Demand-based flushing with AMI and water quality sensors.

WHITE PAPER · DEMAND-BASED FLUSHING

How the City of Gainesville, Georgia replaced timed flushing with data-driven, on-demand flushing using Halogen MP5 sensors integrated with their Sensus AMI network — reducing non-revenue water while improving water quality.

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EXECUTIVE SUMMARY

From timed flushes to data-driven decisions

Water age degrades quality in distribution systems, forcing utilities to flush periodically — often on fixed schedules that waste treated water without knowing whether flushing is actually needed. By integrating Halogen MP5 water quality sensors with Advanced Metering Infrastructure (AMI), utilities can shift to demand-based flushing: flush only when chlorine or pH data indicates a need, at the right volume, at optimal times. Gainesville, Georgia piloted this approach and plans broader deployment.

99.875%

Sensor uptime over 6+ months of continuous operation — only 4 invalid measurements out of 2,200

140,000 gal

Typical volume per manual flush event — demand-based flushing aims to reduce both frequency and volume

Zero maintenance

No calibration or service visits for 6+ months. Previous DPD analyzer required maintenance every 45 days

Cl + pH

Both chlorine and pH monitored simultaneously — critical because pH rises independently in cold months

BACKGROUND

The water age problem

Water utilities are charged with managing their distribution systems to ensure high quality at every tap. Water quality degrades between the treatment plant and the point of consumption — a time difference known as water age. Higher water age is accompanied by declining disinfectant residuals, rising pH, and increased risk of taste, odor, and microbial complaints.

Even well-designed systems have water age problems, particularly at dead-end lines and areas where consumption is insufficient to maintain turnover. The traditional mitigation is flushing — discharging water from hydrants or blow-off points to bring fresh, higher-residual water into the area. Most utilities conduct this manually, rolling trucks and sending field crews to open hydrants on fixed schedules.

Manual flushing is inherently inefficient. Crews flush on a schedule regardless of whether water quality has actually degraded. Workload variations, traffic, weather, and labor availability introduce inconsistencies. Each flush event can discharge 140,000 gallons or more depending on the location — all non-revenue water.

THE APPROACH

Gainesville's path to remote, data-driven flushing

The City of Gainesville, Georgia serves over 60,000 customers and has a history of leveraging technology to advance efficiency. The city established remote flushing sites in problematic areas using Sensus ally water meters with integrated remote shut-off valves. For sites requiring higher flow rates, Gainesville developed automated flushing systems using Sensus 2" Omni meters with ClaVal on/off valves — enabling remote control, volume metering, and off-peak scheduling.

Figure 1. Gainesville's remote flush valve installation with Sensus ally meter for remote control and volume tracking.

To optimize these flushing operations, Gainesville needed real-time water quality data at each flushing point. A previous trial using an online DPD instrument for chlorine monitoring revealed that pH levels rose to unacceptable levels during colder months — meaning chlorine alone was insufficient as a flushing trigger. The DPD instrument also required maintenance every 45 days and failed in freezing temperatures.

Why the Halogen MP5

Gainesville selected the Halogen MP5 sensor for several critical advantages over the previous DPD analyzer: it measures both chlorine and pH simultaneously; it requires no maintenance or calibration for at least six months; it installs by wet-tapping directly into the main and operates in freezing temperatures; it runs on battery power, eliminating utility power requirements; and it produces no waste stream, minimizing non-revenue water from the monitoring itself.

THE KEY INSIGHT

Both chlorine AND pH must be monitored to trigger flushing correctly. During cold months, pH rises to unacceptable levels even when chlorine residuals appear adequate. A chlorine-only trigger misses this critical water quality parameter.

THE SENSOR

Direct-insertion, battery-powered, AMI-connected

The Halogen MP5-A is a multiparameter amperometric sensor that independently measures free chlorine, pH, conductivity, ORP, and temperature — regardless of flow and pressure conditions. Its mechanical and electrochemical self-cleaning system extends intervals between calibration and maintenance to six months or more.

