.



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FTER SPENDING ALMOST SIX YEARS consolidating separate parcels into a contiguous 634-acre tract of mature forest touching seven different lakes—and another four years negotiating a development agreement with the regional Canadian government—the Penney Group embarked on a unique challenge: creating an open-space conservation community restricted to only 634 moderately sized and priced residences, while leaving 60 percent of the pristine landscape undisturbed. It also needed to implement a septic system for the homes without risk of contaminating the lakes..

That effort—the Villages of Seven Lakes—broke ground in 2014 next to the small town of Porters Lake (pop. 3,200), an exurb of Halifax, the capital of Nova Scotia in eastern Canada. A long-time dream envisioned by Penney Group President Gail Penney, the residential development detours from the 21st-century approach of big profits derived from over-sized homes on tiny



Repeat performance. Massive storage tanks store wastewater until it can be biologically broken down and used to recharge groundwater.



A broad plan. The Penney Group's goal is simple: creating an open-space conservation community of 634 moderately sized and priced residences, while leaving 60 percent of the 11-mile-long parcel undisturbed.

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THE PENNEY GROUP

lots, to a quality-of-life philosophy straight out of the Urban Land Institute's (ULI) playbook advocating "land use policies and design practices that respect the uniqueness of both the built and natural environments."

A blank slate this large could easily accommodate many more homes, but the creation of a scaled-down community the scope of Seven Lakes is actually more difficult. A narrow target like this requires "insightful planning and design," ULI says, because "the elements of a thriving community don't come together randomly."

According to Brad Harnett, a certified civil engineering technologist and project manager of the Villages of Seven Lakes, the developer has to think outside the box, then fit all of the pieces back into the box or various boxes of differing shapes. "Classic open-space development leaves a minimum of 60 percent of the area undisturbed," he says. "This means that placement of all roads, services, infrastructure, wells, wastewater systems, driveways, houses and lawns has to be carefully thought out."

Penney, a school teacher for 18 years before joining the 40-year-old family business of automobiles, heavy construction, energy services and real estate, admits this strategy is an expensive, detailed process. But it also "provides us the opportunity to be creative. If you want to innovate, you really just need to listen to what people are telling you and 'use what you have' to help find solutions."

AFFORDABLE, SUN-POWERED AND SEPTIC FRIENDLY

The Villages of Seven Lakes' inventory is a new interpretation of the Craftsman and Colonial-style houses found throughout Nova Scotia. The sustainable, low-impact homes average 900 to 1,300 square feet, with a \$300,000 CAD (approximately \$240,000 USD) starting price. Among their amenities: homes are situated to maximize passive solar energy.

Houses at Seven Lakes are clustered together in "little villages" surrounding nature preserves, with each home site measuring one-quarter to three-quarters of an acre. Eventually, seven clusters (totaling 634 residences worth about \$160 million CAD, or \$128 million USD) of single-family homes, duplexes and four-plexes will be linked by trails for walking, hiking and biking. A single 4.2-mile trail mirroring the road between the development and Porters Lake will cost Penney Group \$700,000 CAD (\$560,000 USD).

"We learned [from focus groups] that while many people currently living in the urban center [a 25-minute commute between Seven Lakes and downtown Halifax on the Atlantic shore] want to live rurally, several things are stopping them from doing that," says Penney. "They want to stay connected to their neighbors and they don't want to have to drive their kids to their neighbors' homes. They don't want to spend all weekend gardening nor too much upkeep. They want trees and the space to recreate in."

Rural homeowners also do not want to worry about having to maintain a septic system. Many prospective buyers are nervous at the prospect, according to Penney.

"Many homebuyers have had no prior experience with individual septic systems and do not understand or trust them," says Randall Arendt, an author, designer, consultant and pioneer of conservation planning whose work influenced Penney's concept of Seven Lakes. "They prefer central systems, and most are probably not much concerned as to whether it is a conventional one that discharges treated effluent into rivers and lakes, or one that recharges aquifers with more progressive approaches."

