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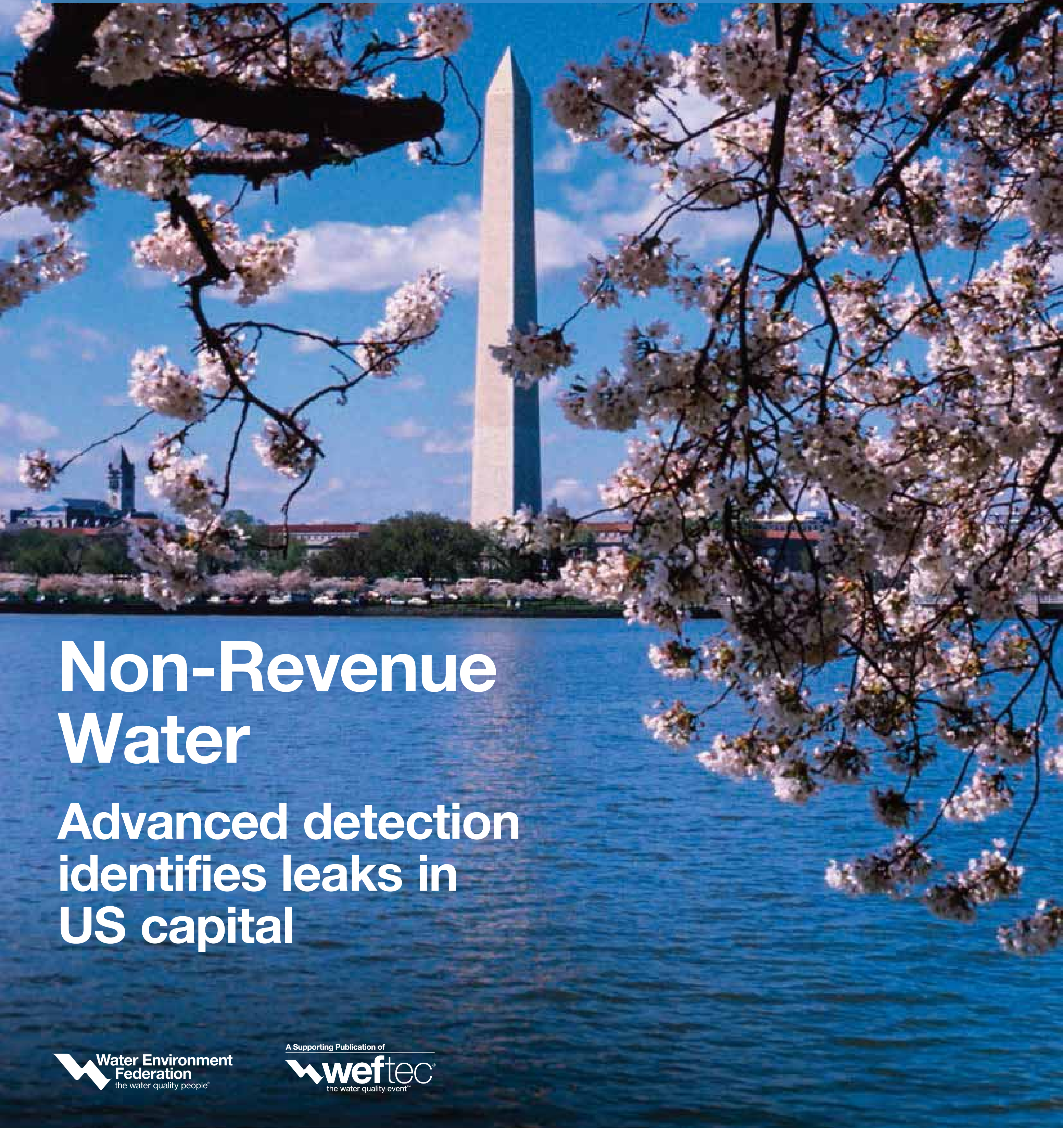

