

Civil Engineering NEWS

PIPELINES

Colorado Utility Taps Dam for Drinking Water

IRONIC AS IT MAY SEEM, Colorado Springs, Colorado, named for a nearby water source, is now seeking more water from a reservoir dozens of miles away.

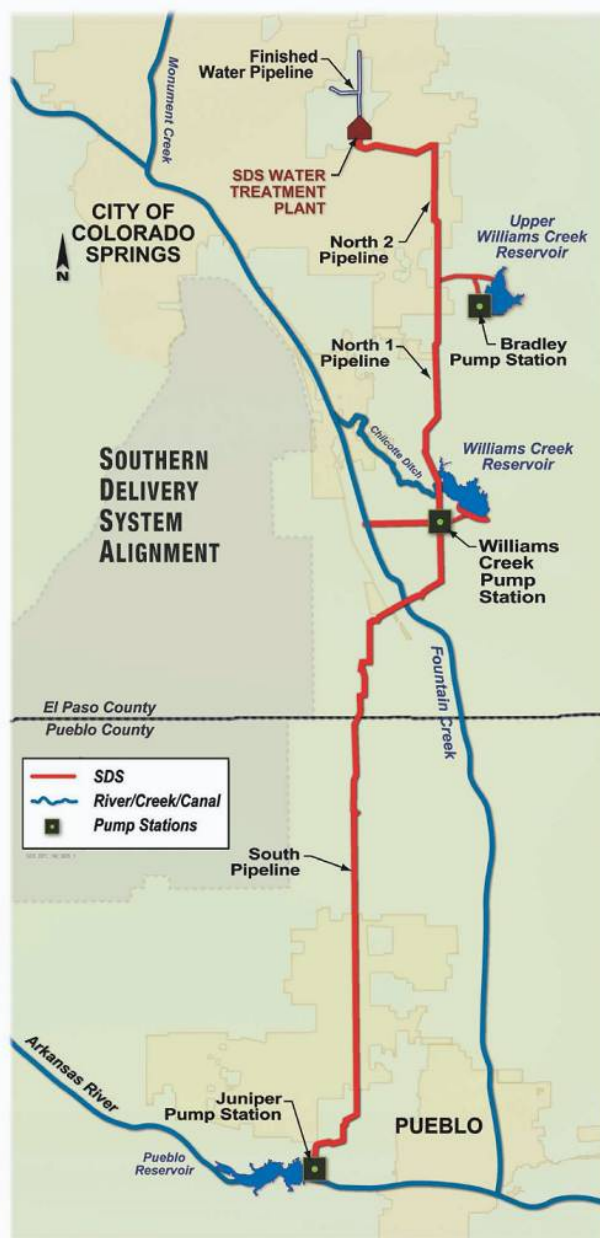
When Colorado Springs was founded, in 1871, its location in the foothills of the Rockies offered many natural advantages, with one notable exception: it lacked access to a major river. For that reason it has been transporting drinking water across long distances for more than half a century. Colorado Springs already relies on 25 reservoirs, four large pump stations, and some 200 mi of pipelines to collect water from sources as far as 100 mi west of the city.

Now the state's second-largest city, Colorado Springs is still growing, and so is its demand for drinking water. As its collection systems near capacity, the city finds itself in an unusual position, explains Dan Higgins, a project manager for Colorado Springs Utilities. The city owns water rights on the Arkansas River but at present has no means of collecting and delivering that water to customers.

Thanks to recently concluded negotiations between Colorado Springs Utilities and the U.S. Bureau of Reclamation, that situation is about to change. In late August the two agencies reached agreement on an approximately \$880-million effort to transport raw water northward through 62 mi of underground pipeline from the Pueblo Reservoir, which is formed by a dam—Pueblo Dam—on the Arkansas River, to Colorado Springs. The



The Southern Delivery System will collect raw water from the reservoir impounded by Pueblo Dam, on the Arkansas River, and deliver it to Colorado Springs, Colorado. A new connection to the existing river outlet works will divert a portion of the flow to the pipeline via a valve structure on a platform to be erected in the river. The remainder of the water will discharge to the river.



negotiations were necessary because the bureau manages the reservoir as part of a federal water project.

