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Phoenix Poised to Deliver Even More Reliable Tap Water

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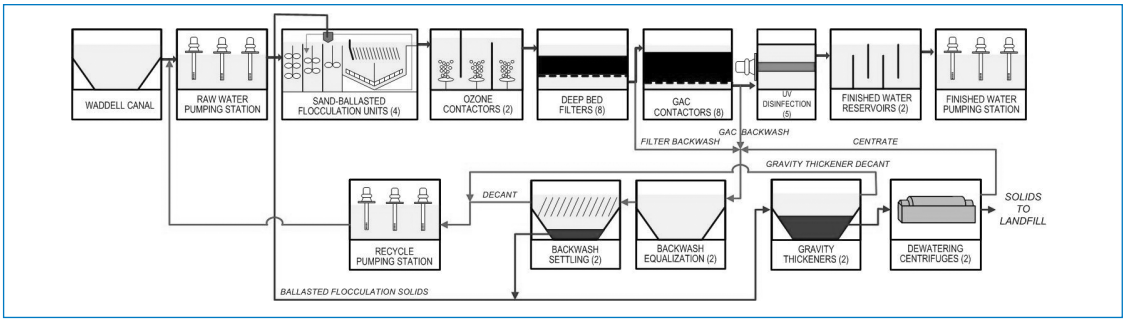
The City of Phoenix is about to take a leadership role in the water treatment industry, as evidenced by the design-build-operate (DBO) delivery of the new Lake Pleasant Water Treatment Plant (WTP), which features an array of advanced technologies. Currently the largest potable water DBO project in North America, the first phase of the Lake Pleasant WTP will deliver the highest quality, state-of-the-art drinking water to 400,000 households. The project stands out, not only for its scope and delivery method, but also, because the All American Water Team (AAWT) maintained the project schedule, within a fixed budget, while facing significant challenges, such as escalating materials costs and substantial labor shortages in the Phoenix area. Change orders were few during a 42-month design, permitting, and construction schedule. Construction started two months ahead of schedule as a result of phased permitting, resulting in a budget reduction of nearly $30 million for the City.

The Lake Pleasant WTP is nearing completion. Functional testing and commissioning commenced in the fall of 2006. Acceptance tests are scheduled for January 2007, at which time finished water will be delivered to the City system. When final completion is achieved in early 2007, a 15-year (plus five-year option) operations and maintenance contract will commence.

The water treatment and residuals handling facilities were designed with extreme flexibility, using many different treatment strategies. The resulting operational flexibility will allow the facility to meet all of its water quality goals regardless of the incoming water quality. DBO delivery has been successful in Phoenix, primarily due to the commitment of all parties to work together. In applying this partnering approach on a fixed price DBO, the outcome has been successful for all the stakeholders.



INCREASED WATER DEMANDS

The City of Phoenix is now the fifth largest in the U.S. Its population has expanded to more than 1.4 million residents today. The City began in the late 1990s to evaluate conceptual designs and delivery methods for a new water treatment facility that would serve the North Phoenix area and meet the standards of prevailing and future anticipated drinking water regulations.

The end result is the Lake Pleasant WTP, with an initial treatment capacity of 80 mgd, expandable in 80 mgd increments, to an ultimate capacity of 320 mgd. The Phase 1 project comprises a raw water

intake on the Central Arizona Project's (CAP) Waddell Canal, sized to handle the ultimate 320 mgd plant capacity, a raw water pumping station, two miles of 90-inch raw water transmission line, a multi-barrier treatment process train, on-site residuals treatment and handling facilities, two 20-mg buried reservoirs, a finished water pumping station, a 69 kVA substation, various chemical buildings, and an operations center.

Administration Building Rendering

FOUR DELIVERY METHODS EVALUATED

The City assembled a multi-disciplinary team of City staff and consultants to investigate alternative delivery methods. The team solicited opinions from contractors, consultants, manufacturers, citizens, and officials on which delivery methods to investigate in more depth. The City team conducted research on the various delivery methods in practice around the world today. After compiling the results of its surveys and research, the team selected four delivery approaches for more detailed review. These included:

- Traditional Design-Bid-Build (DBB) with City personnel operating the plant (Benchmark),
- Design-Build with City personnel operating the plant (DB),
- Design-Build-Operate with a third party operating the plant (DBO), and
- Purchase water from a privately-owned facility (Merchant Plant).

In the ensuing evaluation, the study team considered process elements, risks, level of City control, schedule, market availability and interest, permitting strategies, quality and reliability of delivered water, cost, and financing options. A benchmark design and cost benchmark using the traditional DBB approach was developed to determine what cost-savings could potentially be realized utilizing the DBO method of delivery.

DBO APPROACH SELECTED

The City team eventually concluded that the DBO approach met all of its goals for the project. Of particular interest was that DBO takes advantage of a team philosophy throughout design, permitting, construction, and operations. This would result in a design that utilized the combined experience of the City's Water Services Department Engineering and Operations staff, along with the DBO team's design, construction, and operations personnel to minimize capital and long-term operating costs and maximize design efficiency, constructability, and an operator-friendly approach to planning. Additionally, having the operator involved throughout ensured that care was taken during construction to provide facilities with a long service life that minimized short- and long-term maintenance requirements.

