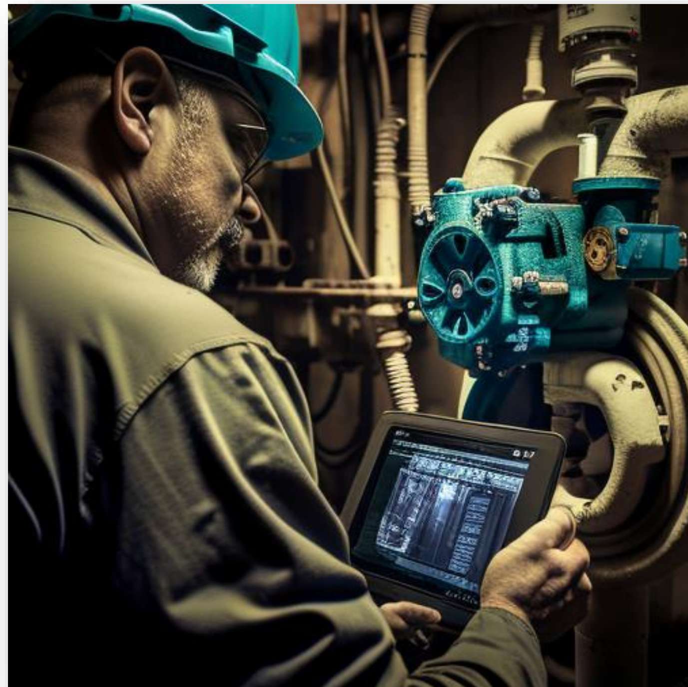
FUTURE OF LIFT STATION MANAGEMENT

A More Efficient Workflow for the 21st Century Utility Worker

Mahesh Lunani, Ravindra Rapaka, David Inman, and Wesley Lozano



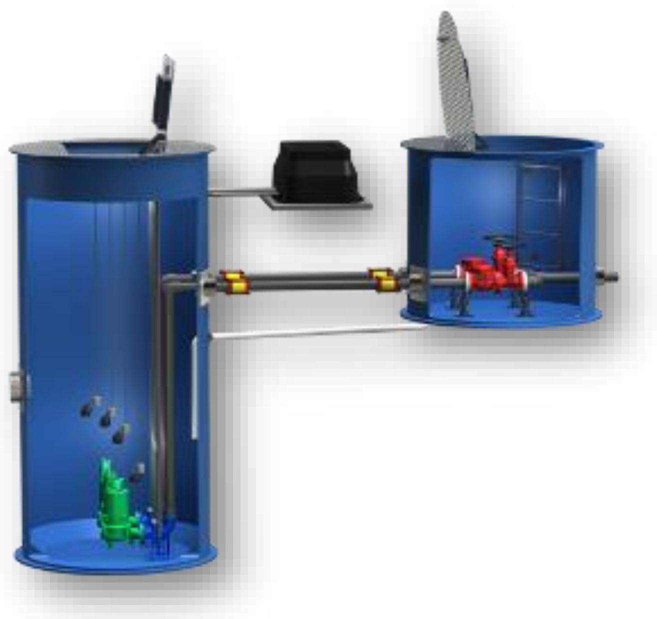
Overview of Lift Stations in The United States

In the United States there are more than two million lift stations. The State of Florida has the highest concentration of Lift Stations with some cities and counties having 100's and 1000's of these underground and unmanned stations. The primary purpose of lift stations is to elevate wastewater through sections of a sewer collection system where it cannot flow by gravity while maintaining a reasonable depth of bury. Some collection systems can convey wastewater by gravity flow alone, while the vast majority require the use of one or more lift stations along the way before ultimately converging and discharging at a wastewater treatment facility. Each and every lift station serves as a single point of failure for all flows upstream from that point in the collection system, and a lift station failure results in disastrous effects on the environment and to public health. The effects of a lift station failure increase in magnitude the further downstream they occur, however any failure may lead to sewer backups, sanitary sewer overflows (at the lift station site, at upstream manholes, or even back into people's homes and businesses), polluted waterways, and loss of public trust.

Challenges in Managing Lift Stations

It is not humanly possible for utilities to manage 100's of lift stations effectively. Utilities are resource constrained and do not have the manpower to keep an eye on all these stations. Many of these lift stations have barebones telemetry for the utility's SCADA system, providing limited monitoring capabilities and often times little or no control capabilities. Most stations do not have flow meters or pressure transducers on pumps' discharge to the force main, and do not have load metering to understand power consumption trends. Addition of such meters and gauges in 100's of lift stations is cost prohibitive with limited return on investment for many of the small to medium lift stations.

Lift stations are composed of multiple pumps with capacities ranging from 50 GPM to 20 MGD for each pump. They are designed to last 15 to 20 years if maintained, but there are several challenges that often result in shortened equipment life. They operate in a corrosive and harsh environment with rags and other solids leading to clogged pumps and accelerated wear and tear on pump impellers. Inefficient process control and overdesigned pumps lead to excessive pump cycling with dozens of start/stops in an hour. Pumps operating outside the allowable operating range cause cavitation or recirculation leading to higher pumping cost. No cost effective and automated method of



monitoring degradation of pump capacities over time currently exists. There is a lack of insights on the impact of real-time wet weather events on lift station flows and capacity constraints. Finally, accumulation of fats, oils and greases in wet wells, if not maintained over time, reduce well capacity, alter system curves, produce terrible odors, and even cause plugging resulting in service interruption.