Non-Revenue Water

Advanced detection identifies leaks in US capital

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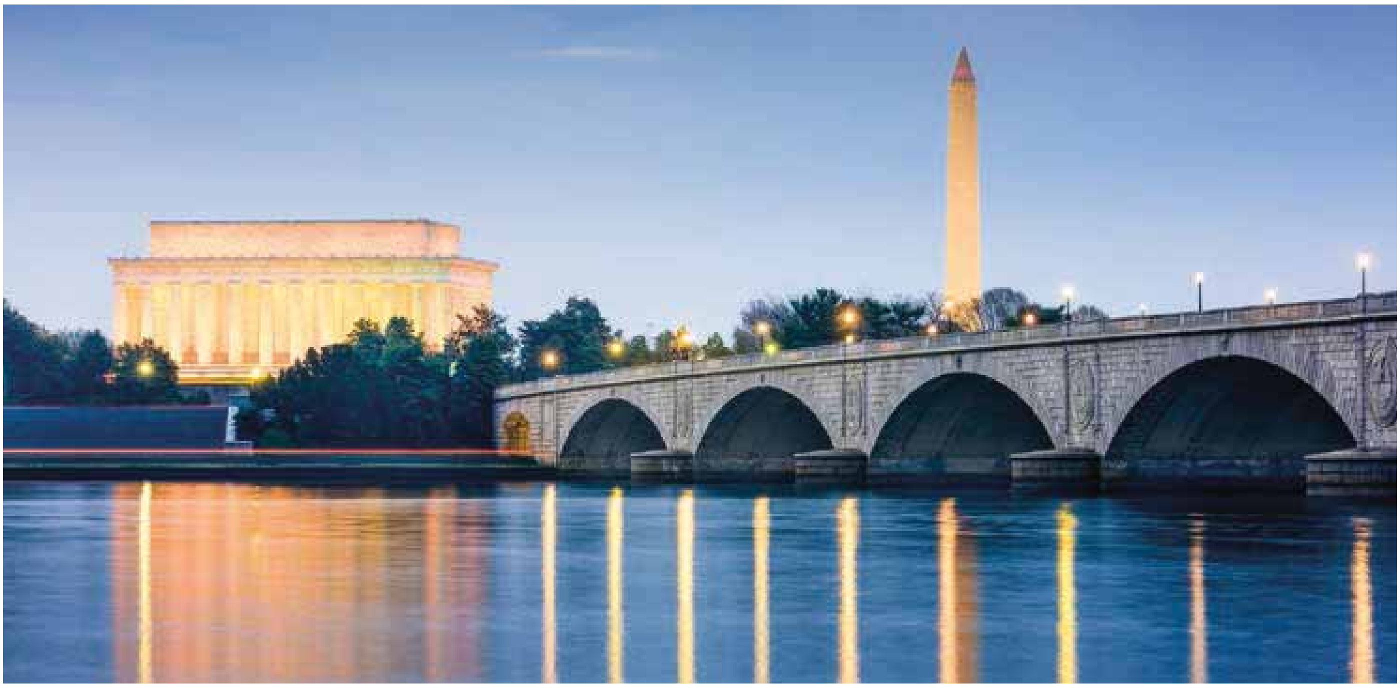

Multi-sensory detection system identifies leaks in Washington DC

A significant portion of Washington DC's non-revenue water, estimated at 20 percent of total water supply, is lost through unidentified leaks. To address this problem, the MTA Pipe-Inspector® multisensory technology was pilot tested in one of the oldest sections of the city's distribution network. Authors Michael Huainig and Sylvia Petschnig of MTA Messtechnik GmbH of Austria, and Gordon Henrich of Pipeline Integrity Technology Associates, explain how the inspection was carried out.

In order to detect possible leakage and evaluate the general pipeline condition, the District of Columbia Water and Sewer Authority (DC Water) used MTA Pipe-Inspector® multi-sensory technology, developed by MTA Messtechnik GmbH, to optically and acoustically inspect a 670-meter section of a cement mortar-lined cast iron main. The pipeline was installed in 1888 in Washington, DC, United States (US), in one of the oldest parts of the city's drinking water network.

