BURNS McDONNELL

CASE STUDY

Progressive Design-Build Optimizes Water Facility With No Operational Disruptions

The water treatment facility in Siloam Springs, Arkansas, underwent significant improvements to satisfy the needs of a growing population and address challenges brought on by aging infrastructure. From the onset of the $31 million progressive design-build project, design and construction were integrated to maximize cost predictability, maintain plant operations and contribute to the project's success.

Challenge

In the nearly three decades since Siloam Springs' water treatment facility underwent its last major upgrade, the city's population has more than doubled. To meet the growing demand and address the never-ending need for infrastructure upgrades, city officials set out to improve water treatment capabilities and capacity with the goal of continuing to meet water needs through the year 2040.

Project Stats

Client
City of Siloam Springs

Location
Siloam Springs, Arkansas

1st
PROGRESSIVE DESIGN-BUILD PROJECT IN ARKANSAS TO USE STATE REVOLVING LOAN FUNDING

1st
PROGRESSIVE DESIGN-BUILD PROJECT IN ARKANSAS FOR A MUNICIPAL DRINKING WATER FACILITY

1st
PROGRESSIVE DESIGN-BUILD PROJECT IN SILOAM SPRINGS, ARKANSAS

$30M
TOTAL PROJECT BUDGET WITHOUT A SINGLE COST OVERRUN

9M
GALLONS-PER-DAY CAPACITY TO MEET CURRENT AND FUTURE WATER DEMANDS

0
DISRUPTIONS TO ONGOING OPERATIONS

The city sought to improve automation, treatment flexibility and redundancy, and to protect public health and produce high-quality water for residents. Keeping the plant operational — without interruption — during construction was critical.

Solution

At the onset of the project the Burns & McDonnell team evaluated multiple alternatives to improve the plant's raw water intake, water treatment processes, finished water storage, high-service pumping and site configuration. Evaluations considered whether the best option was to rehabilitate existing infrastructure, build new, or create a combination of new and existing infrastructure solutions.

Members of the city's project team had a long list of needs they wanted to address within the fixed $31 million budget. By weighing key factors such as project funding, operations, energy consumption, maintenance requirements and reliability, Burns & McDonnell identified improvements to meet the city's needs. This consisted of a mix of rehabilitation and new construction, and included: improving existing water intake, installing a parallel raw water pipeline, rehabilitating and expanding the treatment system, and improving the high-service pump station.

Our self-perform construction execution allowed the team to control quality and critical path activities while maintaining a best-value approach that helped maintain the project budget. Self-perform construction included tasks tied to work with concrete, metals, process piping, process equipment and electrical components.

One of the project's main challenges was implementing this critical infrastructure improvement while keeping the plant fully operational and minimizing disruptions to operations staff and service to the community. For Siloam Springs, one of the biggest issues was starting the construction phase of the project during the COVID-19 pandemic. The health of the population was uncertain, travel was restricted, virtual meeting technology tools were in their infancy, supply chains were severely disrupted, and cost-escalation was at an all-time high.

Additionally, throughout construction, simultaneous operations had to be safely executed. This required regular communication and coordination with the city's staff. Since it was imperative that the water facility continue to run at peak efficiency while construction took place, the construction team employed temporary pumps and piping to avoid unplanned outages and to keep the plant fully operational. By ramping up communication and adhering to our robust procedures and protocols, the project was successfully delivered on budget and on schedule, despite pandemic-related challenges.

Handling Old Problems in New Ways With Progressive Design-Build

By utilizing a progressive design-build approach, the City of Siloam Springs gained several benefits in terms of cost, schedule, efficiency and coordination.

This was the first progressive design-build contract in the city government's history. It also marked the first time that progressive design-build was used to deliver a municipal drinking water facility in Arkansas, and it was the first time the state of Arkansas funded a progressive design-build project through the State Revolving Fund, triggering additional federal provisions and permitting requirements that our permitting team helped the city navigate. These additional provisions included environmental permitting, good-faith efforts to use disadvantaged businesses as subcontractors, and American Iron and Steel compliance.

The progressive design-build delivery method generated confidence in construction quality throughout the process. This approach enabled our team to make the most of best value selection by focusing on contractors' abilities to meet quality and safety standards and complete the job on schedule while working in an existing operational environment. This approach also provided Siloam Springs with the flexibility to evaluate and implement minor changes as needed, without significantly impacting the budget or schedule. For example, six months into construction, the city's team elected to upgrade lighting in the filter gallery. This was easily accommodated through coordination with the electrical subcontractor. With additional self-performing capabilities, Burns & McDonnell was able to manage and execute critical-path construction elements with ease.

Early on, it was concluded that the plant's existing 9 MGD capacity would be adequate to meet the city's near-future needs. While many plant assets would require retrofits or replacements, the major concrete structures at the existing plant were generously sized and in good physical condition. The team identified a construction sequence that would allow for the replacement of equipment within the existing basins, while keeping the plant in service and meeting peak summer water demand. Therefore, new treatment basins were deemed unnecessary, resulting in substantial cost savings. The team's design included increasing the capacity of individual basins for increased redundancy so that the plant's capacity might later be expanded to 12 MGD without major structural changes, if needed.

