Culvert rehabilitation in three easy steps
Centrifugally cast concrete pipe performs well a year after installation

By Angus Stocking

Lake City, in Clayton County, Ga., is part of the Atlanta metro core and parts are very densely populated. More to the point, and like most urban areas, density has increased in most areas, and new construction has overgrown some existing underground assets. This makes rehabilitation of existing infrastructure a challenging proposition. This was certainly the case when the Forest Parkway culvert failed. The 66-inch corrugated metal pipe was 20 feet deep, 220 feet long, and failing so dramatically, that parking lots and commercial buildings overhead were subsiding noticeably and had to be monitored throughout subsequent rehabilitation. Inspection revealed completely corroded inverts, sidewalls that were curling up into the pipe interior, and some collapsed pipe.

After discovery, the failure accelerated. “From quote to award, the culvert had collapsed even further,” says Anita Clyne, president of Utility Asset Management Inc. of Reynolds, Ga., a licensed utility contractor specializing in trenchless technologies for manhole and sewer construction and rehabilitation. “That's when we realized typical procedures wouldn't be enough for this project.”

“It wasn't a surprise,” agrees Terry Moy, PE, program management and engineering manager for the Clayton County Water Authority (CCWA) and an active member of the American Society of Civil Engineers' Pipeline Division. “We’d identified it for rehabilitation a year before and were working through access and business impacts with property owners, but increased storm runoff accelerated the migration of the backfill around the pipe. This eliminated the possibility of a cured-in-place solution.”

Surprise or not, it was almost a worst-case scenario:

• The pipe was no longer reliably supporting overhead soil, so just being in it was unsafe.
• There were commercial buildings directly over the culvert, so trenching was out of the question.
• Capacity couldn’t be reduced significantly. Slipping and other minimally invasive procedures were ruled out.

Tedious but effective

Eventually, Utility Asset Management developed a two-phase procedure that was slow and difficult, but effective.

Phase one: Fifty-four-inch tunnel liner plates were used to stabilize the culvert structurally. These are four-part steel rings, 18 inches wide, which were assembled within the pipe.
“First, we had to cut out curled-in pieces of the old culvert by hand,” Clyne says. “Then we assembled the liner plates inside the culvert section by section. Basically, we were building a new pipe 18 inches at a time. Meanwhile, cars and trucks were driving by in the parking lot above us.”

The liner plates’ four arched sections were bolted together manually. Each completed section created a new 18-inch safe zone for workers, who then repeated the process 146 times.

After the new, bolted-together “tunnel” was completed, the void between the liner plates and what was left of the existing pipe was filled with injected grout—and yes, that was expensive. It was tedious work in a cramped space but it was safe and effective. The phase was completed without injury and no further subsidence of overhead buildings. The culvert was at least stable.

Five-four-inch tunnel liner plates were used to stabilize the culvert structurally.

Phase two: The plates have interior flanges about 1.5 inches thick that give purchase to the bolts holding the arced plates together and allow sections to be bolted together.

To create a smooth, watertight, structurally sound pipe within the new tunnel liner plates and to smooth out the corrugations created by flanges, Utility Asset Management used a relatively new trenchless repair technology, developed by AP/M Permaform, called CentriPipe. CentriPipe is centrifugally cast concrete pipe (CCCP) that relies on a computer-controlled spincaster that’s inserted into round, large-diameter pipes, spraying on thin layers of high-strength cementitious grout as it’s pulled back through the pipe at precisely calculated speeds. (For more information, see page 28 of the 2013 Public Works Manual.)

The contractor began by hand-troweling grout to fill in flange gaps, and to create a smooth invert so that the spincaster could be pulled back without jerking. An engineered, 1-inch thickness of AP/M Permaform’s PL-8000 high-strength grout was then applied, completing rehabilitation.

The process basically created a new concrete pipe within the new tunnel liner plates. Since both are structurally sound, and the PL-8000 adheres to steel and most pipe materials, the combination of tunnel plates and new pipe is exceptionally sturdy and will last indefinitely.

Preventing future failure

There was a third phase. The dramatic failure of the pipe was largely due to extremely unstable surrounding soil.

“This was basically the unregulated piping of a live stream,” Moy explains. “The lack of engineering led to a lot of water flow around the pipe and large soil voids.”

To prevent similar problems for the rehabilitated culvert, county engineers called for stabilization of the surrounding soil with cementitious grout injected until refusal. (For more information on cementitious grout, see page 68 of the 2013 Public Works Manual.)

“It came to a lot of grout,” says Moy. “Picture a box big enough for a pickup truck. About three of those were pumped in.”

To ensure quality, the county had very tight project specifications, applied normal inspection procedures, and contracted with an independent geotechnical firm for onsite representatives. After a year, the project is performing well.

“It’s hard to say you’re happy with an unplanned project that ran to almost $400,000,” says Moy. “But we recognize the value of this solution over others that were considered, and we’re happy that we were spared possible construction impacts, such as trenching.”

The work was procured as a request for proposal (RFP) and was performance-based to allow innovative approaches that minimized construction time and site impacts to businesses.

“Centrifugally cast pipe is proving to be a viable solution,” he says. “Together with the tunnel plates and grout injection, it was certainly effective for us.”

Angus Stocking is a licensed land surveyor who has been writing about infrastructure since 2001. E-mail sjohnston@hanleywood.com your experiences with centrifugally cast concrete pipe.