

# Trenchless TECHNOLOGY. REHAB SHOWCASE™

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Products & Innovations for the Rehabilitation of Pipelines Using Trenchless Technology

## CIPP Used to Successfully Reline Storm Sewers in Oil City, Pa.

As sink holes developed in homeowners' backyards, the City of Oil City, Pa., public works director Miles Truitt and public works foreman Robert Craft knew that a major storm sewer was failing because of extensive structural problems.

Being in a residential neighborhood, the sewer ran near and even underneath homes, making city officials turned to Malcolm Pirnie for a solution. The storm sewer, located in the vicinity of Cowell Avenue, included three reaches: 1) The upstream reach, 250 ft of 24-in. diameter line, ran from a headwall to a manhole in Cowell Avenue; 2) the middle reach, 814 ft of 30-in. diameter storm sewer, had no immediate manholes or access points and — worse — had a 67.5

ft vertical drop between its upstream and downstream manholes; and 3) the last reach, 159 ft of 36-in. diameter storm sewer, discharged to an open channel. After evaluating numerous alternatives, topography and terrain features forced Malcolm Pirnie and the City of Oil City to rule out excavation as a means of repair. As the sewer lines were televised to reveal the dam-

age, finding a solution that did not include some type of excavation seemed to be an impossible challenge.

Malcolm Pirnie and the City of Oil City eventually decided that the best alternative to rehabilitate the Cowell Avenue storm sewer was to install a cured-in-place pipe (CIPP) liner.

Malcolm Pirnie prepared bidding documents and the contract was eventually awarded to Insight Pipe Contracting L.P., Harmony, Pa. Insight contracted Premier Pipe as its main supplier for the project. Insight Pipe and Premier Pipe selected Applied Felts, the industry's only ISO-9001: 2000 certified manufacturer focusing solely on the production of felt liners, because of Applied's technical expertise, product improvement innovations and develop-

ment and experience with custom liners required for this type of storm sewer relining job.

The sinkholes were along the 30-in. diameter vitrified clay pipe (VCP) middle reach. The upstream 24-in. diameter reach and the downstream 36-in. diameter reach also had serious structural damage. All three reaches of storm sewer had numerous cracks and void areas in the pipe; in



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Supplement to *Trenchless Technology*

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addition, the 36-in. reinforced concrete pipe (RCP) storm sewer had a severely separated joint, and the 814-ft, 30-in. VCP storm sewer had a severely collapsed section with an ovality greater than 10 percent. The collapsed section corresponded to a sinkhole in a homeowner's yard. At a depth of approximately 35 ft, excavation for repairs would have been extremely difficult and costly, as well as invasive to residents.

During the pre-construction meeting, the team verified the design and installation parameters. The team also determined where the pipe ID transitioned and where corresponding liner transitions should be provided.

### **CIPP Relining of the 24-in. Storm Sewer**

Accessing the 24-in. reach for CIPP relining was via an easement — only 10 ft wide — between houses. In addition a steep, muddy slope near the inversion staging area made setting up the 24-in. shooter and bypass pumps difficult. The slope of the sewer was 5.2 percent (a 13-ft drop along 250 ft of pipe, which increased the difficulty of designing and installing the liner, compared to a flatter reach). Finally, transporting the liner to the inversion point was a challenge because of site access.

Due to the narrow easement and steep, muddy slope, the team used a tracked, low-ground pressure transport vehicle to move the lining materials and equipment to the inversion point. Insight Pipe foreman Marty Gibson borrowed the latest, state-of-the-art, 24-in. air/water shooter from a fellow Premier-Pipe licensed installer, Michels Pipeline Construction, New Berlin, Wis. For curing, steam lines were run from a steam truck parked about a 150 ft away on Cowell Avenue to the steam dome at the inversion point. The 24-in. liner was designed with a 12-mm thickness — thick enough to serve as a stand-alone, tight-fitting pipe-within-a-pipe capable of structurally rehabilitating the existing pipe while maximizing hydraulic capacity.

### **CIPP Relining of the 30-in. Storm Sewer**

Lining the 30-in. diameter, 814-ft VCP pipe was by far the most challenging reach of the project. At the 12 o'clock position in the collapsed portion of this reach



*Malcom Pirnie and the City of Oil City, Pa., decided that the best alternative to rehabilitate the Cowell Avenue storm sewer was to install a cured-in-place pipe liner. Three storm sewers of 24-, 30- and 36-in. diameters were CIPP lined.*

was a 2-sq. ft hole. The inversion manhole was in the center of a residential street requiring that the liner be installed at a 180-degree angle. The length and weight of the liner required a crane to assist the inversion process. The inversion manhole was approximately 16 ft deep and only 24 in. in diameter for the first 8 ft — and yet it was necessary to install a 30-in. liner through it. There were no intermediate manholes along the reach, and the line had a slope of 8.3

percent (67.5 ft drop over 814 ft).

The work was performed in December 2004, when heavy rains could have wreaked havoc on bypass pumping during the CIPP liner inversion and curing. Therefore, the team installed the liners during a “dry weather” period.

The steep slope in the 30-in. reach required considerable shoring in the downstream manhole. The liner was manufactured with increasing thickness along its length so that the required finished thickness was achieved throughout the reach. This increased liner thickness was needed to compensate for the increasing hydrostatic head along the length of the liner during inversion and curing.

