Case Study: Implementation of AMI and leak detection

AMI and Leak Detections stops the flow of non-revenue water

Non-revenue water loss is a major problem nationwide. AWWA breaks down non-revenue water into three categories – legitimate unbilled consumption; apparent losses from inaccurate meters, billing errors and theft; and real losses from leaks on transmission and distribution mains, at service connections, and from storage tanks.

Of these three categories, real and apparent losses account for the lion's share of the water lost by utilities, averaging about 16% in most water systems according to the Environmental Protection Agency (EPA). Another EPA document published pegs real losses from leaks on underground water mains in the U.S. at 1.7 trillion gallons of treated drinking water per year, costing utilities a mind-boggling $2.6 billion.

Apparent losses also can be substantial, although there is little aggregate data available on how much they cost utilities. An AWWA report detailing the results of 246 water utility audits found that these utilities reported 29.4 billion gallons of non-revenue water losses in one year caused by apparent losses, translating into $151 million for the year.

How are water utilities getting this deluge of real and apparent water losses under control? The City of Elmhurst, Ill., a stately suburb west of Chicago with a population of about 46,000 residents, is a case study on how one municipality took on the issue.

BUSINESS CHALLENGE

Established at the turn of the 20th century, The City of Elmhurst, which purchases water from Chicago through the DuPage County Water Commission, provides approximately 4 million gallons of water a day to its residents through 183 miles of distribution water mains. Elmhurst also retains 15 million gallons of storage in three ground-level reservoirs and three elevated storage tanks and maintains 2,300 fire hydrants and 3,500 valves on the system.

The city faces the same challenges with aging infrastructure that most cities across the country deal with every day. Much of its distribution piping is almost 100 years old, with many sections having been built in the 1920s. In fact, the old pipe system experiences about 100 water-main breaks a year.

In addition, in 2016 over 80% of the 15,000 meters in the city were 25 years old. These mechanical meters had moving parts that were wearing, causing them to under-register water usage, and only recording about 94.5% of water flowing through them. What's more, the inconsistency in accuracy of meters resulted in unfair billing, with customers having old, and less accurate meters not paying their fair share for water.

Elmhurst estimated that between water main leaks and older meters it was losing approximately 800,000 gallons a day in non-revenue water. This equals 292 million gallons of non-revenue water a year, equal to about 20% of what it was purchasing, or $1.4 million.

Of this, approximately 5% - 6% of non-revenue water came from under-registering meters and up to 15% from distribution-main leaks. This meant that the city was not meeting the standard set forth by the Illinois Department of Natural Resources (IDNR), which requires that water utilities reduce non-revenue water to 10% or less.

In addition, the city's drive-by meter reading system needed an overhaul. The drive-by meter-reading system had been in place for over 20 years, having replaced manual meter reading. However, the aging system was still labor intensive, requiring repeated re-reads of meters.

SOLUTION OVERVIEW

Four years ago, the city's new utility operations manager, Paul Burris, identified the meter-exchange program and meter-reading systems as top requirements in the plan to eliminate non-revenue water. He put together a team internally including representatives from various departments including finance, information technology, customer service, and utilities.

The team's purpose was to educate both supervisors and employees on new technologies and to evaluate strategies for upgrading Elmhurst's meters and meter-reading systems.

"We held a symposium, and we had vendors from multiple different meter companies, AMI (advanced metering infrastructure) systems, and customer portals come in and present on why we should go with them," said Burris.

Selecting a new AMI solution and meters

The team evaluated technologies based on specific criteria that the city wanted in its AMI and meter technologies. The AMI system, for example, had to operate on licensed frequencies, while meters had to have brass flow ports rather than plastic. It was also important that the AMI system selected work with meters from multiple vendors.

Eventually, the selection process came down to two fixed-network meter reading technologies as a replacement for Elmhurst's drive-by system. Both operated on licensed frequencies.

The primary difference between the systems was initial costs versus operating costs over a 20-year period. The city selected the Aclara RF™ solution in part because total cost of ownership over 20 years was the decisive factor in the selection process.

In addition, the Aclara RF system could handle meters from multiple vendors. Elmhurst ended up selecting three different meter vendors based on flow range, one for residential meters, one for commercial meters under 12 inches in diameter and another for those over 12 inches. The city chose ultrasonic meters for its projects, which have no moving parts and maintain their accuracy over time.

The city made the decision to change out all its 15,000 meters in less than a year, rather than extend the project over a few years. This eliminated the inequity between people using meters that were 70-90% accurate getting charged less for water than those with new meters that were 100% accurate.