Current Approach to Lift Station Management

The current approach to lift station management is to react to an issue, failure, or SCADA alarm and, in the best case, deploy a crew to try and identify and resolve the issue. This reactive approach is in large part because there are too many lift stations to regularly check in on for many utilities. For example, one operator in a county with 100 lift stations can physically inspect 5 to 6 stations each day and will take a full month to cycle through all lift stations. It is repetitive work, and it has been proven in the manufacturing sector that repetitive work leads to operator errors. Additionally, the utility worker is likely to miss issues that are brewing in the system as they often are not physically visible or require too many resources to determine the full extent of. The status-quo on lift station management doesn't position utilities to be a 21st Century Utility.

We are in the fourth industrial revolution with advanced capabilities of data mining, data meshing, synthetic data generation, machine learning, real-time analytics, asset intelligence, and artificial intelligence, all of which augment the utility workforce. Aquasight envisions a bright future for lift station management; one that has a digital centerpiece that shifts utility workers from being reactive to proactive, scans for real-life asset health and degradation, reports on operational anomalies that might be caused by clogging, ragging, blockages, and air pockets, identifies inefficient control strategies, and shows flow anomalies that may be caused by inflow & infiltration or illegal dumping.

Positioning Utilities to be a 21st Century Utility

At the heart of this solution is Aquasight's ATLAS analytics engine that can deliver the digital eyes that the utility worker needs. The ATLAS analytics engine can consume the bare minimum lift station SCADA control parameters such as continuous wet well level measurements, pump on-off status, factory pump curves, and wet well and hydraulic piping dimensions. This analytical engine can generate virtual flows using wet well draw-down if there are no flow meters, decipher station diurnal curves during pump on-off cycling, estimate power draws from pump curves, and create reference dry weather flow curves.

The ATLAS analytics engine can also produce pump efficiency metrics, digital pump curves, pump capacity degradation, flow deviations during wet weather events, approximate I&I for the sewer shed feeding the stations, highlight when the station is reaching max capacity, and estimate pump cycling frequencies. The analytics engine can also be used to determine if an alternative pump run schedule or wet well set point strategy would result in improved efficiency and estimate the resulting cost savings. This can also be used as a knowledge management tool to refer back to any past day, week, or month and observe how the system behaved. The following case studies illustrate how the ATLAS analytics engine provides the opportunity for better lift station management.

Real-World Success Stories

- **Boston, MA** – Critical lift stations are monitored for pump efficiency, power consumption, and wet well and pump cycling. The diurnal flow loading curve is analytically generated and better allows for impacts of wet weather I&I to be visualized. Anomalies in performance or loading can be quickly identified from a central dashboard monitor.

- **Hull, MA** – Includes complete mapping of the collection system, lift stations, and WWTP which allows for monitoring at each lift station and holistic views of system flows. Dry weather flows were created to better identify the tidal impact of coastal I&I sources. Understanding the impact of I&I at a lift station level has better targeted funding for repairs and rebuilds of the most vulnerable parts of the system.

- **Columbus, OH** – Digital Pump Curve analysis helped understand that pumps were not being optimally utilized with the standard wet well setpoints. Adjustment of wet well setpoints allowed for up to 25% energy savings and fewer daily pump cycles, saving energy costs and extending asset life.

Revolutionizing Utility Workflow

The ATLAS analytical engine will transform four key workflows: Emergency, O&M daily, O&M monthly, and Training workflow.

- During **emergency workflow**, ATLAS can alert using a sophisticated analytical alert system called SAMI. This is quite different from a SCADA alarm. For example, if there is no flow through the system, even though the pump is running, or the station capacity reached 80% levels or the efficiency of the system reaches 25% or below, SCADA cannot alarm if it cannot measure the flows or calculate such metrics.

- **O&M daily**, the ATLAS analytical engine provides a key scorecard and highlights the stations that need more attention. For example, pumps operating below their average efficiency when compared to the previous 30 days point to potential maintenance issues. Additionally, flows are significantly more than the typical dry weather flows showing potential illegal dumping or unexplained flows.

- **O&M monthly** workflow can trend degradation of pump capacities, inflow and infiltration, monthly pumpage, and energy consumption across the system. It can also track anomalies and make decisions on pumps that need to be serviced.

- **Knowledge workflow** will assist new staff under training to quickly go back in time and look at the behavior of the systems but also understand how they operate under various conditions. In addition, the analytical engine output can be used by the engineering team designing the pump station upgrade to save weeks from data collection and understand the real-life operating conditions for the design.

These are just a few of many examples that illustrate how Utility workers can become a knowledge worker augmented by the ATLAS analytics engine and fundamentally transform Lift Station Management. Such analytical engine outputs can be passed through an API and ingested to the utility's favorite application, or it can be fronted by Aquasight's own ATLAS application.

It is important that for the ATLAS analytics engine to work effectively it will require data to be polled at appropriate granularity and transmitted in near real-time, if not real-time. If the data is captured at a frequency higher than pump cycling frequency, then we are bound to miss parts of the whole picture or if data is transmitted at significant delays, then the effectiveness may be slightly decreased.

Conclusion

In conclusion, lift station management is a critical aspect of the wastewater collection system that affects the environment and public health. The current approach to managing lift stations is reactive and resource-intensive, and does not position utilities to be 21st century utilities. With the fourth industrial revolution, advanced technologies such as Aquasight's are now available to utilities. These technologies provide automated monitoring methods that can help utilities identify and resolve issues in real-time and predict potential issues before they happen. Aquasight's smart water technology also improves the workflow for utility workers and transforms the Emergency, O&M daily, O&M monthly, and Training workflows. It is a cost-effective and efficient solution that can improve the lifecycle of equipment and provide safe and reliable services to customers.