Eversource Evaluates Trenchless Technology

Route 140 Bridge Crossing Showcases Benefits of CIPL

By: Sean Wang & Dan Schadt, Eversource

RESEARCHING THE TECHNOLOGY

As a part of Eversource's Gas Engineer Cohort program we were paired up with a fellow cohort and presented a list of potential topics for a capstone project. We had no idea the long, arduous yet rewarding journey ours would take us on, culminating in a pilot project and now a full-fledged program being utilized by Eversource.

We were assigned the topic of rehabilitation of large diameter (16-inch+) cast iron pipe, with a focus on Progressive Pipeline Management's (PPM) Cured-in-Place-Lining (CIPL). From the viewpoints of people who had been in the gas utility business for less than 3 weeks at that point, we didn't understand why we were rehabilitating large diameter cast iron when we could 'simply' replace them with new coated steel or plastic mains. However, once we began researching trenchless technologies and their applications, we quickly realized how invaluable trenchless technologies were for a utility looking to ensure safe operations, repair leaks and reduce emissions.

We were fortunate to be supported by John Leskow, an Eversource Principal Engineer and our project mentor, for the entirety of the project. Although we had never seen the process in action, John had been able to observe it on a project in Rhode Island and emphasized the importance of the technology and its potential for use in Eversource's future.

In December of 2022, we took a trip to New Jersey to observe PPM install CIPL into approximately 950 feet of a 20-inch cast iron pipeline for PSE&G. Braving the cold weather, we were able to learn a considerable amount about the process and take a lot of pictures which would end up becoming extremely useful for our final capstone presentation.

For our capstone presentation, we took the stance that trenchless technologies should become a part of Eversource's portfolio of solutions in improving safety, reliability, repairing leaks and reducing fugitive emissions. We compared CIPL against traditional open cut replacement and external joint sealing in 4 different categories: Safety, Customer Satisfaction, Environmental Impact and Cost. In our comparisons, we found that in specific situations and locations, these trenchless technologies are the most favorable option meaning that while there is no one size fits all solution, they can certainly be an extremely useful tool when options are limited.

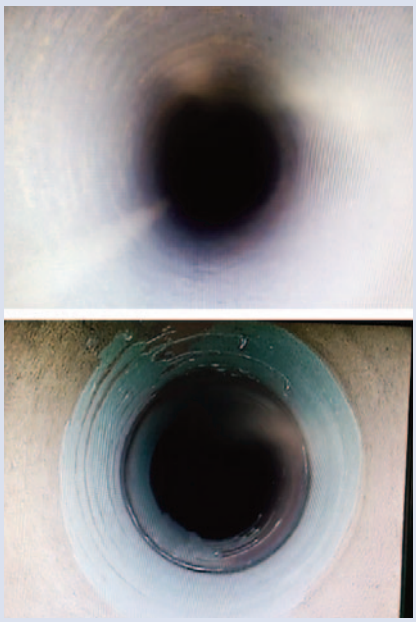
The shoring box used during the project. The shoring boxes are inconvenient as they split the pit into 2 which make it difficult to maneuver personnel and the inversion tube.

When we began our project, we were focusing on the rehabilitation of large diameter cast iron because that has traditionally been one of the costliest to repair of our leak-prone assets in our portfolio. We quickly found that New England, having such an old infrastructure system, still contains many miles of cast iron to rehabilitate or replace. However, these large diameter cast-iron mains maintained by Eversource are mostly located in densely populated territories such as Cambridge, Somerville, Worcester, and Springfield, which makes lining projects difficult due to the number and density of services. When looking for possible projects to propose for the presentation, we were introduced to a leaky segment of 8-inch Steel HP pipe going across a bridge in Duxbury by Eversource Lead Engineer, Richard Salvarezza. The pipe on the bridge is crossing a heavily traveled Route 3, and had extensive corrosion due to pouring water from a road drain above the main, and during the winter months, road salt, directly onto the pipe.

