While many Midwestern cities have suffered the effects of a declining population in recent years, Columbus, Ohio, has continued to grow. In fact, Columbus has surpassed Cleveland and Cincinnati to become the most populous city in the state.

To keep pace with the growth, and to meet stipulations of a consent decree, Columbus has embarked on a major sewer expansion program that includes major tunneling projects. Key components include the Big Walnut Augmentation/Rickenbacker Interceptor (BWARI) and the Big Walnut Outfall Augmentation Sewer (BWOAS). Along with other improvements including expanded treatment capacity, these projects comprise a 40-year, $2.5 billion capital improvements program that will reduce CSOs and SSOs and improve water quality.

Project Background

BWARI, the first major undertaking of the Wet Weather Management Plan, involved construction of four miles of 14-ft diameter lined interceptor sewer between the Alum Creek sanitary trunk sewer and the Southerly Wastewater Treatment Plant, as well as seven access shafts and several hundred feet of 14-ft square box section connecting the sewer with the new headworks of the plant.

Working primarily below the water table, the Jay Dee/Michels/Taylor Brothers joint venture employed a 16-ft di-
Also included in this project were five shafts (one working shaft and four access shafts), 5,000 lf of surface sewer and two 400-lf lengths of pipe jacking. The surface sewer work was completed by mid-2006 by open-cut method. Sub-contractor Complete General trenched 4,600 lf, 7 ft wide and 25 ft deep to install the Hobas 42-in pipe.

Tunneling halted approximately 2,500 lf along in order to maintenance the TBM and replace the seal on the articulation seals. During this break, the Lovat machine from BWARI holed into the working shaft on BWOAS. Once the BWARI TBM was clear of the shaft, the BWOAS machine was able to continue on its drive.

On Aug. 1, 2007, the TBM broke through into the recovery shaft, completing excavation on BWOAS.

**Lining the Tunnels**

Initial lining of the tunnels consisted of bolted, precast concrete segments. Because of the corrosive environment of the sewer, engineers specified a corrosion-resistant barrier as a final liner. Initially, a chemically attached PVC lining system was specified to provide this corrosion barrier. However, crews experienced problems with the installation of the PVC lining system, causing engineers to look for another solution.

The problem engineers faced was two-fold. First, they had to find a suitable product that would provide corrosion resistance with the tunnel, and second, they needed something that could be done quickly to maintain the schedule as best as possible.

After examining a number of different options, engineers decided to use an epoxy lining for the entire length of the two tunnels, as well as shafts and tie-ins. Eventually, they turned to Sauereisen, a manufacturer of corrosion-resistant materials for new construction and rehabilitation of concrete structures with a long history in the wastewater industry.

“Engineers were looking for materials that could provide long-term resistance to aggressive wastewater environments, especially hydrogen sulfide gas, which creates a very aggressive chemical environment,” said Lake Barrett, area manager for Sauereisen. “The Sauereisen product has excellent resistance, which does not allow chemicals, acids and gases to permeate through the system and attack it.”

The Joy Dee/Michels/Taylor Brothers joint venture, the contractor for the BWARI project, was retained to oversee the lining on BWARI and BWOAS. BWOAS was also slated to be lined with the PVC sheeting, but was unwilled until officials found an alternate liner. The lining of the tunnels was subcontracted to Martin Painting Inc.

To boost productivity, crews used a spray-applied polymer in the tunnel when applicable. In cases where spray-applied lining was not practical, such as connections between shafts and the mainlines, crews used a trowel-applied product. The products used were Sauereisen’s SewerGard No. 210 S (sprayable) and SewerGard No. 210 T (trowelable), both designed to protect concrete from chemical attack. When cured, these products provide an impermeable, high-strength corrosion resistant product lining for areas exposed to hydrogen sulfide gas. Additionally, a layer of SewerGard G Glaze was placed over the lining to provide extra protection.

The tunnel lining process consisted of three steps. First, a crew prepared the concrete segments using SSPC and ICRI industry standards. Following the prep crew, another crew came in did restoration work, including filling voids in the seams and bolt pockets of the segments. A final crew followed and applied the product using a Peerless pump. In areas identified as scour zones by engineers, the trowelable product was applied.

In all, crews covered 200,000 sq ft of concrete, reaching peak production of 8,000-9,000 ft per day within the tunnels. All lining work was completed by late February 2010.

“This is one of the first projects completed using this lining systems within a segmented tunnel,” said Steve Kelso, Sauereisen project manager. “This was a project that was very problematic with the previous lining system, but the owner was able to find an alternate long-term solution for the problem.”

Jim Rush is editor of TBM.