The new pipeline will originate at Pueblo Dam, a concrete structure with an earthen core built in the early 1970s. With a crest elevation of 4,925 ft, the dam impounds river water in a reservoir having a surface area of 5,664 acres and a total storage capacity of approximately 358,000 acre-ft. The pipeline will begin with a connection to the river outlet works, which take the form of two 4 by 4 ft sluice gates inside the dam that control the flow of water from the reservoir into the river.

At present, water entering the river outlet works flows from the reservoir into a rectangular channel on the upstream side of the dam that narrows gradually until it reaches the sluice gates. After passing through both gates, the water continues through another channel that widens as it leads to an 8 by 12 ft opening on the downstream side of the dam.

The new pipe will be attached to the downstream face of the second gate in the existing channel, so no new penetrations of the dam will be required, says Bruce Spiller, P.E., the principal engineer for the project for CH2M HILL, of Englewood, Colorado, which is designing the connection and other pieces of the project. At the attachment point, the pipeline will have a square cross section to match the dimensions of the sluice gates. That shape will give way to a circular cross section that will be 90 in. in diameter as it exits the dam. Because the rate of release could reach 80 ft/s, the pipe inside the dam will be made of stainless steel. "A coated liner would not survive those velocities," notes Spiller.

CH2M HILL, TOP; © 2009 CITY OF COLORADO SPRINGS FOR COLORADO SPRINGS UTILITIES, BOTTOM

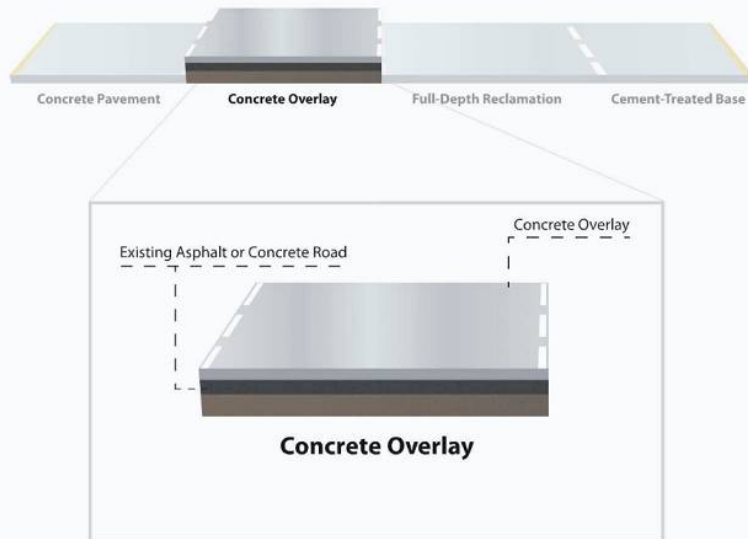
To optimize the size of the pipe and prevent any surprises during construction, CH2M HILL used high-definition surveying equipment to perform a laser scan of the channel inside the dam. The scan produced a three-dimensional model accurate to within $\frac{1}{16}$ in. "We did not want to rely exclusively on the as-built drawings, because our tolerances were going to be really tight," says Spiller. "We wanted our pipe to be as wide as it could be going through that tunnel."

When the connection is complete, the Bureau of Reclamation will continue to control the river discharge, but a portion of the flow will be diverted into the new conveyance system. The diverted water will first pass through a valve structure on a platform to be erected in the river and from there will proceed to the first of three new pump stations. The pipeline, most of which will be 66 in. in diameter, will then cross an interstate highway, a creek, and three railroads, increasing in elevation by some 1,800 ft as it makes its way to Colorado Springs. There the water will enter a new water treatment facility before being distributed to city residents.

The first phase of the project, referred to as the Southern Delivery System, includes the connection to Pueblo Dam, the pump stations, the pipeline, and the water treatment plant and is designed to deliver up to 50 mgd. A second phase, however, will include the construction of two new reservoirs capable of storing respectively 25,000 and 30,500 acre-ft. This second phase will also include upgrades to the pump stations and water treatment plant, and these improvements will increase system capacity to more than 100 mgd.

Construction work on the connection to Pueblo Dam and portions of the water distribution pipeline is expected to begin by the end of the year. The entire project is scheduled to begin delivering water to customers in 2016. Although Colorado Springs is the primary beneficiary, the Southern Delivery System is actually a regional project, notes Higgins, since it will also serve the smaller Colorado communities of Fountain, Security-Widefield, and Pueblo West. —JEFF L. BROWN

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BUSINESS BRIEF

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