Effluent sewers sustainably accommodate growing communities

By Geoff Salthouse and Mike Insole

Many rural communities that use septic systems have outgrown that technology. Some are experiencing widespread failure of aging systems. Others are growing, but their soil conditions won't accommodate additional septic systems. Larger communities want to grow, but their existing sewer systems can't accommodate new connections. In all these cases, neither conventional septic systems, nor gravity sewer systems, are feasible.

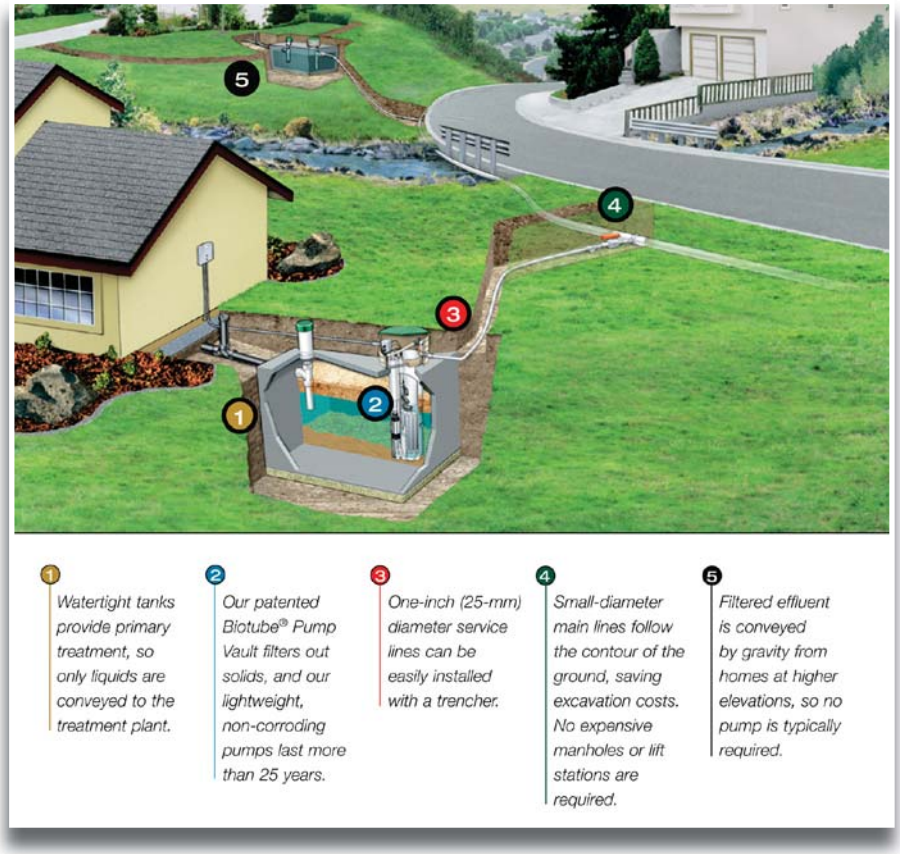
Effluent sewers are a proven and sustainable solution for decentralized and rural wastewater collection across Canada, and in many other countries. Not only can effluent sewers serve rural areas, but they are also a cost-effective way to serve fringe development, just outside towns that do not want to expand their conventional sewer system.

How effluent sewer systems work

In an effluent sewer system, primary treatment takes place in a small, watertight, underground tank (called an interceptor tank) at each property. Raw wastes separate into solid sludge, floating scum, and liquid effluent; this is a passive and reliable process, requiring no energy input. The solids remain in the tank for years. Because the anaerobic biological processes in the tank tend to consume the solids, most tanks only need to be pumped every ten or more years, with larger tanks even less frequently.

Unlike solids, clarified liquid effluent remains in the tank for only a couple of days. Then it is conveyed from the tank to the next treatment step. Systems in which the effluent flows by gravity are called septic tank effluent gravity (STEG) systems. If each household has a pump that pushes the effluent, the system is called a septic tank effluent pumping (STEP) system. Both types of connections can exist on the same collection network.

Because only liquid effluent is pumped intermittently, special small, energy-efficient pumps (typically one-half horsepower) are used, costing the homeowner only pennies a month for electricity. Effluent collection lines are typically 50-100 mm in diameter and can be shallowly buried following the terrain. Installation can be done by directional drilling, further reducing the impact on the community and the environment.



Both pumped and gravity-discharge lots can be connected to the same small-diameter effluent sewer system. (Credit: Orenco System Inc.)

No expensive lift stations are needed, and the watertight effluent sewer system does not require manholes. This significantly reduces costs, while also eliminating critical points where spills can occur. Interceptor tanks are high quality, but simple vessels that provide emergency storage and remain almost unnoticed by homeowners.

Packed-bed treatment systems

After primary treatment in the interceptor tanks, liquid effluent usually must receive secondary or advanced treatment. Effluent sewers can discharge to traditional municipal treatment plants and can be connected into a regional gravity sewer, but many are part of satellite or decentralized cluster systems. In decentralized effluent sewer systems, further treatment of wastewater is often done cost-effectively in packed-bed (media) filters; again this is a passive, reliable process that requires minimal energy to trickle effluent over the filter media bed.

Traditional sand filters are still used in some communities. However, engineered filter media provides more surface area than sand to facilitate the growth of microorganisms. It also provides more open pore space for the movement of oxygen. For example, in AdvanTex® treatment systems, manufactured by Orenco Systems®, Inc., effluent circulates over hanging curtains of a specific synthetic fabric. A single 2400 x 5000 mm AX100 pod can treat design flows of 19,000 litres per day (LPD) of residential-strength wastewater, which would require 93 square metres of sand filter to treat.

