American Water Works Association

WILEY

Opflow

PRACTICAL IDEAS FOR WATER OPERATORS

VOLUME 47, NO. 9 NOVEMBER 2021

GIMMICKS & GADGETS SHOWDOWN

2021 CONTEST WINNERS

DISINFECTION
Increase Disinfectant Residual While Reducing Disinfection Byproducts

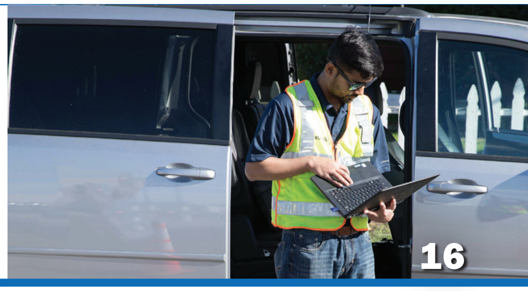
DISTRIBUTION
Discovering the Real Condition of Pipes

MEMBRANES
Improved Process Monitoring Isolates Root Cause of Turbidity Events

STORAGE
How We Did It Ourselves: A Case Study on Water Quality Improvement

Contents

VOLUME 47, NO. 9 NOVEMBER 2021



WINNER 2020 APEX AWARDS FOR PUBLICATION EXCELLENCE

Opflow
WWW.AWWA.ORG/OPFLOW

Opflow (ISSN: 0149-8029 print; ISSN: 1551-8701 electronic) is published 10 times per year on behalf of the American Water Works Association by Wiley Periodicals, LLC, 111 River St., Hoboken, NJ 07030-5774, USA. Periodicals postage paid at Hoboken, N.J., and additional mailing offices. Printed in the United States by Sheridan, Hanover, N.H.

POSTMASTER: Send address changes to *Opflow*, American Water Works Association, 6666 W. Quincy Ave., Denver, CO 80235-3098. Telephone (303) 794-7711; fax (303) 794-7310; email opflow@awwa.org.

American Water Works Association

WILEY

Established in 1881, the American Water Works Association is the largest nonprofit, scientific, and educational association dedicated to managing and treating water, the world's most important resource. With approximately 50,000 members, AWWA provides solutions to improve public health, protect the environment, strengthen the economy, and enhance our quality of life.

Opflow's editorial purpose is to present new and established technologies and ideas that readers can apply to drinking water treatment and distribution, alert readers to possible related problems and solutions, interpret regulatory and technical information in a clear format, and foster and promote innovative ideas that help readers provide safe water to all.

FEATURES

COLUMNS

DEPARTMENTS

On the Cover: This year's Gimmicks & Gadgets Contest winners are (clockwise from the top) John Lins, Des Moines Water Works (Iowa); Mike Blake, City of Central Point, Ore.; and Jim Pollett, Government of Newfoundland and Labrador, Canada.

In the Field

PRACTICAL SOLUTIONS TO COMMON PROBLEMS

Data Analysis Isolates Water Main Breaks

BY BEN SMITHER AND MATTHEW A. LUEDERS

To address pipe break problems within its distribution system, Missouri American Water (MOAW) worked with a monitoring and analysis company to find the causes and solutions, ultimately giving the utility valuable insights.

MOAW serves approximately 1.5 million customers in Missouri. The utility owns and operates a network serving St. Louis County, as well as portions of St. Charles and Jefferson counties, through a piped distribution system of approximately 4,500 miles, with pipes ranging from 2 to 42 inches in diameter. These mains pump water at a pressure ranging from 30 to 200 psi across 14 pressure gradients.

GETTING TO THE BOTTOM OF PIPE BREAKS

MOAW was concerned about the pipe breaks in its system, so it partnered with Syrinix, a company that specializes in water system monitoring and analysis, to develop a "network calming" project. The project aimed to provide an extended overview of network behavior and identify problematic assets or operational issues through transient mitigation.

Thirty transient pressure loggers were deployed in MOAW's St. Louis County territory. The utility first selected hardware and planned the deployment of the pressure loggers, which were backed up with regular analytical reports to implement any operational changes resulting from the insights provided.

Syrinix requested details of MOAW's previous pipe breaks in the area to

- identify which areas of the network had pressure-related issues, such as water hammer;
- produce detailed deployment plans for those areas;
- review the collected data and suggest mitigating actions for any transients captured; and
- track key performance indicators (KPIs), such as burst rate, number of transients, etc., to prove that mitigation was effective for the MOAW network.

Two pressure loggers were selected (Syrinix PIPEMINDER-S and PIPEMINDER-ONE Hydrant), which take sample pressure data at 128 samples per second and send 1-minute summary pressure data, guaranteeing that fast and aggressive transient events are detected. The data can be used later for other analytical techniques such as triangulation, which occurs when a transient event—detected by two or more units that are hydraulically linked with the units' time stamp functionality—is used to identify the event's source. Along with any findings via pressure data, supervisory control and data management (SCADA) data can be overlaid to find any correlations.

PROJECT SETUP

Because of the large extent of St. Louis County, the area was divided into 50 KPI zones to track the transient activity more accurately. To determine the best locations for the transient loggers, Syrinix focused on the areas with the highest break densities. Break data were compiled, and a break heat map of the KPI zones was created to identify the most critical areas.

