

Hamilton pilots real-time pressure monitoring in a challenging pressure zone



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The City of Hamilton's municipal water distribution system is shaped by the escarpment, making it challenging to deliver water to some 590,000 residents. With an elevation change of approximately 89 to 100 metres between the lower city and the upper city, this Ontario city manages 25 pressure districts with an extensive network of pressure reducing valves (PRVs) to prevent over-pressurization and maintain consistent service levels.

These pressure districts each have unique characteristics with varying peak demands, fire flow requirements, and operating pressures. The city relies on periodic manual inspections and annual maintenance programs to check its PRVs, which provide snapshots of the system's performance. This means that valve malfunctions, pressure anomalies, or developing leaks can go undetected between inspection cycles, particularly in a system where multiple PRVs operate hydraulically and in parallel.

Dave Alberton, Manager of Water Distribution for the City of Hamilton, said, "We wanted to pilot real-time pressure monitoring, so we chose to retrofit an existing valve with the Cla-Val XP2F monitoring system in one of our more complex pressure districts. If the solution delivers results in the most difficult of circumstances, then we have a good use case for a larger implementation."

UPPER PARADISE PRV STATION

The city selected the Upper Paradise PRV station in Pressure District 5 because it is one of the largest districts covering the front portion of the escarpment and has older infrastructure with high and variable user demand, and



The 200 mm PRV for high-demand and the 100 mm PRV for low-flow with the Cla-Val XP2F monitoring system mounted on the wall.

rocky soil. These factors mean leaks are less likely to surface.

In addition, there was a pattern of unusual nightly consumption pressure spikes. These make the district more vulnerable to leakage and main breaks. "We wanted to understand the reason for these nightly spikes and any indication of leaks that were not surfacing, so we needed more eyes in the system to gain a better understanding of where to look," said Alberton.

The station's configuration has two PRVs operating in parallel. The first is a 200 mm valve for high-demand periods and the second is a 100 mm valve for low-flow conditions. This dual valve arrangement is common in the city's system as it provides an alternate option for low flow or increased flow for fire. It also offers a level of redundancy for servicing and backup in case of failure. This configuration is ideal for real-time monitoring as it provides an understanding of which valve is active, when, and how transitions occur between the valves.

The station's location on the north end of the escarpment places it where water

transitions from a high-pressure feed to controlled pressure for the mountain communities. Alberton says, "As the water descends around 23 metres down a hill static pressure increases by approximately 0.433 psi per foot of elevation drop. If our PRVs are not functioning properly, the downstream infrastructure would experience pressures exceeding design ratings, which can result in pipe stress leading to an increase in leak rates, and main breaks."

FROM SETUP TO SIGNAL WITHIN TWO HOURS

Installation of the pressure monitoring system was completed with minimal difficulty and the entire process took two hours with two technicians. Pre-testing all components ahead of time ensured a smooth start. Pressure transmitters were added quickly to monitor the supply and discharge pressures, while the position transmitter installation required closing each downstream isolation valve for about twenty minutes, one at a time.

The controller was mounted directly onto the concrete wall, followed by a few simple wiring connections. Once in place, the system was powered up and accessed via Wi-Fi through a mobile app. This provided immediate visibility into instrument readings, calibration functions, and parameter settings. The chamber already had an antenna pole, so there was no need to run a cable to an above-ground antenna, and the connection was also tested.

The chamber was equipped with a single XP2F unit. The equipment takes the pressure signals upstream and downstream of the PRV as well as the valve position. It then calculates the instantaneous flow through the valve by using the equation $Flow (Q) = \sqrt{Dp - \text{Differential Pressure}} \times Cv$. The valve's Cv (flow capacity) varies with how far open it is. Cla-Val has the valve's Cv for each percent open.

The monitoring equipment has room for four analog inputs but it only needs

the three (upstream, downstream pressure and valve position). The 100 mm valve is set to deal with most daily flow requirements. If there is a larger demand, the 200 mm valve will open. Normally this valve is closed.

For this reason, the monitoring equipment is used to calculate the flow through the 100 mm valve. As there is a spare input, the city can also track the position of the 200 mm valve.

Calibration was straightforward. Pressure transmitter readings were verified by comparing Wi-Fi data against gauge readings, while valve position calibration involved checking signals at fully closed and fully open positions.

OPERATIONAL BENEFITS

Monitoring data revealed that the 100 mm valve was opening fully, a condition indicating that the system required rebalancing. "With this information, we sent out a crew to fine-tune the PRV pilot chamber to prevent unnecessary pressure in the system. An issue like this, undetected, can lead to a watermain break and an increase in water loss," said Alberton.

Like other municipal water distribution systems, the city can experience as many as 100 pressure transients per day. This causes stress to its aging infrastructure, leading to leaks and pipe bursts. By capturing flow fluctuations, staff can see the impact of these events on the system.



Dave Alberton, Manager of Water Distribution for the City of Hamilton.

Alberton adds, "A lot of these transient events are due to pumps going on or off, or valves needing maintenance beyond our planned schedule due to a change in the system. If we can identify patterns of where and when these pressure and flow anomalies occur, we can investigate the problem. Sometimes it is a simple fix that we can do remotely, so having this information is really valuable and allows us to measure improvements."

Operators can now see how pump changes ripple through the distribution system, improving coordination across

departments. The data can be used for hydraulic model calibration to improve the accuracy for planning and design. Staff can export data into an Excel spreadsheet for detailed analysis and connect specific events, such as main breaks or flushing operations, with pressure and flow patterns.

Nighttime minimum flow analysis has established a baseline for consumption patterns and has also helped identify anomalies that indicate leaks and even unauthorized connections or water theft from hydrants. Remote alerts can be set for high-flow or high-pressure events, enabling a rapid response.

"We are really pleased with the consistency and accuracy of the data we are receiving from the new system," said Alberton. The city hopes to expand the deployment of the XP2F technology to other pressure districts. ■

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