Packed-bed filters can be built, or in-

stalled, as needed in sequential modules to match phased construction. They consistently produce high-quality effluent at low operational cost, even with wide variations in flows and waste strength.

Case Study - Victoria, PEI

Victoria, Prince Edward Island, is a small but popular tourist community, with a peak season between June and September. Its wastewater system, designed by Engineering Technologies Canada (Stratford, PEI), in cooperation with Harland Associates 02 Inc., consists of about 48 STEG systems. Effluent from these flows to a lift station that pumps it to the treatment plant. The effluent sewer system also incorporates five residential STEP systems and two commercial STEP systems.

Campbell's Concrete Ltd. of Charlottetown, PEI, manufactured the interceptor tanks, and Atlantic Purification Systems of Dartmouth, Nova Scotia, supplied the effluent sewer and treatment equipment.

The treatment system consists of ten AdvanTex AX100 pods, with room to add an additional five units, if the community grows. The modular system accommodates the large seasonal variation in flows. During winter months, flows average 22,7000 LPD and only one-third of the treatment system is used. During the summer, flows rise to 49,200 LPD, and the entire modular system is utilized.

Green space was preserved at Habitat Acres in Alberta using a decentralized wastewater system.

After secondary treatment in the AdvanTex pods, effluent is dispersed to the ground. The system has two drainfields: a pressure dose sand bed, and a drip irrigation system. The pressure dose bed works all year round; the drip system comes online automatically in mid-June and goes offline September 22. During these months, both drainfields are in operation.

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Effluent sewers allow low-impact installation with small trenches and directional drilling.

Case Study: Habitat Acres, Alberta

Sten Berg, a farmer, livestock producer, and consultant, wanted to create a sustainable housing development on 27.5 hectares of his land near Sherwood Park, Alberta. Habitat Acres, a 29-home planned community, is the result. It includes an 18.2-hectare nature reserve, two waterfowl nesting areas, and the first self-contained effluent sewage treatment system ever approved in Alberta.

To maximize open space and preserve wetlands, Mr. Berg wanted to reduce lot sizes from the usual 0.8-hectare minimum, so conventional septic systems were out of the question. An Orenco effluent sewer with AdvanTex treatment solved the problem. Onsite Specialties Inc., of Sherwood Park, supplied the collection and treatment system.

Each of the 29 lots has a 4,500 litre concrete interceptor tank, supplied by Alberta Wilbert Sales, Edmonton. Effluent is pumped to three AdvanTex AX100 pods. After treatment, effluent is discharged to a drip irrigation system.

Managing effluent sewer systems

Remote monitoring allows utility companies, or other authorities, to efficiently manage decentralized systems. In both Victoria and Habitat Acres, STEP units at individual homes are equipped with Orenco VeriComm control panels. The AdvanTex treatment systems are also controlled by TCOM telemetry control panels from Orenco.

VeriComm panels communicate with the system operator, via the home's phone line or broadband connection. Once a month, they check in and upload operation data to a secure Web site. They also alert the operator to problems, such as excessive pump cycles. In many cases, the operator can diagnose the problem remotely and adjust settings to correct it. Even if a site visit is required, the operator arrives prepared with information about the likely cause of the problem, such as a stuck float or a leaking toilet.

Several models for wastewater system management exist throughout North America. While some require the homeowners to take responsibility for equipment located on their lot, a private or public utility is typically better equipped and more efficient in responding to onsite service needs. Therefore, the preferred model is for a responsible management entity (RME) to accept that responsibility. The RME may be as small as a homeowners' association, or as large as a County. Web-based services, such as OnlineRME (www.onlinerme.com), allow jurisdictions to verify that all on-lot systems in their area are being maintained in good order.

Effluent sewers can be ideal solutions for villages and small cities, but there is no limit to the number of lots connected to the collection network. Many larger cities have incorporated this technology into their overall sewer management system, where the effluent sewer serves thousands of homes and commercial lots. This allows city engineers to choose the best option to serve various areas in the city, without being limited to only gravity sewers.

Other benefits

There are may other benefits from using an effluent sewer system, including:

- In most systems that are built to serve new developments, the cost of the on-lot equipment is included in the homeowner's mortgage, so upfront investment by the community or developer is minimal.
- Small-diameter collection lines can be installed in shallow, narrow trenches, or directional drilled, minimizing disruption in the community. Lines follow the contour of the land, avoiding difficult and expensive deep trenching.
- Service can begin as soon as the first household in a new development is connected. No minimum velocity is required for the effluent sewer network, as solids are excluded, simplifying design, installation, and operation.
- Effluent sewer systems are watertight, eliminating infiltration and inflow common to gravity sewers, and reducing the hydraulic loading on the treatment plant.
- Sludge management is greatly reduced through natural, passive, anaerobic digestion in the interceptor tanks, simplifying treatment plant design and minimizing life-cycle costs.
- Since primary treatment occurs at each home or business, abuse of the system, such as disposal of chemicals, generally affects only the household responsible.
- Risks are minimized and distributed as malfunctions generally affect only one household at a time. In the event of a malfunction or natural disaster, the septic tank provides reserve holding capacity.
- Properly maintained effluent sewer systems require fewer personnel and less heavy equipment to service than other sewer systems do.

Together, effluent sewers and media filter advanced treatment form a sustainable and robust system that uses minimal energy, safeguards groundwater and the environment, and imposes costs fairly on the users. Communities of all sizes can benefit from this technology.

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