WHITE PAPER

AMERICAN WATER

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# Leveraging Technology Innovation to Detect Leaks

## Introduction

In this era of new technologies, a blind eye is often turned to the things that should be addressed. One of the most important of those is the aging water and wastewater treatment infrastructure in the U.S.[1]

According to the American Water Works Association (AWWA), the price tag for the critical upkeep and replacement of the nation's outdated water systems is at least $1 trillion over the next 25 years. Although it seems like a lot of money, not taking action will only add to the problems in the coming years. The AWWA estimates the cost of fixing the water infrastructure could double to more than $2 trillion if action is not taken today.

Across the country, water systems – and their customers – are enduring the ramifications of underinvestment and, consequently, poor maintenance. It is estimated that 240,000 water main breaks occur per year in the United States, wasting over two trillion gallons of treated drinking water.[2]

Additionally, beyond tackling infrastructure, providing solutions to water supply challenges is another significant concern for the water industry. Interestingly, the report on freshwater supply from the Government Accountability Office (GAO) states that 40 of 50 state water managers expected shortages in some portion of their states under average conditions in the next 10 years[3].

By 2030, nearly half of everyone in the world will be living in countries highly stressed for water, according to United Nations predictions.[4] Additionally, Bank of America Merrill Lynch reported that water scarcity is our biggest problem worldwide, and projects that climate change will only make it worse.[5]

Safeguarding against future water shortages is not just about producing enough water to meet demand. Equally as important is the need to control the amount of water that is lost in transit between the point of production and the end user.[6]

The Environmental Protection Agency's (EPA) WaterSense Program estimates that more than 1 trillion gallons of water - which has been pumped, treated and transported at an incredible expense - leak from U.S. homes each year.[7] Another 2.6 trillion gallons of treated water is lost every year through leaky pipes before it even reaches consumers.

Water utilities around the world are faced with enormous infrastructure challenges that will demand better strategies for delivering the expected efficiencies that have become the standard within other more

[1] Louise Musial. The real costs of the aging US infrastructure. Water Technology. July 6, 2016
[2] ASCE, "2017 Infrastructure Report Card"
[3] U.S. Government Accountability Office, http://www.gao.gov/products/GAO-14-430
[4] Ellie Kincaid. California isn't the only state with water problems. Business Insider, April 21, 2015
[5] Ellie Kincaid. California isn't the only state with water problems. Business Insider, April 21, 2015
[6] ABB White Paper "Leakage monitoring Reducing leakage through effective flow measurement."
[7] Veronica Blette, Jason Turgeon, Wendy Wilson. Saving Water & Energy – Reducing Greenhouse Gases by Improving Efficiency. U.S. EPA & The Watershed Academy, Webcast, May 17, 2011

progressive industry environments. In addition, like all companies, American Water is challenged to find innovative ways to operate at the lowest possible cost for the benefit of the company and its customers.

American Water has continually pursued innovative leak detection solutions because the gain is so great: meeting customer needs, conserving resources, saving energy, protecting public health, and improving the quality of life.

## Background

Water leaks can never be completely eliminated. However, experience has shown that combining an effective leakage management strategy with the latest innovative technology can have a major positive impact on helping water operators greatly reduce leakage in their networks.[8]

For water utilities, detecting and repairing leaks is one of the key ways they can conserve water. Results of deteriorating infrastructure, fluctuating water temperatures, soil movement, vibrations and water pressure changes are just some of the factors contributing to water leakage.

The quest to control water loss frequently focuses on identifying and efficiently minimizing water distribution leakage (real losses). While the public is most aware of the huge leaks that flood streets or spray water dozens of feet into the air, often the leaks that do not readily surface and run for extended time will have a greater impact on the water loss of the water utility.[9]

To combat water loss, it is up to utilities and municipalities to adopt and implement technologies to more effectively manage and conserve water supplies by developing methods to detect, locate and reduce leaks.

## Leak Detection Technology

To ensure water is available for future generations, water industry experts have developed comprehensive water preservation and efficiency strategies utilizing leak detection technologies that support conservation and consumption changes significantly affecting overall supply.

In its initial implementations of advanced leak detection, American Water has learned that savings in repairing hidden leaks quickly have additional benefits beyond water savings as the repairs can be scheduled during regular business hours with proper mark-out of nearby utilities, reducing overtime costs and providing a safer work environment. Repairing leaks before they escalate reduces the potential for damage claims and higher restoration costs.

### Software Application - District Metering Areas (DMA)

There are a number of options for identifying non-surfacing leaks in lieu of waiting for the leak to surface. American Water has built a software application that has enabled it to integrate system delivery data (input) with metered consumption within a geographical view in Geographic Information System. System pressure drops or an unusual persistent spike in flow can signal a leakage issue and be analyzed immediately. Leaks can also be investigated via listening devices more strategically when the extent of leakage is known.