Figure 2. MP5-A sensor installed via saddle clamp and corporation stop on a distribution main.

Figure 3. Sensor installed at the Gainesville pilot site on a corporation stop valve.

Installation uses conventional wet-tapping equipment in active distribution lines. A corporation stop valve is installed, the Halogen sensor with integrated remover assembly is attached, and the sensor is inserted into the flow. A sample port enables calibration checks using handheld colorimeters. The sensor operates at pressures up to 184 PSI (as demonstrated at the Gainesville site) and at any flow rate including zero.

AMI integration

The MP5-A sensor interface supports low-power mode for up to six months on a 50 Ah rechargeable battery. Four 4–20 mA outputs connect to Sensus Smart Gateways for data transmission to the Xylem Data Lake dashboard. Data uploads are triggered every 15 minutes, providing near-real-time water quality visibility at each flushing point.

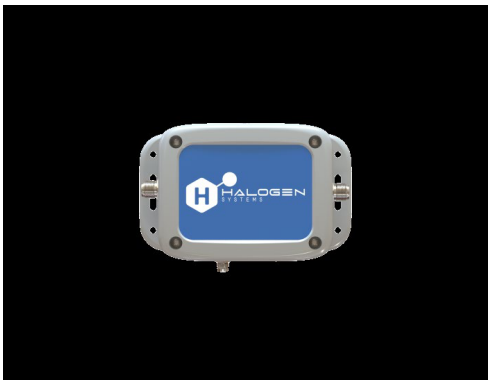

Figure 4. Halogen sensor interface — IP68-rated for vault and meter box installation.

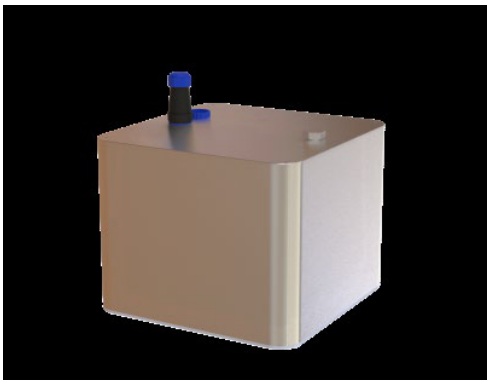

Figure 5. Battery enclosure with solar panel connection for extended unattended operation.