Infrastructure for stormwater or wastewater can degrade the environment or play a beneficial role, Arendt says. "Wastewater infrastructure rarely registers as a consideration among homebuyers, except perhaps as a very minor one," he says. "[And even then,] only when innovative wastewater solutions are highlighted as part of the marketing."

INAPPROPRIATE INFRASTRUCTURE'S ENVIRONMENTAL RISK

The developer's tenet of environmental integrity commences with the water quality of the lakes (Bell, Canoe, Thief, Porters, Conrod, Fiddle and Thompson). It extends to Seven Lakes' riparian buffers,

The main reason [gravity sewers] were invented several millennia ago was because the Romans could no longer tolerate the smell.

—Halifax Regional Municipality



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The nature of things. Gravity-driven sewer systems get a thumbs-down from Seven Lakes developers, because they require removal of a large amount of vegetation from homesites.

wetlands, vernal pools and flood plains. Although the popular area provides numerous access points for boating, swimming, fishing and other activities, Penney says they decided not to locate homes around the lake front. Besides guaranteeing everyone full access, the policy protects the lakes from at least some human footprint.

Septic systems could have been risky. For example, a typical 1,000-gallon tank used by a family of four would require pumping every three to five years. If homeowners lapse into a flush-and-forget mentality, the tanks and leach fields could deteriorate within decades and put everything in jeopardy.

“Septic wasn’t the choice for us because it is too limiting,” Penney says. “For buyers, the environment and for developers. In the long term, it presents too much risk for the environment and ultimately the development overall.”

Modern septic systems are widely accepted by the Halifax Regional Municipality (HRM). In some cases, HRM considers them superior to traditional gravity sewers which will, it asserted in a report, “invariably begin to leak and become conduits for surface and groundwater to enter and dilute sewage in the collection system.”

CAVEATS OF GRAVITY SEWER DESIGN

HRM’s report contends that gravity sewers “have never been more than a means of relocating a problem in a manner that is convenient to us.” The main reason they were invented several millennia ago, it adds, was because “the Romans decided they could no longer tolerate the smell.”

The HRM does not recommend gravity sewers in the area because of the proximity of bedrock and vulnerability to frost heave. Unsaid was the environmental disruption necessary for a gravity sewer’s large-diameter, deeply excavated mains.

“The (Seven Lakes) terrain is quite challenging, and a gravity

system would have required many manholes and several pump stations,” Harnett says. “Some homes would still require pumps to get up to the sewer main. Septic tanks at each home would require them to be monitored and pumped at an unknown potentially high cost, and there would always be the fear of contamination from leaks.”

Gravity sewers likely would have required removing acres of trees, which the developers were committed to preserving. “There is no clear cutting of lots at Seven Lakes, and we retain as many trees as possible when we are clearing for a home,” says Nicole Perchard, Seven Lakes’ community communications manager.

THE ATS SOLUTION

The Villages of Seven Lakes retained engineering firm WSP (WSP/Parsons Brinckerhoff) for a state-of-the-art solution. WSP endorsed innovative ALL-TERRAIN SEWER (ATS) products for pressure sewer systems manufactured by Environment One (E/One) Corp. in Niskayuna, N.Y.

Coincidentally, the HRM report noted that constraints associated with conventional gravity sewers, given typical geological and climatic conditions, “suggest the need to investigate alternatives.” Pressure sewers, it stated, “represent a revolution of these traditional techniques.”

Seven Lakes’ sewer system is a low-pressure unit that uses two- to four-inch small-diameter pipes and E/One grinder pumps (a component of the ATS system), which are installed at each home, according to Harnett. The grinder pump station collects all of the wastewater from the home and grinds it into slurry. The wastewater is then pumped directly to the development’s wastewater treatment plant, he explains.

“It was either a (developer-financed onsite) wastewater treatment plant or individual on-site septic disposal systems,” Harnett says.