Of the 30 pressure loggers used in MOAW's project, 15 units were deployed in pump/booster stations through the entire length of the project while the rest were moved from zone to zone once enough information had been collected. The survey units collected information in an area for

Figure 1. Pressure Oscillations

A graph shows the magnitude of the oscillations, which were caused by a faulty pressure-sustaining valve at a pump station.

https://doi.org/10.1002/opfl.1600

Ben Smither is vice president of engineering at Syrinix (www.syrinix.com/us), Henderson, Nev. Matthew A. Lueders is asset planning manager at Missouri American Water (www.missouriamwater.com), Brentwood, Mo.

one to two months on average before being relocated. Project reports were delivered every 15 days; if a significant event was detected, it was reported immediately.

BRINGING ISSUES TO LIGHT

Analysis of the data collected from monitoring MOAW's network showed several incidents that needed to be addressed.

Pressure Surge. One incident was tracked directly to a pumphouse. A pressure logger set up at a booster station began to detect transient events of considerable magnitude. These events occurred once pressure started to decrease smoothly and steadily, at which point a sharp spike in pressure was recorded by the transient logger. Several of these pressure surges were analyzed, showing up to 121 psi of difference between the highest crest and the lowest trough, in less than a second, occurring roughly at 10 p.m. CDT.

This discovery indicated that the transient spike could be generated by an operational scheduled event. To identify the source of the event, Syrinix imported SCADA data and compared the times and dates of the transient events with the known operational events on the network. It was found that the smooth and steady drop in pressure matched with a particular pump turning off at the pump station in which the logger was located.

Events of this magnitude that are captured near pump stations are typically caused by nonreturn valves slamming shut or poor control of actuated valves. Discussions with MOAW confirmed that this event was generated by an actuated valve at the pump station being quickly closed. MOAW said the pump station was scheduled for retirement and that the event would be taken into consideration in designing the replacement station.

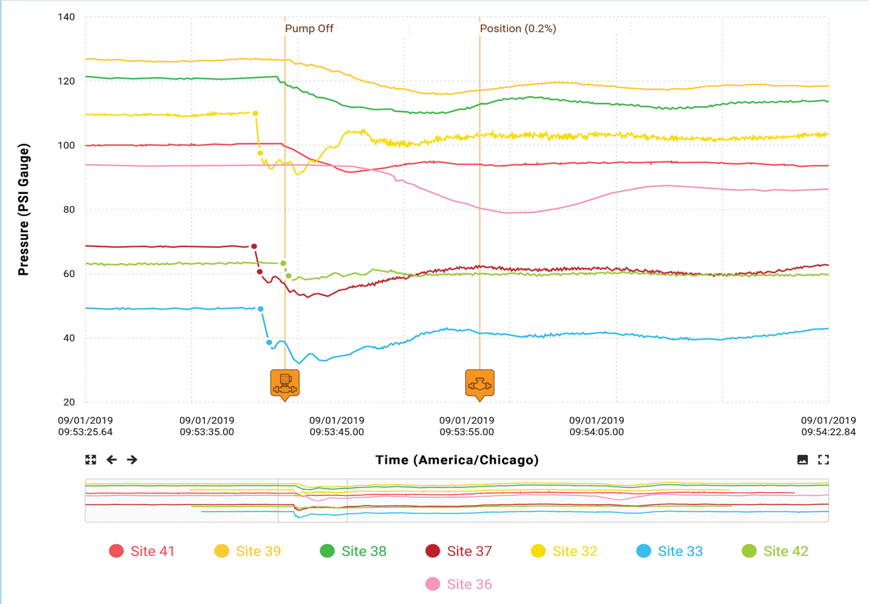
Pressure Oscillations. The second period of the analysis revealed a hot spot of longitudinal breaks in a different area of the St. Louis County territory in which KPIs showed high transient activity. Pressure transient information collected by the units revealed a sustained oscillation captured by several units in the area. Data from the transient logger at the pumping building nearby revealed regular periods of prolonged pressure oscillations, with an amplitude of 32.5 psi and a frequency of 22 Hz (Figure 1).

As with the valve closure event detected at the pump station, Syrinix imported SCADA data and looked for correlations. The event lasted several minutes, which could indicate the event was generated by a valve operation. SCADA data for valves were again plotted in parallel to the pressure oscillations detected by the logger device.

At the end of the project, after further investigations that resulted in a study of the plans for the pump building, it was observed that the opening percentage of a butterfly pressure-sustaining valve (PSV) matched with the times the oscillation was observed. The oscillations were due to a faulty PSV at the pump station, which oscillated when regulating the pressure at the pipe.

Figure 2. A Recurrent Pressure Drop

A graph shows a transient event detected by all devices. Overlaid SCADA data showed that a pump at a nearby pump station was turned off.



Recurring Pressure Loss. In a final example, a review of pressure data on one specific area revealed a recurrent drop that reached up to 15 psi in range and propagated through most of the survey sites across that area. The high sample rate data were used to triangulate the source of the event. The result of the triangulation was located close to a pump station in one of the surveyed zones. SCADA data were overlaid on the pressure data, showing that one of the pumps at the pump station was turned off, creating a transient event that was detected in the surrounding area (Figure 2).

PROJECT SUCCESS

The project gave MOAW the necessary insight and additional network knowledge to make changes to infrastructure assets or operations as needed. The project's success and findings led to a recommendation to an affiliated water company, Pennsylvania American Water, which is undertaking a similar investigative project.