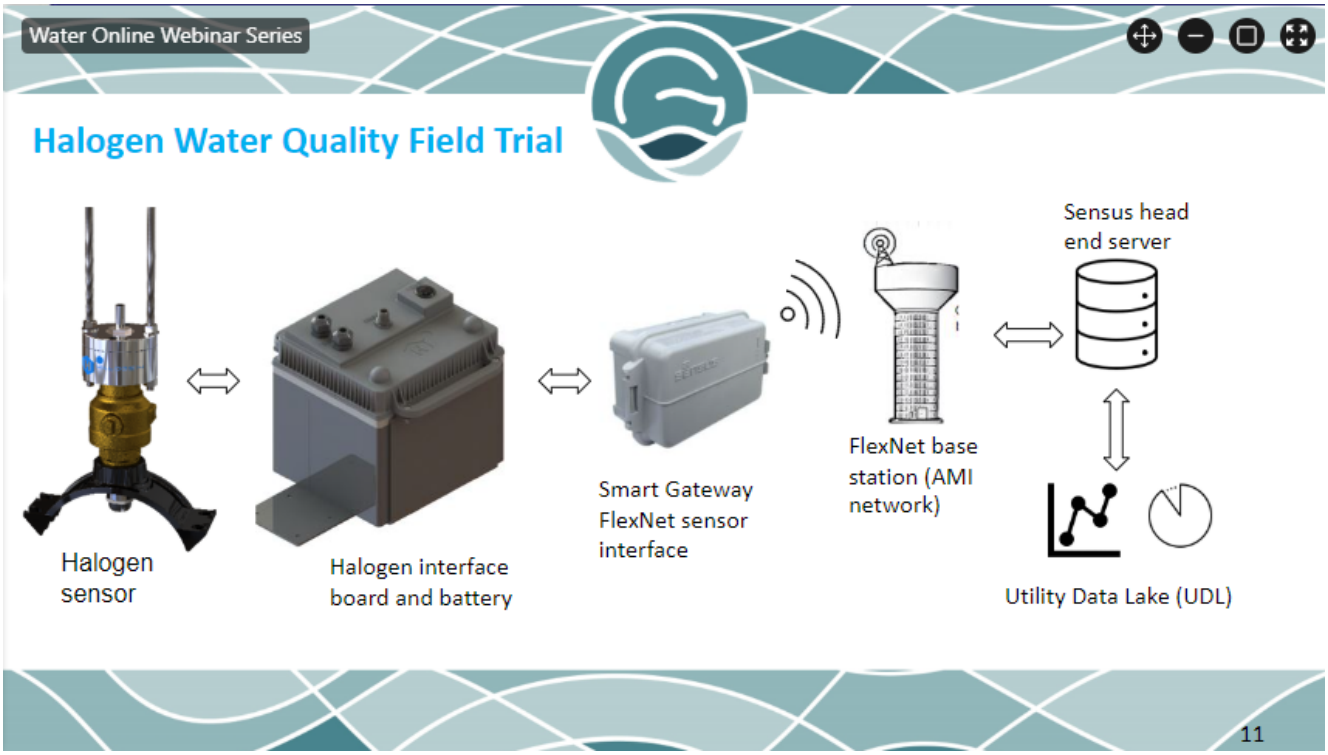

Figure 6. System architecture: Halogen MP5-A sensor connected to the Sensus AMI network via Smart Gateways, transmitting chlorine, pH, conductivity, and temperature data to the Xylem Data Lake.

R E S U L T S

Six months of continuous, maintenance-free operation

The Halogen MP5-A sensor operated without downtime or maintenance for over six months at the Gainesville site. Out of 2,200 measurements, uptime was 99.875% with only four invalid readings. The installation ran continuously at 184 PSI.

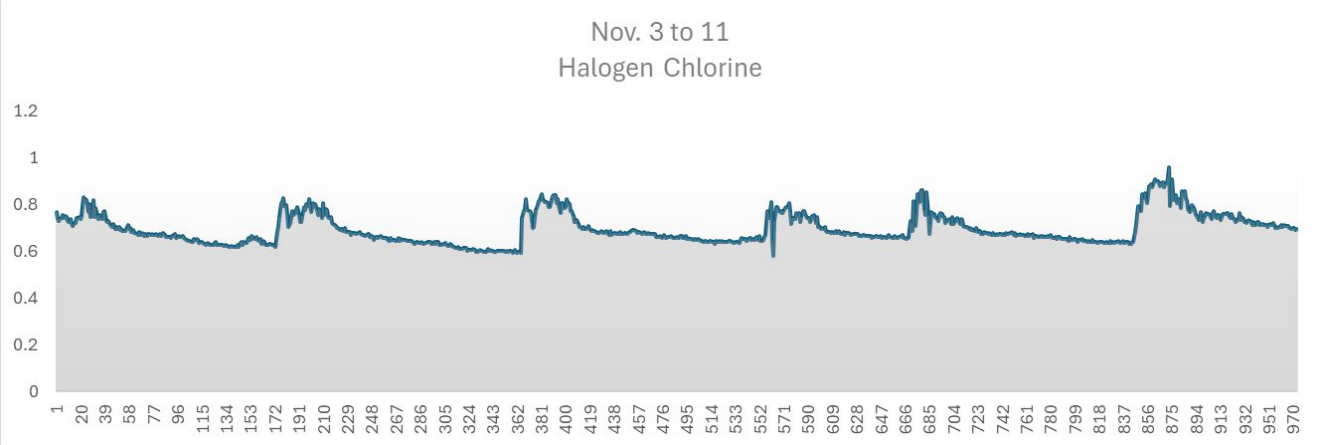

Figure 7. Chlorine levels at the Gainesville pilot site, November 3–11. Chlorine drops during aging periods and recovers sharply after nightly flush events, demonstrating the sensor's ability to detect water quality changes in real time.