In addition to treatment improvements, one of the top priorities was to improve the raw water intake and conveyance from the Illinois River. The solution was to install 2.3 miles of new raw water conveyance pipeline to back up the aging raw

waterline. The existing raw water pipeline was 65 years old, so a second pipeline that provides redundancy was a necessity for reliability of the city's water supply. The proposed pipeline route was chosen with care to minimize impacts to home and property owners, as well as the scenic to the scenic forested hills, which stretched from the intake on the Illinois River to the water treatment facility at the city's edge. The existing pipeline easement was already kept mown and clear, so the team opted to route the new pipeline immediately adjacent, cutting by 40% the amount of new easement area required and greatly reducing environmental impacts compared to other available alignments.

Keeping Safety and Sustainability Top of Mind

The project's design and construction incorporated several features to improve safety and sustainability. One priority was to upgrade the treatment plant's disinfection system. The existing chlorine gas storage and feed system was replaced with one using sodium hypochlorite, an alternative disinfectant that greatly reduces public safety risk. This change helped reduce operators' occupational exposure to disinfection chemicals.

Additionally, high-service backwash pumps were modified so that they can be removed for inspection and maintenance without the need for a diver to enter the clear wells (a confined space) to unbolt pipe connections. Plus, turbidimeters in the filter gallery were relocated so that operators were no longer required to climb over the 36-inch backwash pipe to read them, eliminating fall hazards.

From a sustainability standpoint, the project team took special care when choosing the brick that was utilized, confirming that it was regionally sourced and that the new structures aesthetically matched the existing plant. To reduce energy consumption, continuous insulation was utilized in all the buildings and new, high-efficiency pumps were installed. Plus, white roofs were selected to limit the heat island effect and increase reflectance at the building; and overhead doors that were used were partially made from recycled materials.

Results

The project successfully marks the first time the State of Arkansas utilized an optimized progressive design-build approach to deliver a project funded by the State Revolving Fund, positioning Siloam Springs as a leader in innovative capital project delivery.

While keeping the plant fully operational as improvements were made, government funds were used to successfully replace aging clarifiers, filters, pumps and chemical storage systems, as well as to implement more modern instrumentation and control systems. Additionally, solutions that support greater automation, treatment flexibility, security, safety and sustainability were also implemented.

The water treatment facility's modernization was completed on time and under budget and is set to serve the businesses and residents of Siloam Springs for decades to come.

Project Highlights

Clarifiers

- Purpose: Remove solid particles from the water and prepare the water for additional treatment.
- Solution: Replaced clarifier mechanism, rehabilitated infrastructure and raised walls.
- Result: Saved money reusing existing infrastructure, increased capacity and improved water quality.

Filters and Filter Building

- Purpose: Remove remaining particles and microorganisms in order to treat water; serve as the operations center for the plant.
- Solution: Demolished and replaced the filter underdrains, media and the blower.
- Result: Improved operational flexibility, reduced energy use and noise and increased automation for chemical cost savings.

Clearwell and Pumping System

- Purpose: Serve as the final storage stage in the treatment system.
- Solution: Installed variable speed pumps to meet capacity demands and improve reliability.
- Result: improved operation and maintenance, making treatment easier, safer and less expensive.

Chemical Storage and Chemical Building

- Purpose: Provide storage for treatment chemicals and enable distribution of chemicals to the plant safely.
- Solution: Enclosed a portion of the existing chemical building and switched from chlorine gas to sodium hypochlorite (bleach).
- Result: Saved money and provided safer chemical storage and processing.

Electrical Upgrades

- Purpose: Power the plant and allow SCADA to monitor and control the plant in real time.
- Solution: Replaced aging electrical infrastructure, installed new backup generator, and designed plant control system (PCS) for complete plant automation and monitoring.
- Result: Upgraded electrical components for more reliable service and updated PCS systems to give operators a more modern interface for improved automation and operability.

Raw Water Intake at the Illinois River

- Purpose: Supply water directly to the plant or storage reservoirs.
- Solution: Renovated the raw water pump station and built an electrical building.
- Result: Upgraded electrical components and improved pumping configuration, allowing operators to remotely monitor and better control the station for more reliable service.

New Raw Water Pipeline

- Purpose: Transport raw water 2.3 miles to the treatment plant.
- Solution: Installed additional pipeline, fiber-optic line and underground electrical conduit for plant control.
- Result: Improved reliability and redundancy, provided flexibility for future expansion, and reduced weather impacts to the SCADA system and intake power supply.

About Burns & McDonnell

Burns & McDonnell is a family of companies bringing together an unmatched team of engineers, construction and craft professionals, architects, and more to design and build our critical infrastructure. With an integrated construction and design mindset, we offer full-service capabilities. Founded in 1898 and working from dozens of offices globally, Burns & McDonnell is 100% employee-owned. For more information, visit **burnsmcd.com**.

182900-0423