Analysis of water loss can employ a comparison of flow measured on district meters and the aggregate of metered flow captured by AMR and AMI systems. AMR (drive-by metering) can provide a month-to-month analysis and AMI (remote metering) may be able to examine the difference hour-to-hour.

Additionally, the application is integrated with the company SCADA's and Work Management systems.

[8] ABB White Paper "Leakage monitoring Reducing leakage through effective flow measurement."
[9] Water Research Foundation, "Continuous System Acoustic Monitoring: From Start to Repair [Project #3183]" 2011.

This integration enables calculation night flows (lowest flow measurement per 24 hour period), which are used as benchmarks of the systems integrity as well as an integration with a work management system that captures hydrant flushing data, main break & service leak information.

DMA zones are being created in conjunction with the piloting of Stream Control devices that reduce pressure into residential pressure zones when flow drops during the night. The Stream Control device responds to flow data, which is also conveyed to system operators. Several American Water sites were equipped with Stream Control devices in 2015, and two zones in California are expected to be outfitted with flow monitors in the summer of 2017.

Echologics Acoustic Leak Detection

American Water has deployed over 2,000 fixed-base acoustic leak detectors, which are identifying non-surfacing leaks in four state affiliate districts. American Water helped develop this technology in 2009, piloted prototypes in 2013-14 and purchased the first commercially available units in 2015.

The company R&D group is also working on a leak detection research that centers on a $1.5 million California Energy Commission (CEC) grant-funded project. The project is intended to bring to California American Water and California utilities in general, a demonstration of different ways to monitor and locate water loss. It also is a test of new innovative technologies. Nearly 400 Echologics-correlating acoustic monitoring units have been installed on the pipe network in Duarte, Calif. that listen for leaks nightly and transmit alerts if leaks are identified. For the project, Echologics is providing some additional newly modified acoustic monitors targeting pockets of plastic pipe in the Duarte system. This system will be compared to the newest leak detection technology, which is satellite imaging with L-Band RADAR. A series of satellite flyovers by Utilis will be conducted to determine if the same technology used to find water on Mars can find water leaks on Earth.

FCS - Cellular Acoustic Monitoring

At Pennsylvania American Water, there are nearly 5,000 fixed leak detection loggers installed across more than 10 districts. These loggers listen for leaks covering nearly 560 square miles of pipe. In less than a year, the company has successfully detected approximately 400 previously unknown and non-surfacing leaks that are now repaired. These repairs are estimated to have saved more than 7 million gallons of water per day.

The great advantage of this technology is the software is web-based and provides the company's Operations team with near real-time data about newly forming leaks, an advanced early warning system that allows making repairs while the leak is smaller and less disruptive. Small leaks aspire to become larger, correcting them early is key to water loss management and good operating efficiency.

Utilis - Satellite Leak Detection

American Water is performing validation tests of Utilis, a satellite leak-detection imaging technology to detect water leaks, in Tennessee, Indiana, California and Missouri. This non-invasive technique can identify water leaks through the ability of L-band radar to detect wet soil with high electroconductivity.

The technology utilizes reflectance and does not require the leak to be surfacing. This innovative technology will be tested against conventional leak detection methods such as fixed-based acoustic sensing to create a new way to minimize water loss. A second-generation version of this technology is already under investigation whereby the L-Band RADAR is mounted on an airplane instead of a satellite, which should allow for obtaining higher resolution images with smaller pixels, thus, increased precision and accuracy of leak identification.

Non-disruptive Pipeline Inspection

American Water has a patent pending for a “pipe fixit drone”, a device that can fix a leak from the inside of a pipe. The device can be inserted into a live water main through existing appurtenances such as a hydrant or pressure reducing valve, travel down the pipe, see the leak and fix the leak.

American Water is working with a number of companies that have a suite of products, which can access pipelines, while under pressure and operating, and inspect with CCTV, hydrophone and other non-destruction testing monitoring systems. There is no need for excavation or tapping, which significantly reduces the cost of inspection.

American Water is also collaborating with a startup company to develop the fixit module that can be attached to the robotic drone delivery mechanism. Testing of the delivery mechanism is ongoing and a prototype of the fixit module is expected by the end of 2017.

## Conclusion

As new challenges in the water industry arise, so will the opportunity to increase collaboration and innovation between companies. American Water uses its expertise and research capabilities to evaluate new technology and its facilities to pilot test and become early adopters. As a result, the company is not only benefitting from an innovation, but also helping to bring a valuable new technology to the rest of the water industry.

No matter the technology used to detect leaks, it is imperative the field crews have the best equipment and training for boots-on-the-ground location, confirmation and repair. As an industry leader in innovation, American Water is taking the lead in creating and developing new tools to manage water loss in potable water systems.