In addition, the city implemented a consumer portal that allowed customers to monitor their water usage and identify leaks in their homes.

"It's been a huge benefit to the city to have the ability to get customers reliable data on a regular basis. Now residents are getting leak alerts when their toilets are running, or their garden hoses are left on by the kids. It's saving them hundreds, if not thousands, of dollars a year in water costs," said Burris.

Deploying acoustic leak detection

A key element that also played into vendor selection was the availability of acoustic leak detection capabilities on the Aclara RF system.

The city knew it had a serious non-revenue water issue because it had been regularly auditing its water system to identify areas where underground leaks might be a problem.

"We [previously] hired a third party to come in on an annual or biannual basis, and they would audit a quarter, a third, or half of the city, and then they'd come back a year or two later and do the other sections as funds allowed," said Burris.

However, since the city was already paying for leak-detection services, Burris had to educate his management on the benefits of trying a different solution. Burris explained that there were several challenges with the strategy the city employed.

First, it was expensive, costing upwards of $50,000 per year. Second, because the city could get only a partial picture of what was happening in the distribution system, leaks might start in areas that were not being audited.

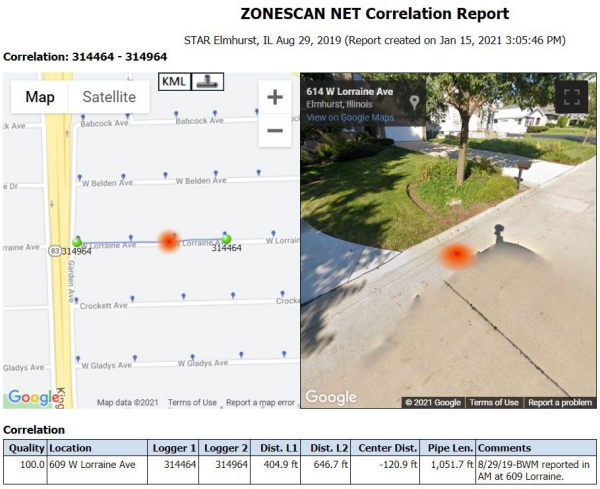
“When we’re doing this once a year, let’s say 50 miles of main, that still leaves 130 miles that doesn’t get done. Now, let’s say the next year we do another 50, and then another 50 the year after, and we just keep doing it, the pipes done in the past might start leaking before we get back around to checking them,” said Burris.

The acoustic sensors that are part of the Aclara RF ZoneScan correlated acoustic leak detection system were placed on 610 auxiliary fire-hydrant valves covering the city’s 183-miles of distribution piping. Auxiliary valves were chosen over main valves because of concerns that snowplows might hit the raised valve boxes in the winter. Utilities have the flexibility to decide where the sensors can be located to meet their requirements.

The permanently placed acoustic sensors can quickly identify leaks that start due to freezing, ground movement, soil erosion, pressure transients, aging material failures, and any number of other problems.

This allows the city to fix the issue before a main break occurs, which can lead to flooding of homes and businesses, and traffic hazards.

The system not only monitors for leaks but uses software correlation to identify their locations within a few feet. The ability to pinpoint leaks to a relatively small area makes it easier for Elmhurst to find and fix them.



Previously, leak detection audits only identified the general location of the leak. Finding the leak so it could be fixed after an audit often required extra on-site correlation and a large amount of over-excavation.

BUSINESS JUSTIFICATION

By taking a team approach to new meters, an AMI system, and acoustic leak detection, the City of Elmhurst was able to reduce its unaccounted for water to 8% and non-revenue water to 12%.

Key points:

1. The city reduced unmeasured non-revenue water by 5.5% by changing out meters, providing more accurate billing for water used by customers.

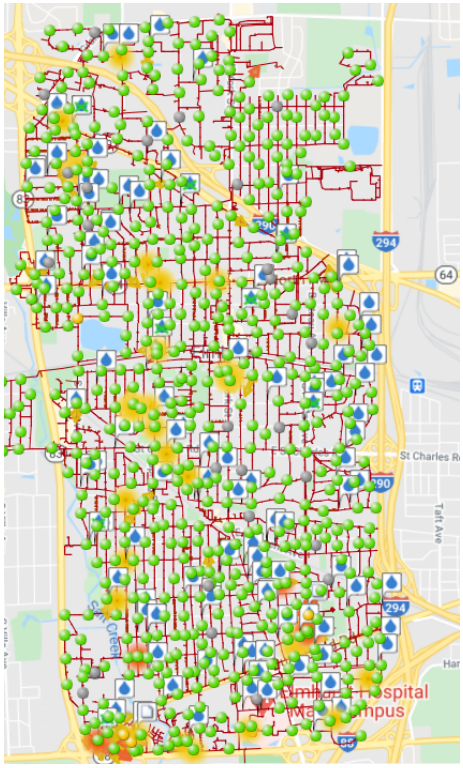
2. The consumer portal deployed by Elmhurst provides insights into AMI data that allows residents to monitor their usage and look for leaks in their homes. As a result, city residents are using nearly 7% less water annually.

