

## 5.8 Gate Automation

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### *Applicability*

This best management practice (BMP) is applicable to gravity fed and partially pressurized pipeline agriculture surface water irrigation systems and other water conveyance systems. The requirements and applicability of gate automation varies between specific geographic regions and political subdivisions throughout Texas.

### *Description*

Gate automation with supervisory control and data acquisition (SCADA) programming provides irrigation districts and other water districts water savings by minimizing spills, identifying obstructions quickly as well as remotely managing data on water levels and flow rates within the delivery system. The extent of remote management can vary depending on the capability of the system. There are two major aspects of this best management practice, the physical gate equipment and construction and the telemetry installation and programming.

#### 1. Gate Construction and Equipment:

The specific size and structure of the gate leaf and frame can vary depending on geographical needs and conveyance system. There are four main components:

- The gate structure – a barrier across the width of a canal defining upstream and downstream control section
- The gate – an aluminum/steel/ plate that can slide within an aluminum/steel frame imbedded in the gate structure which can be prefabricated or custom fabricated in-house if expertise and machinery are available.
- The actuator – the mechanism that moves the gate up and down
- The control panel - an enclosure that contains the internal circuitry for gate control, water level instrumentation controller/telemetry.
- Energy source –12vdc solar power system (solar panel, battery, and charge controller).

#### 2. Telemetry and SCADA:

This is the monitoring and remote-control system that allows for better management of canal water levels, pumping, metering and data collection. This system includes:

- Telemetry System – the communications system that relays data to and from the gate controller to a data acquisition system. This could be a proprietary radio network system “900MHz, 2.4GHz” or a local broad band cellular provider connected back to a central acquisition system, either to a stand-alone server or a cloud-based platform.

- Site Controller
  - Each site has a main controller or Remote Terminal Unit (RTU) that controls the gate actuator or monitors the water level instrumentation.
- Control logic can be done at this time or data can be pushed out to the data acquisition system.
- Central Data Acquisition System
  - The data acquisition system also can perform logic on the data from the site controller and then send data back down to the site controller via the telemetry system.
  - The Data acquisition system will send out alerts to operational staff and will display the data to a user interface. From here data can also be shared to other systems such as a billing system or long-term data storage system.

### *Implementation*

For implementation of this BMP, it is important to understand that each conveyance system requires distinct gate measurements and design. Engineering experts should be consulted to determine structure design and type of control system. Typically, it is not necessary to automate every gate structure within the system. To help decide what structures need to be automated the following information should be gathered: elevation change from the beginning to end of a canal line, number of gate structures per mile, flow rates at each structure, typical head pressure difference between structures, historical pumping data, and information from canal operators regarding the frequency of adjustments normally necessary at each structure. This information can be used to prioritize structures to automate first, estimate anticipated savings, and potentially skip automation on structures that do not need to be adjusted often. This is particularly relevant for a large canal system when acreage fluctuates substantially from one year to the next and/or acreage served is significantly lower and more scattered geographically than when the canal system was built.

Gate automation could include building new gates and structures or motorizing the actuators on existing gates. If retrofitting existing actuators is under consideration, building a pilot installation to test the concept is recommended.

Existing internal and external communication and control systems in place, the expected longevity and replacement cost of internal communication systems, security requirements, the type of data acquisition system and desired data retention timeframe should all be considered when deciding how to integrate the telemetry and SCADA systems. Planning for simple integration of additional structures and any anticipated supply chain issues should also be considered upfront. Control of canal water levels can use either downstream control

(feedforward) or upstream (feedback) control. If downstream canal level control is implemented, it is possible to manage river diversion pumping volume based on downstream demand.

### *Scope and Schedule*

This BMP can be implemented by irrigation districts and other water management districts or entities managing other irrigation delivery systems with multiple landowners. Gate automation with SCADA is a management tool specifically for water conveyance systems. The gate size, frame, and design can vary depending on geography and political subdivision. Telemetry and SCADA generally correlates with gate structures, but monitoring can be conducted at other parts along the canal, particularly at the end of a canal line to quantify spills.

For the construction of gates including SCADA implementation and programming, a 10-12 site project can take roughly 6 months, typically with construction completed outside of the irrigation season. For the whole project, including engineering design (structural, electrical, and communications), procurement, and post-installation testing, a rough estimate of one year is anticipated.

### *Measuring Implementation and Determining Water Savings*

Water savings can vary based on geography, pre-existing water use efficiency, canal structure, and other various aspects. The main way this BMP saves water is by prevention of spills during weather-related shut-downs and timely identification of canal system operational issues. Remote access to flow settings from secure laptops and highwater level alerts sent to mobile devices are important features to implement to maximize potential savings. Improved water level control increases the accuracy of water volume delivery. The telemetry and SCADA systems are key aspects to realize reliable water savings through the remote monitoring of water levels and controlling optimal storing capacity, which in turn increases the efficiency of the system. It is not recommended to implement gate automation without SCADA system integration as many of the water and labor savings benefits will not be realized with only local control. Savings estimates range from 3-5 percent of annual diversions assuming a project with full SCADA integration and at least 90% of the water flow controlled through automated gates.

### *Documentation*

The irrigation district or political district who manages the conveyance system should collect and document data regarding water usage, water flow, and water loss. Projects should include automated water level monitoring at the ends of canal lines to quantify reduction in spills and ideally baseline data should be collected prior to project implementation. Savings can also be quantified through regression savings analyses over several seasons, however savings estimates using these types of models tend to have very large ranges, so data indicating reduction in spills is useful to corroborate these analyses. A side benefit of gate automation projects is the ability to conduct ponding tests easily on canal segments between automated gates. This can be done

annually at the end of the irrigation season when irrigation demand is low, but the canal system is still fully charged.

### *Cost-Effectiveness Considerations*

The cost associated with this BMP can vary significantly depending on the number of gates, the location, the gate size/design, and historical/environmental/geographical context of the conveyance system. Some sources cite one to three gates with SCADA integration costing between \$25,000 and \$35,000 per gate structure. This does not include the initial set-up cost of a SCADA system (including a radio telemetry system) or the cost of a complete structure rebuild if it is not possible to use the existing structure. The Lower Colorado River Authority's Garwood and Gulf Coast projects and the Harlingen Irrigation District's projects both incorporated large-scale improvements to their conveyance system. The complete Gulf Coast system, which cost approximately two million dollars, was completed in phases between 2010 – 2018 at a unit cost of approximately \$30/ac-ft/yr. Multiple studies have shown that improvements to conveyance/delivery systems are the most cost-effective way to save water in the surface water delivered irrigation sector.

### *References for Additional Information*

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