Salt River Outfall Rehabilitation

City of Phoenix, Arizona

BC's Role in Project
Designer in a CMAR Delivery

Project Value
Total: $101 million

Project Dates
1999 - 2006

Brown and Caldwell

100% Environmental
Employee Owned
Offices Nationwide

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Brown and Caldwell (BC's) led the design of 35 critical large-diameter sewer rehabilitation projects as part of the Salt River Outfall (SRO) Rehabilitation program, which utilized a construction-management-at-risk (CMAR) delivery approach. As noted by *Trenchless Technology* magazine, the Salt River Outfall (SRO) project, which includes 22 miles of pipeline ranging from 48 to 90 inches in diameter, was one of the largest and most challenging projects of its type completed in the U.S.

Faced with high risk of failure in some sections within the SRO and the Southern Avenue Interceptor (SAI), this large and fast-tracked rehabilitation and replacement required construction to be conducted without interference with conveyance to the area's two large wastewater treatment plants, 91st Avenue WWTP and the 23rd Avenue WWTP. The 91st Avenue WWTP, the SRO and the SAI are operated by the City of Phoenix and owned by the Multi-City Sub-Regional Operating Group (SROG) comprised of the cities of Phoenix, Tempe, Mesa, Scottsdale and Glendale.

Prior to the rehabilitation efforts, BC provided condition assessment of 273,000 linear feet of pipeline and helped the SROG to prioritize areas of critical need. BC was chosen to lead the design of 35 prioritized CMAR projects in a 72,275 linear feet area of SRO with pipe diameters ranging from 48 to 90 inches and with a capacity of 170 mgd. Several different companies provided services as the CMAR under contract with the City.

SRO background. The SRO transports raw sewage for the cities of Mesa, Tempe, Scottsdale and Phoenix to the 91st Avenue WWTP. It was constructed prior to the early 1960s, and is made of unlined, reinforced concrete. The SRO has long sections of flat slopes and transports sewage with warm temperatures, sometimes in excess of 90 degrees. These conditions result in the conversion of hydrogen sulfide gas into corrosive sulfuric acid which forms on the crown of the pipe and causes severe corrosion that can lead to eventual pipe failure.

Rehabilitation design. To ensure development of the most cost effective project, an extensive investigation was conducted to identify design and construction issues including structural condition, sewage bypass requirements, public impact, and

alternative methods for rehabilitation.

A structural investigation was conducted and to develop site specific design criteria for use by the CMAR. Field investigations to identify the pipeline condition were conducted including geotechnical borings, closed circuit television inspection, and pipeline coring. The pipeline was analyzed as a rigid conduit using estimated load conditions corresponding to the current profile and soil cover. As-built drawings provided information pertaining to reinforcing size, spacing, location within the pipe wall, and wall thickness. The pipelines were analyzed to determine both the structural adequacy of the pipeline for continued service and the theoretical residual capacity before failure.

Alternative methods for rehabilitating the pipeline were investigated to ensure that the most beneficial application was selected. The alternatives were limited primarily to sliplining, Cured in Place Pipe (CIPP) and conventional dig and replace. Ultimately, due to the extensive corrosion and the need to retain the full capacity of the pipeline, the use of CIPP was recommended and selected.

Construction. During construction, community impact was to be minimized and normal traffic flow was to be maintained through the construction site. In addition, extensive investigation and evaluation was conducted to ensure that the bypass pumping operation created minimal odor. Odor control activities were required through the addition of ferric chloride and hydrogen peroxide based on historical levels of sulfides in the sewage.

Additional requirements and project limitations were developed to further define the project including the need to submit structural calculations for the liner, sampling and testing requirements for the liner, end seal requirements, chemical resistance requirements, CMAR qualifications, and specific issues associated with hot weather construction.

The total cost for the 35 CIPP projects was $101 million, which was slightly under SROG's budget. The project was completed slightly ahead of the owner's schedule as well.