DC Water is an industry-leading, multi-jurisdictional regional utility that provides a reliable water transmission system to more than 680,000 residents, 16 million annual visitors, and 450,000 people commuting to employment within city limits every day.

DC Water's oldest cast iron pipe still in service was installed in 1858, just as its population reached 75,000 residents. Initially, these pipes were primarily used for public hydrants as fire protection, but over the past 160 years they have been connected to the entire system supplying treated drinking water as well as firewater. The average age of DC Water's underground water supply pipes is almost 80 years, with more than 480 kilometers (km) of the 2,100-km network now more than 100 years old. On average, 400 to 500 water main breaks occur each year in the city, mostly during the winter.

As water mains age, the number of leaks in the system increases. Joint leaks, a major cause of DC Water's revenue loss on older mains, are difficult to locate because many of the city's water mains have been laid under streets surrounded by numerous other underground utilities. In this situation, leaks do not easily surface and instead follow along any underground pipe until the water reaches a wastewater sewer, electrical vault, or some other easy point of escape. Unidentified leaks represent a significant portion of the 20 percent of the water that never reaches a customer meter.

Cable-less multi-sensor inspection

DC Water is addressing this problem by considering advanced leak detection technology. Utility leaders were intrigued with the capabilities of MTA Messtechnik's cable-less video inspection with integrated acoustic leak detection, which simultaneously provides other in-pipe data such as temperature, pressure, and distance.

DC Water decided to carry out a pilot project using MTA Pipe-Inspector multisensory technology to inspect a cement mortar-lined cast iron potable water main.

The pipe was predominantly 600 millimeters (mm) in diameter with an inline reducer to 500 mm and a total length of 670 m, located along 14th Avenue, running parallel to The White House and grounds one block away. Adding a challenge, this pipe also contained three horizontal butterfly valves, which could impede an in-pipe inspection. Due to the butterfly valves along the line, the size of the MTA Pipe-Inspector was reduced by one size to ensure passage through the valves.

Sound preparation

DC Water agreed to take on the responsibilities of providing a continuous supply of water in adequate quality, pressure, and quantity for the entire duration of the investigation. All site traffic safety and security was also its responsibility to ensure compliance with local regulations. DC Water

provided its own competent local forces to make the necessary modifications for the start and end points by means of hot tapping with valve and flange fittings as well as onsite assembly and dismantling of parts required for the implementation of the project.

It was determined that pipe preparations would begin during the two weeks prior to the set survey deployment date of November 6, 2017. These activities included developing an isolation plan for opening and closing branch valves from the water main that served other streets and main building fire systems and drinking water. During this necessary valve testing exercise, some mainline valves were found to be inoperable and were replaced immediately. This action improved the system in case of an emergency and in case further rehabilitation or repairs were needed as a result of the MTA survey.

Permitting was a factor in the planning stage. Due to the anticipated short duration of the survey, a 3-day emergency works permit was obtained in addition to inclusion of the work under a normal manhole access permit. The extraction location was directly in front of the US Department of Commerce headquarters.

During planning meetings, it became apparent that the intended locations for the access into the pipe would need to be re-evaluated due to pedestrian and traffic movement, buried utilities, and streetscape. By the time access locations were field verified and finalized, the inspection distance became approximately 670 linear meters. Roughly 25 minutes from plunging the MTA Pipe-Inspector into the pipe, it was tracked and confirmed that it had arrived at the retrieval location. Once the locator confirmed this, the in-line valves were closed, as well as the hydrants, and the flow was stopped.

Flow rate and turbidity

Actual wall thickness was confirmed by measuring the pipe coupons retrieved from the pipe tapping operations prior to the deployment date. It was also noted that the pipe was cement-mortar lined, and the lining still adhered to the host pipe after its many years in operation.

As darkness set in on the night of the work, crews were mobilized, traffic control was set up, and the contractor selected by DC Water removed road plates that had covered previous preparation pits accessing the main. As a video record of the survey was required, it was important to obtain turbidity readings prior to the start of the survey. Turbidity was tested at the insertion and extraction location to be within normal acceptable range to enable clear video imaging.

