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WHITE PAPER / **THORNTON WATER TREATMENT PLANT**

ALL-NEW THORNTON WATER TREATMENT PLANT POSITIONS GROWING COLORADO CITY FOR THE FUTURE

BY Jason Schaefer, PE

The City of Thornton was looking for a solution to consistently manage water quality challenges. Through an innovative new water treatment plant, the city used ozone and biofiltration to maintain water quality standards for its community.

Like many communities in Colorado, the City of Thornton has long faced challenges in maintaining high standards for its water quality due to a range of issues affecting raw water sources.

In 2005, Thornton unveiled the upgraded and expanded Wes Brown Water Treatment Plant, a facility that has become a model throughout the industry for innovative treatment standards using ultrafiltration membranes to eliminate impurities. At the time of its completion, it was recognized as the largest submerged membrane treatment plant in the U.S. and the largest membrane retrofit in the world.

Now, 15 years years later, Thornton is finished with the next phase of its ongoing commitment to high-quality water with construction of the new Thornton Water Treatment Plant (TWTP), a 20 million-gallons-per-day (MGD) facility that replaces an existing 16-MGD treatment facility that is still operating but well past its original design life. The new treatment plant serves as an example of the technological capabilities other cities can adopt to secure safe and reliable water supply.

FLEXIBLE WATER TREATMENT PROCESS

Before Thornton and its design-build team of Burns & McDonnell and Garney Construction began design on the new TWTP, in March 2017, it was clear that further investment in treatment processes at the existing facility would be less cost-efficient than building an all-new facility. The new 68,000-square-foot treatment facility serves as the city's baseload treatment plant, operating at or near full capacity year-round, even during winter conditions. Located on a 13-acre site adjacent to the existing treatment facility, the new TWTP was completed in November 2020.

Though the existing plant meets all current regulatory standards for water quality, the new TWTP is a flexible plant that can adjust to treat several source water conditions and exceeds pre-existing water treatment standards. In addition, the TWTP has been designed with hydraulic capacity for emergency treatment during high-flow periods. The TWTP treats water from Thornton's two primary existing surface water sources: Standley Lake and the South Platte River. Water from Standley Lake

presents few quality issues, though seasonal fluctuations sometimes create reduced volumes of water available from that source.

Thornton has faced chronic challenges with taste and odor, a problem stemming primarily from the presence of organic matter, algae blooms and other constituents. Though it is not a health hazard, it can create perceptions about water quality. So rather than continuing to invest in treatment processes at the pre-existing plant, the decision was to address the issue within the treatment trains at the new TWTP.

COMMITMENT TO HIGH-QUALITY DRINKING WATER

Thornton officials have consistently maintained high standards for drinking water quality and the TWTP elevated that effort. Officials have adopted policies that will adhere to higher treatment standards than required by current regulations, and design features of the new TWTP allow Thornton to meet its Partnership for Safe Water Program goals.

The Partnership for Safe Water is a voluntary self-assessment program administered by the American Water Works Association that assists in the optimization of water treatment plants and distribution system performance. It focuses on rigorous data collection and reporting as a means to hold the reporting entity to the highest standards of public health and safety for water quality.

RELIABILITY AND EASE OF OPERATIONS

To provide operational flexibility, the new TWTP is able to isolate treatment of the respective water sources coming into the plant. This gives operators the flexibility to isolate or blend the two raw water sources as needed, optimizing chemical use and potentially saving costs. The inclusion of multiple chemical injection points throughout the treatment train also aids in operational flexibility. This feature, combined with strategically placed instrumentation, allows the city to quickly respond to significant variations in water source quality.

The new facility ties into an existing raw water and distribution system connected to the existing plant, so very little new pipe was required outside the footprint of the new plant. This arrangement allows for treatment processes to roughly follow existing grade, therefore minimizing the amount of excavation required and allowing for gravity flow through the facility.

The piping configuration at the plant is designed with enough space to accommodate the addition of a third water supply source in future years. All design layouts for treatment areas, storage and maintenance have been designed for easy access for operators and staff as well as convenient access for routine equipment maintenance.

TREATMENT PROCESS FOR IMPROVED WATER QUALITY

The TWTP is designed to treat the wide range in water quality provided by the city's multiple source waters. The raw water intake area is designed to allow for isolation or blending of the raw water sources before the water is sent to the pretreatment processes that reduce turbidity caused by smaller particles and condition the water for filtration.

Flash mixing, the first component of the pretreatment stage, involves injection of chemicals via a nozzle within the raw water pipeline to destabilize particles suspended within the water. From there, the water moves to the flocculation stage, a mixing process with three zones of decreasing intensity, allowing the destabilized particles to combine and form larger particles to more easily settle to the bottom.

Next, the water moves into a sedimentation zone with stainless steel plate settlers designed to separate solids via gravity. The plate settlers are designed with an incline to increase the settling rate for optimal separation. After flowing through the plates, the water is then ready for ozone injection in an intermediate treatment stage.

The ozone injection process addresses MIB and geosmin, naturally occurring compounds that are the primary cause of taste and odor within the raw water supply. The ozone oxidizes these and other organics as well as pharmaceutical compounds and algal toxins. Additionally, ozone provides disinfection that reduces the formation of chlorinated disinfection byproducts, if they are present.

Following the ozone injection, the water moves to a biological filtration stage consisting of granular media filters without chlorination or other compounds that could deter growth of the microscopic beneficial bacteria. Functioning similarly to conventional granular media filters, biological filtration is an additional treatment stage that typically is used within wastewater treatment facilities as a way of removing remaining impurities.

The final treatment stage is a chlorine disinfection process to remove Giardia lamblia, a microorganism that can cause intestinal distress if present in larger amounts, as well as viruses. The entire treatment process produces drinking water that exceeds existing state and federal water quality standards.

PROGRESSIVE DESIGN-BUILD

Faced with a strict budget and tight timeline, officials in Thornton quickly realized that a traditional design-bid-build approach would be unlikely to meet their needs. That's why they welcomed progressive design-build. With its inherent flexibility, the schedule would be expedited, with less time spent on the construction and design process.

With the costs of capital projects spiraling for many municipalities, collaborative project delivery methods like progressive design-build are increasingly emerging as effective ways to meet stakeholder needs. All those factors were in play in Thornton.

Beginning with pilot testing and engineering design in March 2017, the Burns & McDonnell and Garney project team began collaborating daily with Thornton staff and owner's adviser to identify and mitigate risks that could adversely affect the city's cost, schedule, and treatment goals.

The team presented multiple engineering design packages as part of the process for reaching agreement on the optimal design. Because of the flexibility of this design-build approach, foundation work began after only 60% of the design had been completed.

Substantial completion was reached in September 2020 and the TWTP began treating water for the community in November 2020.

WATER SECURITY FOR THE FUTURE

Utilizing ozone and biofiltration technology and other advanced treatment processes gives water utilities more options to innovatively resolve water quality issues. Having the ability to effectively treat water from multiple sources and consistently provide clean, great-tasting water to communities will be an invaluable asset to any city for decades to come.

BIOGRAPHY

JASON SCHAEFER, PE, serves as a Water Group department manager for Burns & McDonnell in the Rocky Mountain Region. He is responsible for managing, planning, designing and troubleshooting conventional and advanced water treatment facilities. He has experience with greenfield water treatment facilities and complex water treatment facility retrofits and expansion projects.

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