3. The city prevented 131 million gallons of water from leaking into the ground in 2020.
4. Acoustic leak detection that finds leaks before they surface resulted in a $1,000,000 reduction in purchased water cost in 2019. Burris estimates that the leak-detection system will reduce future non-revenue water loss by 7% per year .
5. The city saved over $500,000 in fixed network cost by having meters and leak detection on the same RF network.
6. Data from the systems meter data management system is available to support and validate reports the city makes to the IDNR comparing water purchased to water sold.

Today, Burris estimates that Elmhurst is finding 30% of its water main breaks before they surface. Confidence in the leak detection system has grown as the city began to repair leaks identified with a probability of 90% to 100% in the system.

Two of the largest leaks identified by acoustic leak-detection technology to date were:

- A nearly 200 gallon per minute leak going into a sanitary sewer and not surfacing. This led to nearly 288,000 gallons of lost water daily that was ultimately recovered.
- A hydrant that when dug up revealed a 50 gallon per minute leak from a hole near the auxiliary valve. Fixing the leak resulted in saving an estimated 72,000 gallons a day.



Elmhurst now has a sustainable method in place for early detection of non-surfacing leaks on the aging distribution infrastructure. One of the biggest benefits of the new system is the ability to find and repair underground leaks during regular business hours rather than when a water-main breaks and a leak surfaces, which could be in the middle of the night or on weekends.

Other benefits the city found when using acoustic leak detection are the ability to identify:

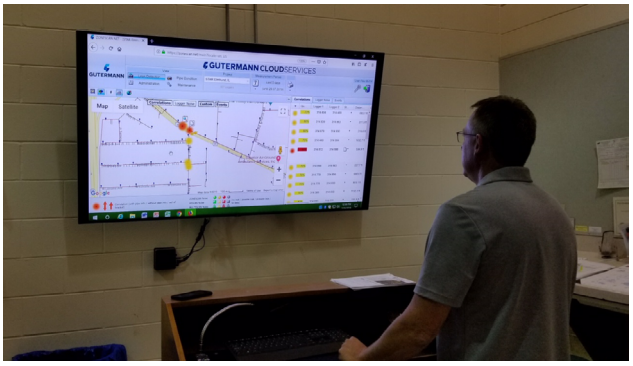
1. When a hydrant is leaking due to improper operation by water department staff, fire personnel, or contractors who rent a meter for construction. Contractors often do not open the hydrant fully, so when the meter valve is shut the water starts to leak out the weep hole of hydrant. With the leak detection system, the city is notified within 24 hours and can follow up with contractors on proper use of hydrants.

2. When leaks are occurring on residential service lines. This allows the utility to provide even more information to customers that can help them fix leaks in their systems, saving money and reducing usage. By using Aclara's powerful AclaraONE® software, Elmhurst can provide reports that show hourly customer usage and track when leaks begin on a service line.

In the future, Burris said the city will continue to look for ways to add value to its AMI system. This could include adding other types of sensors. For example, adding sensors that detect sanitary sewer overflow could help the city identify and fix inflow and infiltration problems when it rains.

"Rain puts a lot of stress on the collection system and the water reclamation facility, so where it should be getting sewage it's now getting rainwater too," said Burris.

"Plus, if there's too much [sewage mixed with rainwater] and it can't get through the pipe, where does it go? Somebody's basement or overland to a stream."



Elmhurst has won several awards for its leak detection and AMI projects. These include the Chicago Chapter of the American Public Works Association (APWA) 2020 Technical Innovation Award for the development, management and implementation of a creative idea, program, process, or system that enhances the delivery of public works services to the public.

In addition, the City received the prestigious AWWA Water Saver Utility Award (Illinois Section) for 2019, and the DuPage, Ill., Mayor and Managers (34 communities represented) also recognized the City of Elmhurst for the most innovative technology use in 2019.

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