Prior to deployment, the start point and end point were prepared with T-pieces and valves to be able to connect insertion and retrieval sluices containing the MTA Pipe-Inspector system. The insertion sluice was attached at the valve at the start point. The pipe was filled with water to minimize the quantity of air introduced to the pipeline by inserting the inspection device.

Access and retrieval point

The retrieval sluice was attached at the valve at the end extraction access location. It was used to insert a retrieval net, which covered the complete main pipe inside diameter to catch the MTA Pipe-Inspector tool. Before the assembling of the retrieval sluice and retrieval system, all components of the catching net were disinfected with a liquid disinfectant.

The entire retrieval system was installed in place prior to final preparation at the start access location. This eliminated the risk of accidental deployment of the tool into the pipe and potential loss in the system once the flow was restored. Since the device had to pass the three horizontal butterfly valves, the inspection tool required ballast modification to ensure that the device was running through the pipe as closely as possible to the bottom ground level of the pipe. This necessary adjustment meant that the optical inspection would be focused on the lower part of the pipe.

Device tracking and retrieval

Once the MTA Pipe-Inspector tool was disinfected and inserted into the sluice, the sluice valve was opened to allow the inspection device to be plunged into the main pipe and start the inspection run. Due to the emitted signal, the MTA Pipe-Inspector was tracked along the main pipe until it reached the retrieval net at the end-point.

The catching net was pulled back into the retrieval sluice, and the valve below the sluice was closed to disconnect the sluice from the

Far left (below): Start access sluice valve installed by DC Water
Left: Confirming tracking receiver locates pipe and MTA device
Far left (top): The MTA Pipe-Inspector retrieved from the system and net
Top right: MTA video capture of 1 of 3 inline horizontal butterfly valves
Photos by MTA Messtechnik GmbH

main pipe. By slightly opening the top flange, the pressure inside the sluice was released, and the inspection device was taken out for downloading the inspection data.

Leaks identified and caught on video one block from White House.

Findings and recommendations

Pre-inspection line isolation and coordinated flow manipulation during the inspection between MTA and DC Water operations proved the ability to control the deployment within the pipe, eliminating the possibility of losing the device in the system. Tracking the device from the surface and vertically up the retrieval sluice demonstrated MTA's deployment control confidence.

The temperature and pressure data recorded by MTA Pipe-Inspector inside the pipeline did not show any anomalies. The recorded pressure difference inside the pipe from the start point to the end was 14.5 psi, which matched exactly the difference in altitude between the two points. The optical evaluation revealed the condition of the three valves in addition to identifying several deposit areas where some of the cement mortar lining had dis-bonded from the cast iron pipe.

The first identified leak, located near the entry point street intersection, was very small and therefore not deemed to require immediate further actions aside from future monitoring. It was located south of a branch line on the right side of the flow direction. The ability to provide a clock position in this case identified the leak as a possible service connection leak.

The second leak, while being rated larger yet overall considered small, was found further down along the pressure pipe. This location was almost equidistant between a branch on one side and two branch T connections running perpendicularly in both directions.

MTA recommended that a water loss analysis should be initiated to quantify the real water loss from the leakages prior to planning for further actions. Additionally, to obtain a total 360-degree detailed optical overview of the interior pipe condition, a second MTA survey could be set up to run along the topside (obvert). Prior to any excavation for a leak, it was recommended that the leak position be verified by another technology, such as geophones or standard leak detection technologies.

DC Water is continuing cable-less video inspections of more segments of its aged cast iron water pipes using the MTA Pipe-Inspector in 2018. Engineers will use the data to provide an existing condition-based asset management evaluation for further remedial actions.

Authors' Note

Managing Engineer DI Michael Huainig and Marketing & Business Development Manager Sylvia Petschnig of MTA Messtechnik GmbH are based in St. Veit an der Glan, Austria. Gordon Henrick is the founder and chief executive officer of Pipeline Integrity Technology Associates, MTA Messtechnik GmbH's North American business partner, based in Red Bay, Ontario, Canada.

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