A custom-made hold-back system was developed for the 30-in. liner, strong enough to control the speed of the inversion and hold back increasing weight during inversion. During inversion and curing, the downstream end of the liner was subject to 30 psi of pressure — equal to approximately 20,700 lbs of force.

Controlling the speed of inversion was critical for the liner transitions to coincide with changes in the pipe diameter at the collapsed point. Fortunately, this worked out well because it was necessary to cut out only a few feet of turn back needed at the downstream manhole, and more turn back would typically be expected in an installation with such a steep slope.

A few hours into the “cook” of the 30-in. liner, re-circulation problems developed on the boiler truck. Insight immediately contacted AM-Liner East, a fellow Premier-Pipe installer, and arranged for one of its boilers to finish the cure. By the time AM-Liner's boiler arrived, the re-circulation issue in Insight's boiler was corrected and both boilers were used to accelerate the liner cure time.

The 30-in. diameter, 26-mm thick, 814-ft CIPP liner was water-inverted and hot water cured. Insight Pipe conducted a reverse taper at the inversion end of the liner to invert through the 24-in. diameter upstream manhole. Because of the length, vertical drop and ovality of the collapsed portion of the pipe the liner was custom designed at the request of Malcolm Pirnie to transition from 23 to 30 in. to 26 and back to 30 in. along its length. Also, the liner thickness increased from 24 to 36 mm to compensate for the collapsed section and the large hydrostatic head at the downstream manhole.

### **CIPP Relining of the 36-in. Storm Sewer**

Most contractors would not consider it feasible to invert a 36-in. diameter liner into a 24-in. diameter manhole — but this was necessary to line the third reach. Also, the 37-ft depth of the inversion manhole had the potential to pose significant suction lift problems to bypass pump water out of the inversion manhole. Hydraulic pumps were used in the past to overcome these severe suction lift requirements. However, bypass pumping from the upper 24- and 30-in. lines eliminated the need for bypass pumping in the 36-in. reach.

The inversion manhole for the 36-in. diameter line was located in vegetation by the side of a road. Because of the way the refrigeration truck needed to be staged at the inversion manhole, the liner needed to be turned 90 degrees during the inversion process to ensure proper alignment. The inversion manhole was 37 ft deep with the first 10 to 12 ft being 24 in. in diameter. The end of the 36-in. diameter reach discharged into an open channel 10 ft below. Installing a steam shoe on the open outlet would be challenging. Finally, like the two upper reaches, the 36-in. line was also on a steep slope: 9.1 percent (14.5 ft drop along 159 ft of pipe).

The 36-in. diameter, 26-mm thick, 159-ft CIPP liner was water inverted and steam cured. Insight conducted a reverse taper at the inversion end to invert it into the 24-in. diameter manhole. Because there was no downstream manhole, a water cure for the liner would have been difficult because there was nothing to which end-stop blockings could be attached. A steam dome was fabricated and attached to the downstream end of the liner for steam curing. A tracked vehicle was utilized to access the downstream end of the pipe to install the steam shoe. The liner was successfully installed at the end of the first week of December 2004.

### **Summary of Success**

Insight Pipe completed rehabilitation of the Cowell Avenue storm sewer in nine weeks. Utilizing the technical resources of Premier-Pipe, Applied Felts and Malcolm Pirnie, the best custom liners and installation procedures were developed for these challenging conditions.

"The City is very pleased with the successful outcome of the project. We commend the expertise of the project team in overcoming the significant challenges of the project to provide a structurally sound pipe, within the project budget and with minimal disruptions to area residents," said Christina Sporer, P.E., engineer for the City of Oil City.

As a result of the work, The City of Oil City now has a stand-alone pipe-within-a-pipe that has an expected life of at least 50 years, while maximizing hydraulic capacity. In addition, property owners along Cowell Avenue are no longer disturbed by sinkholes.

"By combining the entire team's extensive knowledge and expertise in the relining industry, we were able to find an effective solution to what many felt was an impossible undertaking," explained Insight's foreman Marty Gibson.

*Rhonda Bergeron is president and owner of E\*magine Public Relations, based in Leesburg, Va.*

## **Meet the Team**

*The City of Oil City, Pa., implemented the project and obtained easements and permits for the work. The city also coordinated with residents of the work area before and during construction.*

*Malcolm Pirnie engineers worked with the Oil City officials to identify the most cost-effective and resident-friendly method for rehabilitating the Cowell Avenue storm sewer, prepared bidding/construction documents and provided construction oversight. Rehabilitation methods considered were: dig and replace; install an alternatively routed line and fill up the existing line; pipe bursting; slip lining; and CIPP. CIPP was determined to be the most cost-effective and neighbor-friendly repair option.*

*Insight Pipe Contracting L.P. was the prime contractor and performed: preparatory line cleaning and television work; repaired holes in all three line segments with cementitious grout; wet-out the liners; set up bypass pumping; installed the liners; post-televised the CIPP lined reaches; and performed site restoration.*

*JWM Environmental Inc./Premier-Pipe USA provided technical advice on the liner installation approach and materials. JWM was also present during the installation of the 30-in. line to provide oversight and advice.*

*Applied Felts furnished the liners for the project. General manager Charlie Mattox provided technical expertise on manufacture of the liner and its characteristics and his expertise was employed in designing the multi-layer liners.*



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