City of St. Peter Interceptor Project Wins Merit Award

The Minnesota Society of Professional Engineers has awarded a 2004 Merit Award to the City of St. Peter and Bolton & Menk, Inc.

While explosives ripped through the solid sandstone bedrock 27 feet beneath a historic residential neighborhood of St. Peter, MN, seismic measurements showed that the blasting was less noticeable to nearby residents than the large machinery operating outside their homes. Consulting engineers Bolton & Menk, Inc., exhibited true ingenuity in the design and coordination of an 1800-foot tunnel blasted beneath the city by Lametti & Sons, Inc., to install a new sewer interceptor, while causing only minimal inconvenience to the city's residents.

A sanitary sewer interceptor is a major sewer line that receives wastewater from collector sewers. It is the main line into which 70% of St. Peter's private service connections flow. The city contracted with Bolton & Menk in 1999 to install a new interceptor in order to reduce the amount of inflow and infiltration the old system was taking on. Inflow and infiltration is water that enters sewer systems through deteriorated pipes. St. Peter's old sewer interceptor was constructed in the early 1960s, and because of its parallel alignment to the nearby Minnesota River, it was threatened by the river's meandering path and rising flood plain. Rising water levels in the river were a significant contributor to the inflow and infiltration problem.

The construction of the 1800-foot tunnel through solid bedrock 27 feet under an existing alleyway between Highway 169 and the river required a combination of advanced engineering skills and techniques. Open-cut excavation was not an option for this project due to the extreme depths and a mere 20 feet of right-of-way.

Bolton & Menk's solution was a series of jacking pits augured into the bedrock at 730-foot intervals. They were staggered along the streets in a pattern designed to minimize traffic disruption on the surface. These pits were 10 feet in diameter and provided an opening through which the interceptor pipe sections could be lowered into the tunnel.

Lametti & Sons chose to use a three-step process to excavate the tunnel. First, high-pressure (8,000 psi) water was used to carve a three-by-five-foot dome-shaped perimeter. Secondly, a cross pattern of holes was drilled into the perimeter, stuffed with explosives and charged. The third step involved a high-powered vacuum truck to remove the resulting sandstone debris.

An average day saw 15 feet of progress until the full 1,800-foot tunnel was realized. Because so much of the project occurred in historic residential neighborhoods, seismic measurements were taken in residents' basements while blasting to limit liability claims. As the progress of tunneling continued, so did the seepage of water through the tunnel walls. Continual de-watering of the tunnel was accomplished by pumping the water up a 27-foot vertical shaft into the city's storm sewer system. Air quality was continually monitored to make sure acceptable levels were maintained in the tunnel.

Large diameter (27”) interceptor pipes were individually lowered into the jacking pits, placed on a sled and pulled to the opposite end of the tunnel. Offset bends were used inside the jacking pits to maintain gravity flows. Once all the pipes were placed within laser tolerance, the pipe was capped, filled with water and strapped to the tunnel floor to prevent it from floating from extreme buoyant forces. Finally, the void between the tunnel wall and pipe was pumped full of lightweight foam concrete slurry. Four-inch vent pipes were suspended from the tunnel ceiling to release trapped air. The tunneling, de-watering, pipe placement and grouting techniques brought together a unique blending of engineering skills and tactics.

St. Peter's interceptor project presented another complex challenge: the city had to maintain the existing sanitary flow of 3,000 gallons per minute while construction of the new system was underway. Plus, the flow needed to be directed to both the existing lift station and to the city's new wastewater treatment plant while the new plant was being tested.

The strategy to maintain the constant flow of sewage involved a series of sluice gates at 30-foot depths, phased construction, complex bypass pumping, and connecting to a combined sanitary/storm tunnel encased in solid rock and concrete built in the 1930s. The sluice gates were strategically placed along the pipe and could be opened and shut to divert sewage flows to either the old lift station or the new plant. Phasing construction reduced bypass pumping but required construction to "leapfrog" to accommodate live lines. Bypass lines were run through existing storm culverts under Highway 169 to minimize pumping distances. Protective contingency measures such as backup generators and pumps were always on site. In order to make the difficult connection to the combined sanitary/storm tunnel, a massive 30-foot trench was dug. The connection itself required extensive handwork. All these factors added a high degree of engineering complexity to the project.

In addition, the new interceptor made it possible to abandon the old sedimentation ponds, which had a tendency to flood and spill raw sewage into the Minnesota River. With the construction of a new wastewater treatment plant and the new interceptor, the old sedimentation ponds and lift station could be converted to a storm water treatment system to treat storm water before it is released into the Minnesota River.

The project met St. Peter's goal of reducing inflow and infiltration by creating a new, efficient alignment for the interceptor and also offered an opportunity to replace existing clay, asbestos and cast iron sanitary service lines. The city has already benefited from decreased flow rates due to the reduction of inflow and infiltration.

The St. Peter interceptor project contributed to the growth and advancement of the engineering profession by proving that major infrastructure improvements can be made in the heart of a city with minimal impact to the surrounding residents. Great efforts were made to finish the project within one year and to minimize inconvenient street detours. Phased construction limited the number of closed roads at any one time to oblige city residents. The project allowed city residents to witness a major infrastructure improvement that had little effect on their daily lives, resulting in a real appreciation for the value of the careful planning and creative problem solving that the engineers brought to the project.