Hi-tech fix for Ottawa main

Failure of a large-diameter water main in the Canadian capital resulted in the use of robotic inspection and monitoring systems, explains Lauren Rutherford

THE Woodroffe Avenue transmission main in Ottawa, Ontario, experienced a major failure in January, which opened a big hole across three traffic lanes, causing major disruption.

The 1,200mm (48in) pipeline runs under a major four-lane roadway in the west end of the city and supplies water to about 80,000 people. This was the second failure of the pre-stressed, concrete cylinder pipe (PCCP); the first occurred in 2007 in another part of the line downstream.

The City of Ottawa, Pure Technologies and Robinson Consultants of Kanata, Ontario, joined forces to develop a plan of action that put this critical pipeline back into service in May.

The first step, as part of the condition assessment programme, was to undertake an internal, manned, visual inspection of the failed section of the main; this included a significant length of upstream and downstream sections while the pipeline was out of service.

Manual inspections are a reliable method of detecting which pipes are in an advanced state of distress. This involved a Pure Technologies field team visually inspecting the pipe internally to identify where the rupture had occurred. Following this, an electromagnetic inspection using the PureRobotics device found that 41 of the 865 (4.7%) inspected segments were distressed.

PureRobotics modular, robotic pipe inspection systems are remotely operated, tracked vehicles that are tethered by a fibre-optic cable, which can be configured to inspect any pipe application of at least 300mm. The tool is capable of performing multi-sensor inspections in dry pipe or while submerged; in the case of Woodroffe, the unit was deployed in the dewatered line.

The analysis provides a rating condition for each pipe segment. It also showed that the segment that failed, and the adjacent one, were experiencing chloride-induced corrosion of the pre-stressing wires and steel cylinder.

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Crew ready to insert the robotic device into the water main

Once the Woodroffe Avenue pipeline was repaired, with a substantial section replaced, a SoundPrint AFO monitoring system was installed along 5km of the main to monitor the old sections and the newly replaced pipes in near real time. SoundPrint AFO is a patented, acoustic fibre-optic system for structural monitoring, and leak detection in both water and wastewater pre-stressed, concrete cylinder pipes.

The Woodroffe transmission main was installed in 1975-76. According to the Ontario Ministry of the Environment Assessment Renewal Guidelines, the lifespan of this pipe and others in that age range is 50-100 years.

After the results of the condition assessment programme determined that several areas of the pipeline were in critical distress, with a high risk of eminent failure, the city determined that the water main failed well before its expected lifespan, as described by the Ministry of the Environment; it could not, therefore, be recommissioned without a high risk of a further pipe failure.

Crews working on the broken water main in Woodroffe Avenue in January

The city's ability to supply water to this area was greatly limited by the premature deterioration and failure of the Woodroffe main, which normally supplies nearly all of the drinking water in the surrounding areas. During the recent repair period, the affected areas were served by a much smaller back-up system, but it could only deliver 10% of the normal water volume that the city usually delivered.

As such, the city had to implement an outdoor water ban in April, which affected about 80,000 residents and remained until the pipeline was replaced in May.

The city also had to create a contingency plan in case the demand for water exceeded supply. Otherwise, serious problems could have resulted, such as potential contamination of the water supply, depressurisation of the system, loss of supply and difficulties in providing effective firefighting.

"Using emerging technologies in order to better understand the condition of critical pipelines allows us to better manage our ageing infrastructure," says Shelley McDonald, Ottawa city water distribution programme manager. "Being able to obtain near real-time data and notification on any wire break activity via the SoundPrint AFO monitoring system enables us to potentially avoid another catastrophic failure."

Robotic device used to inspect the water main

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