Data from the Xylem Data Lake clearly shows chlorine levels dropping as a function of water age and recovering after flush events. The same pattern is visible in pH data, with pH rising during aging periods and falling after flushing — with the effect more pronounced during colder months.

The sensor tracked well against lab samples measured on-site with reference instruments for both free chlorine and pH. After an initial calibration in September 2024, the sensor maintained accuracy for the remainder of the trial period without recalibration.

Flushing triggers

The sensor provides sufficient resolution to trigger flushing when chlorine levels drop to 0.35 ppm or when pH rises to 8.9 or higher. During the trial, flushing occurred nightly for 6 hours on a timed schedule. With the quality data now available, the city plans to extend intervals between flushes and trigger based on actual water quality readings rather than fixed schedules — the core of demand-based flushing.

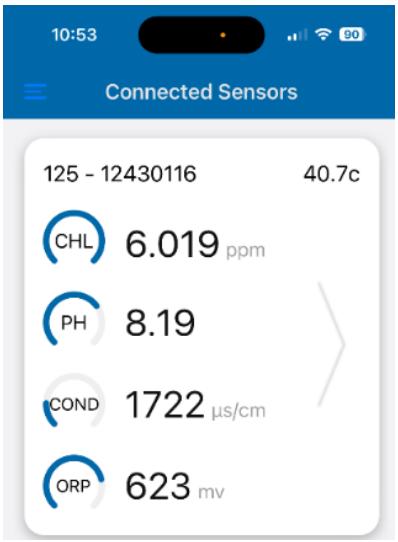

Figure 8. The Connected Sensors mobile app provides on-site access to real-time chlorine, pH, conductivity, and ORP readings via Bluetooth.

GEN 2 SENSOR INTERFACE

Based on feedback from the Gainesville trial, Halogen introduced a next-generation sensor interface featuring: Bluetooth module with mobile app for on-site calibration checks; IP68 battery enclosure for vault, manhole, or meter box installation with solar panel connection; and two independent Smart Gateway triggers for reliable four-parameter transmission. A new sensor model adds direct monochloramine measurement alongside free chlorine.

CONCLUSION

The path to optimized flushing

The Gainesville pilot demonstrates that integrating reagent-free, battery-powered water quality sensors with AMI infrastructure creates a practical path from scheduled flushing to demand-based flushing. The combination of continuous chlorine and pH monitoring, zero maintenance for six months, direct pipe insertion without power or drain requirements, and native AMI connectivity makes distribution system water quality monitoring feasible at scale.

The benefits cascade: fewer unnecessary flushes mean less non-revenue water; data-driven triggers mean flushes happen when quality actually requires it; remote monitoring eliminates truck rolls for routine checks; and the dual chlorine-plus-pH trigger catches water quality issues that single-parameter monitoring misses — particularly the pH increases during cold months that prompted this investigation.

The City of Gainesville is satisfied with the results and plans to deploy additional sensors across its distribution system. Their experience is documented in a Water Online webinar available to utilities considering similar deployments.

REFERENCES

1. City of Gainesville, GA. Demand-Based Flushing Pilot Program Data, 2024.
2. Halogen Systems Inc. MP5-A Sensor Technical Documentation and Installation Guide.
3. Sensus/Xylem. Smart Gateway and Data Lake Integration Documentation.
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ABOUT THE AUTHOR

Michael Silveri

Michael Silveri is the founder of Halogen Systems, Inc. and inventor of the company's amperometric sensor technology. With over two decades of experience in electrochemical water quality measurement, he has led the development of reagent-free chlorine analyzers deployed across municipal water treatment plants, building water systems, and industrial applications worldwide.