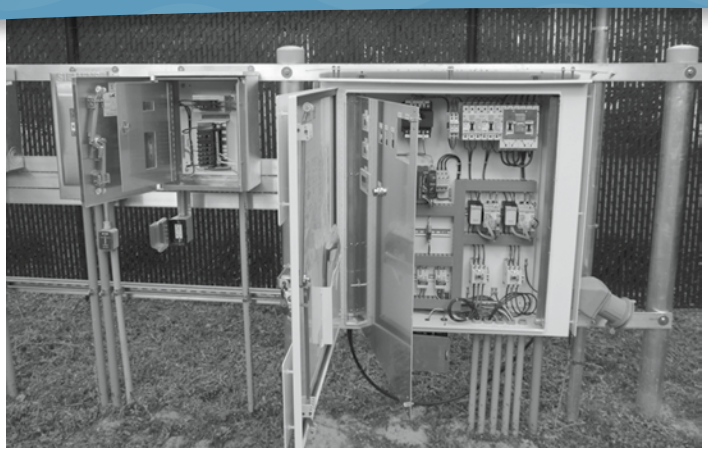
Executive Summary

WERF

Reducing high energy costs and associated greenhouse gas emissions from lift station operations at wastewater facilities



A lift station control panel interior.

Optimization of Wastewater Lift Stations for Reduction of Energy Usage and Greenhouse Gas Emissions (INFR3R11)

The Central Issue

The pumping regime of lift stations pose several challenges to wastewater facilities. In a typical utility, pumping accounts for an enormous amount of electricity usage and lift stations can have relatively high maintenance costs. The high energy use also contributes to the production of greenhouse gas (GHG) emissions. Additionally, many collection system lift stations still operate with instrumentation and control systems that were developed many years ago. In many instances, these units utilize local or basic controls that have no hydraulic relationship with other collection system lift stations. This project demonstrated an energy-efficient control method of lift station system operation.

Context and Background

The Jacksonville Electric Authority (JEA) sewer system consists of more than 3,760 miles of collection lines and seven regional and eight non-regional sewer treatment plants. Because of the flat topography, JEA has more than 1,200 lift stations to convey wastewater to the plants. The existing pumping control system for the 1,273 lift stations that keeps wastewater flowing was simply outdated and verifying communication between the data concentrators and the remote lift stations was primitive. The research results showed how hydraulic model simulation could be integrated with new generation SCADA programming so that lift station pumping could be scheduled and controlled from a central location for energy-efficient operation and reduced operations and maintenance costs.

Findings and Conclusions

This project demonstrated an energy-efficient control method of lift station system operation that utilizes hydraulic modeling results generated from site-specific conditions to optimize the pumping units and reduce simultaneous running cycles. The study findings suggest that the development of optimal collection system control strategies utilizing hydraulic modeling results may provide energy savings of approximately 15% with corresponding GHG emission reductions. Although, solely on the basis of energy savings, this strategy might not always provide an advantageous payback period. Considering the other operational benefits, this approach is likely economically advantageous. Additional operational benefits include:

- Improved practices to manage installed assets. For example, this new SCADA system provided detailed information on each pump's run times, current, voltage, power, and other diagnostic alarm set points.
- Savings in facility operating costs from designing system capacity based on optimized system operations.
- Reduction of force main operating pressures, total dynamic head, and power consumption.
- Avoidance of future oversizing of pumps due to the improved understanding of the system.
- Energy savings and increased useful pump life now that the smaller pumps can operate based on a sequencing program.
- Costs associated with pump renewal and replacement may be reduced because the pumps now operate more efficiently.
- Labor costs should be reduced since system troubleshooting and reprogramming can now be performed remotely.

Management and Policy Implications

The research had two objectives: Determine whether lift station optimization could reduce energy costs and GHG emissions, and produce guidance to help other utilities with their lift station systems. As mentioned above, the results showed that there are reduced costs through energy savings and O&M activities. GHG production was reduced as a result of the decreased energy demands to operate the system. The guidance document gives a step-by-step description of what's needed to optimize lift stations by reducing energy and O&M costs and extending asset life which helps defer capital expenditures. The guidance introduces capabilities of new generation hydraulic models and SCADA systems, demonstrates how hydraulic modeling can be utilized to identify energy efficient operating conditions, and illustrates how hydraulic modeling can be integrated to develop optimal control strategies for lift stations. Other system design and operational parameters are also presented because of the interdependent nature of the conveyance and treatment systems.

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Related WERF Research

Project Title	Research Focus
Effective Practices for Sanitary Sewer and Collection System Operations and Maintenance (01CTS20T)	Provides a toolkit of practices for the operation and maintenance, management, and capacity assurance of sanitary sewer collection systems. A useful reference for utility managers as well as technicians and operators who perform operation and maintenance functions. It can help utility managers develop, enhance, and implement programs to improve effectiveness and efficiency. It also can help utilities, reduce the risk of sanitary sewer overflows, and improve asset management practices.
SIMPLE: Sustainable Infrastructure Management Program Learning Environment (03CTS14)	This online knowledge enhances the ability to train personnel and provide guidance and tools to utilities of all types, sizes, and levels of practice in asset management. Moreover, SIMPLE helps practitioners learn how to extend the life of existing assets through changing strategies, tactics, and by implementing optimal maintenance practices and rehabilitation interventions, ultimately improving operational efficiency and reducing operational costs. SIMPLE contains over 16,000 pages of best practices and guidance developed over a 20-year period and from extensive international experience and collaboration with AM practitioners.
Energy Efficiency in Wastewater Treatment in North America: A Compendium of Best Practices and Case Studies of Novel Approaches (OWSO4R07e)	Includes case studies on many of the types of CHP systems addressed in the CHP-SET tool and elsewhere. Provides detailed information on the application of systems to recover heat and power from biogas.
Energy Efficiency in the Water Industry: A Compendium of Best Practices and Case Studies – Global Report (OWSO9C09)	Looks at current best practices and technologies and identifies promising new developments for energy management in the wastewater and water industry worldwide. This is a supplement to the WERF report OWSO4R07e above.
Leading Practices for Strategic Asset Management (SAM1R06h)	Identifies, documents, and validates leading practices through site visits and a research forum held in 2010. Leading practices are presented in an easy-to-follow format that cites and explains the practice and provides examples. The research is intended to assist utility managers in the practice areas of Organization and People, Strategic Asset Planning, Business Risk, Maintenance, Secondary Data and Knowledge, and Accounting and Costing.
Methane Evolution from Wastewater Conveyance (U2R08a)	The evolution of methane (CH_4) from wastewater conveyance, treatment and sludge/biosolids handling may represent a significant contribution to the carbon footprint of a wastewater utility. The goal of the first phase of the collection system investigation was to determine if CH_4 could be detected in the wetwells and forebays of a sanitary wastewater collection system. During that initial phase, CH_4 emissions were quantified from DeKalb County's 64 pumping stations. The results of that investigation documented that approximately 1,000 MT of carbon dioxide equivalents (CO_2e) are emitted each year from CH_4 evolution at these pumping stations.

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