This required the Arizona State Legislation to create a legislative refinement to allow for alternative project delivery methods. This was followed by a financial and technical prequalification stage and a lengthy, 18-month, three-phase procurement process, which culminated when the City received three technical and cost proposals in November 2002. The proposals were evaluated and ranked by the City and its advisors. This ranking, combined with scores for both technical content and overall costs (capital, operating, and maintenance), allowed the City to rank proposals and select a successful respondent. The AAWT was awarded the $336 million contract in June 2003.

THE ALL AMERICAN WATER TEAM

The AAWT is comprised of American Water Services, Inc., as the prime contractor and operator; the American Water Works Company as project guarantor; and Black & Veatch Corporation/McCarthy Building Companies, Inc., in joint venture for the DB portion of work. Major subcontractors included Ames (earthwork); University Mechanical, Inc.; and Ludvik Electric, Inc.

ENHANCED WATER QUALITY GOALS

The service agreement requires the production of water that meets all requirements of the Safe Drinking Water Act (SDWA) plus some foreseeable future regulations. The agreement includes performance standards more stringent than the SDWA requirements for such parameters as alkalinity, aluminum, arsenic, bromate, calcium carbonate saturation index, biodegradable organic carbon, chlorine, total coliform organisms, true color, Cryptosporidium and Giardia, fluoride, geosmin and e-methyl isoborneol, trihalomethanes and haloacetic acids, iron and manganese, and turbidity.

Filters Deck

The challenge was to, in less than 42 months, develop a treatment process to achieve the enhanced water quality goals, meet the City's quality standards for

treatment facilities, be designed, permitted, constructed, commissioned, and pass rigorous acceptance tests.

Collaborative efforts commenced in 2001, during the procurement phase. Process experts from Black & Veatch and American Water developed treatment alternatives that, in turn, were reviewed and evaluated by McCarthy for cost and constructability, and by American Water for reliability, ease of operation, and cost of operation projected over the 15-year operations contract period. This collaboration continued during the entire project, where the AAWT has, with the City and its consultant, joined in a formal partnering approach, to allow early and amicable issue resolution.

OPTIMIZED CONSTRUCTION AND MINIMIZED COST THROUGH PROJECT STAGING

The AAWT developed a project schedule that included design, internal operational and construction reviews, City reviews, permitting (over 50 different permits from federal, state, and municipal entities), procurement, construction, start-up, commissioning and acceptance testing. The facility was divided into six areas so design and permitting could be staged to optimize construction, minimize cost, and satisfy regulatory authorities. This staging also allowed the construction to begin two months prior to the start date in the service agreement.

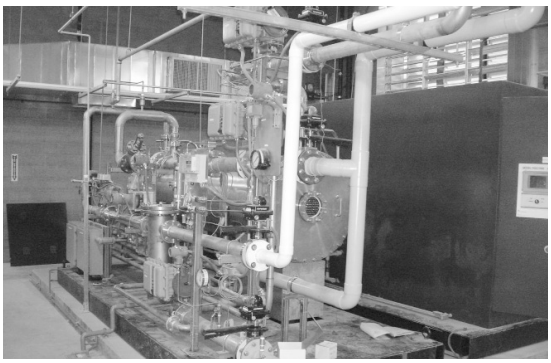
TECHNICAL INNOVATION RESULTS IN OPERATIONAL FLEXIBILITY

The Lake Pleasant WTP has a robust process design that employs multiple barriers for maximum operational flexibility and treatment of varying raw water qualities. The treatment includes a complement of processes not typically brought together in one facility in the U.S. The process configuration took advantage of the team's multiple perspectives on technologies and reduced the size and complexity of construction. It also afforded a plant layout that minimized impacts on the desert environment that was a service agreement requirement. Some highlights of the design include the following:

- Site layout was configured to minimize impacts on native washes and indigenous plant life, reducing permitting requirements and the consumption of open space, while allowing for future expansions. The landscaping and architecture was designed to match the natural environment, consistent with the Frank Lloyd Wright architectural philosophy. Extensive use of indigenous materials and native plants in the landscape design links the worlds of nature and man.
- Ballasted flocculation was selected for primary pretreatment because the high-rate process is robust, able to handle a wide variation in raw water influent quality, and requires a significantly smaller footprint than traditional sedimentation basins.
- Deep bed anthracite filters and granular activated carbon (GAC) contactors were combined in series to ensure maximum turbidity reduction and removal of naturally-occurring organic matter prior to disinfection.
- Ozone and ultraviolet radiation were included to add additional barriers to pathogenic compounds and reduce the chlorine disinfection demand, thus reducing the risk to the operations staff from large amounts of chlorine storage.
- Solids-thickening and dewatering via centrifuges provides on-site solids separation. Plant solids are transported off-site.
- GAC regeneration facility provides on-site carbon regeneration capabilities and an option for regeneration of activated carbon from other water treatment facilities.

This level of multiple-barrier process technology will allow the operator flexibility for developing optimum treatment strategies for maximum control of multiple parameters. For example, if removal of natural organic matter is optimized in the ballasted flocculation and ozone/biofiltration processes, organic loading on the GAC contactors will be reduced, and GAC will require replacement less frequently. Or, if the water periodically contains high bromide levels, ozone may require reduction or be turned off; in which case, GAC would provide primary control for taste and odor compounds.

Ballasted Flocculation



Ozone Generator