"[ATS] allows us to place homes anywhere on our site whether it be at the top or bottom of a hill and anywhere in between."

Besides water features, the topographical challenges include slopes exceeding 30 percent, rock outcroppings and potential archeological sites.

"Traditional septic systems result in expansive lawns, and large spaces between home sites. Our design addresses these issues. We can design our lots to suit the land and the needs of homebuyers first and foremost," says Penney. "We do not need to plan the homes around the soil conditions required for septic design."



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It's a grind. E/One grinder pump station can propel wastewater for more than two miles—even uphill—and help re-invent the terrain.

The E/One grinder pump station begins with a tank about the size of a dishwasher that is buried in the ground, its lid easily camouflaged with minor landscaping. Components include a 1-hp, semi-positive displacement pump whose robust torque can propel wastewater through small-diameter, inflow-and-infiltration-free pressurized pipe for a distance of more than two miles—or even uphill—to a force main or treatment plant. As in the case of Seven Lakes, it can help re-invent the terrain.

This technique performs well in harsh, frozen climates, Harnett says. "Frost does not normally penetrate deeper than [5.5 feet], and our sewer lines are installed at least that deep," he notes. "If rock is an issue and we cannot achieve that depth, we can insulate the pipe."

INNOVATIVE, MODERN WASTEWATER DISPOSAL DESIGN

Harnett estimates that each home will produce approximately 1,000 liters (264 gallons) of wastewater daily. "In a community of 103 homes (the initial phase under construction) that is a lot of water," he says. Each home's E/One grinder pump requires zero preventive maintenance to "move wastewater quickly and efficiently away from the home and transport it through the closed ATS system to our

wastewater treatment facility," Harnett adds.

When the wastewater reaches the facility, it meanders through five 25,000-gallon tanks, where it is separated into scum, effluent and sludge. The effluent's nutrients are broken down in a biological process before passing through ultraviolet light for tertiary treatment and pumped uphill to a subsurface dispersal system (drip irrigation), which delivers the cleaned water back into the ground to help recharge groundwater.

Seven Lakes developers have approval for a total of 634 homes. Each dwelling has its own E/One unit regardless whether it is detached, semi-detached or a townhouse, according to Harnett. For him, it's not a first-time scenario. "I was introduced to E/One's ATS when I worked for a local firm that engineered a subdivision where they are in use," he says. "We are the first on this scale."

The Seven Lakes wastewater configuration includes a cost-per-home of around \$6,500 CAD (\$5,300 USD), depending on the exchange rate, Harnett says. The cost includes supply, pump startup and homeowner education on its use and operation.

Each E/One grinder pump is owned by the homeowner. "This puts the responsibility for proper use and care on the homeowner, who is more likely not to abuse the system if they are responsible for repairing or replacing it," Harnett says.

A local plumbing company is trained in pump replacement and if service is required, the pumps will be sent to the regional supplier for repair. The pump is easily swapped out of the tank by removing bolts in the lid and unlatching the pump from the tank's accessway.

"Our homeowners so far love the fact that they do not have to deal with a septic tank or disposal field on their property," says Harnett, "and that the system is monitored by a qualified professional, a retired municipality treatment plant operator licensed by the provincial department of the environment."

NO SUCH THING AS A "CONVENTIONAL" SUSTAINABLE ALTERNATIVE

Seven Lakes' sewer system wasn't just a revelation to its new homeowners. WSP's forward-thinking proposal is almost unique among its peers, Arendt observes. In his book *Rural by Design*, he lamented that normally "many engineering consulting firms, whose core expertise lies in designing larger conventional systems, are biased against these alternative systems."

"It sounds like the (Seven Lakes) system is designed to do everything in the most-environmental manner, from start to finish," says Arendt. "I like small-diameter pressurized systems. They make a great deal of sense."

According to Harnett, "This may sound like a lot of trouble to develop a single project, but in the end you are left with a unique, environmentally friendly, sustainable community." **GB**