

# An innovative Canadian water infrastructure rehabilitation approach saves money, water and reduces greenhouse gas emissions

By Joe Loiacono

**A**s were metals in the 19th century and oil in the 20th, water is becoming the most valuable commodity in the 21st century. It is common knowledge that water infrastructure is ageing and past its useful life in many areas of the industrialized world. Therefore, our most precious resource must be managed to minimize loss in water distribution networks.

In Canada, most of the water infrastructure was built in the post-WW II era. Every year, cities, large or small, have to repair many breaks and leaks at a great cost to the community. For example, the City of Toronto experienced 1,115 breaks in 2011. These repairs can cost as much as \$5,000 to \$8,000 each, which can amount to hundreds of thousands if not millions of dollars annually for certain cities. This does not include the cost of water lost and the hardships endured by citizens.

Large Canadian cities lose as much as 42% of the water treated in the distribution systems. The lost water often flows to the



*Water main break. (Photo courtesy of City of St-Jérôme.)*

deteriorated sewage system and is treated as sewage before being discarded. This is costly and environmentally unsound.

The results of a survey carried out in several Canadian cities by the Centre for Expertise and Research on Infrastructure in Urban Areas (CERIU), show that the total annual cost, for a city, due to breaks and water loss is estimated to be between \$500,000 and \$100 M depending on the size of the water system. It is evident from these results that important potential savings can be achieved by simply reducing or eliminating water main breaks and leaks by implementing a water main renewal program.

Up until 10 to 20 years ago, open cut replacement was the method of choice for replacing old deteriorated water mains with newer ones. Compared to other available methods, open cut can be very costly and disturbing to residents. Now, most Canadian cities are reverting to trenchless cured-in-place piping (CIPP) to renew their water mains. CIPP methods use a lining system that allows the owner to renew their water mains with a fully structural solution without the inconvenience of digging trenches.

Distribution water mains, which account for the majority of mains installed in North-America, are typically much smaller in diameter (150 mm to 300 mm)

than transmission mains. They are also equipped with service connections located at every home and business in order to provide them with drinking water.

Although trenchless technologies such as pipe bursting, slip lining and horizontal directional drilling could be used to renew these small diameter distribution water mains, their installation methods require the excavation of every service connection in order to restore water service to the home owner. These technologies can be more easily used in larger diameter transmission mains where there are few or no service connections.

Structural CIPP has been installed in well over 900 kms of water mains in North America. The technology not only provides a structural solution but it also allows for the reinstatement of the service connections from inside the pipe with the use of robotics.

Sanexen Environmental Services Inc. developed the AQUA-PIPE® technology in the mid nineties to provide a low dig structural solution for deteriorated water mains and the robotic reinstatement of service connections. AQUA-PIPE is the only Canadian liner certified for potable water use by the BNQ to NQ Standard 3660-950 and by NSF to NSF/ANSI Standard 61.

Two projects awarded in 2010 and



*Installation of the structural cured-in-place liner.*

Description	2010	2011
Length of CIPP installed in the City of Montreal (km)	20.0	10.0
Total water loss before rehabilitation (L/h)	90 963.9	46 297.7
Total water loss after rehabilitation (L/h)	927.5	285.9
Overall water savings (L/h)	90 036	46 011.8
Overall water savings(m <sup>3</sup> /year)	788 719	403 063

Table 1. Total water savings after CIPP rehabilitation of distribution water mains.

2011 required the structural rehabilitation of 20 km and 10 km, respectively, of small diameter distribution water mains throughout a dozen boroughs of the City of Montreal. Both contracts specified that a hydrostatic pressure test be carried out on the water mains before the start of construction, and that a similar test be carried out after work was completed. The final results of these tests can be seen in Table 1. The overall annual water savings for these two projects are over 99%.

For the years 2008 to 2010, the City saved over \$60 M in direct construction costs for the structural rehabilitation with CIPP of approximately 36 kms of water mains, compared to replacing the pipes using the open cut method.

Structural CIPP provides many other benefits beyond being a low dig and less costly structural solution, including: increased pressure and flow capacity; prevents future tuberculation; possibility to line through bends; rapid and less disruptive construction; reduced breaks and water loss; reduced social impacts.

Another important benefit of CIPP technology is the reduction of greenhouse gas (GHG) emissions. Calculations of AQUA-PIPE's GHG emissions were completed according to a rigorous quantification protocol based on the ISO 14064-2 international standard, the principles of life cycle analysis and two other validated protocols. The quantification report has been verified by the BNQ, a

standard development organization, according to the requirements of the ISO 14064-3 international standard.

It was determined that AQUA-PIPE reduces GHG emissions by 84% compared to traditional open cut replacements. This figure does not include GHG savings due to other impacts such as traffic detours and increased vehicle idling.

Structural CIPP is now a proven technology which is approved and used by water utilities throughout North America.

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