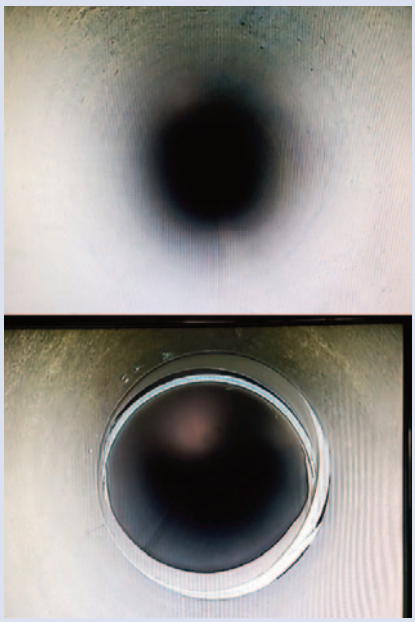
PUTTING THE PROJECT INTO MOTION

As we began discussions on the Duxbury bridge crossing and the major stakeholders became informed about the project, we were informed about a 6-inch Coated Steel HP bridge crossing on Route 140 that ran over Interstate 495 in Mansfield. This bridge crossing was classified as a class 2 leak and required urgent repair as gas odor was smelled from over 100 feet away. It is a particularly difficult location to perform the required repairs or replace the pipe due to its proximity to freeway ramps and being within a mile of the Xfinity Center Concert Venue. Additionally, with Route 140 being a state road, state permitting would be a requirement. These constraints, along with the difficulty of replacing or remediating pipe on bridges through the abutment wall, made this bridge a great opportunity to showcase the benefits of CIPL.

Internally, we discussed the possibility of using CIPL to repair the current leak and rehabilitate the pipe to prevent any future leaks and we followed that up with a site walk with PPM to discuss the viability of the project. After these preparatory discussions, we moved forward with the decision to design and schedule the project. Our biggest concern was with the schedule, as with any work performed in this area, we would need to avoid conflicts with any events being held at the Xfinity Center. As luck would have it, we found a 2-week gap between concerts where we hoped to be able to prep, line, pressure test and tie-in the pipe. After overcoming some minor hurdles, all that was left to do was order the materials and complete the project.



Pre-clean inspection of the pipe at the bridge abutment.



Camera inspection after cleaning was done of the pipe at the bridge abutment.

"We quickly realized how invaluable trenchless technologies were!"

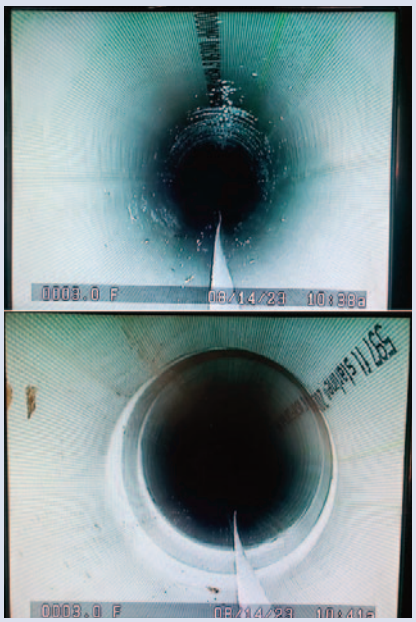
As our scheduled dates drew closer, the weather report grew more ominous with heavy rain threatening to derail the timeframe. We determined that with our limited options for alternative schedules and with the quick time frame that PPM proposed completing the lining process, it was worth it to push forward.

Before PPM could begin the lining process, Eversource crews worked for 2 days to excavate the proposed pits and prep the pipe in the bridge to begin purging. Mueller linestops were used on both sides of the bridge and the pits were dug to PPM's specified dimensions to allow for the inversion of the liner. The morning of August 10, 2023, we were finally ready for PPM to begin running their procedure. Eversource crews reopened the excavations, removed the end caps on the project pipe and installed end caps on the live ends of the pipe before turning the pipe over to PPM to begin their cleaning process.

Once Eversource crews turned over the pits, PPM technicians quickly got to work prepping to inspect and clean the pipe. The first entry into the pipe was made by a camera rover to perform a pre-cleaning inspection of the pipe. The pre-cleaning inspection is to determine problem spots in either the pipe geometry or characteristics of the pipe that will prevent the lining project from going smoothly. As seen in Figures 1 and 2, the interior of this pipe was relatively clean due to it being part of a high-pressure system.

After inspection, the sand blaster was deployed to clean the pipe walls, so that the liner could adhere properly to the pipe wall. Due to the segment of pipe being just under 500 feet, all entries into the pipe were able to be performed through a singular pit. There was potentially an opportunity to perform cleaning and lining on the same day but with heavy rain looming on the radar, the decision was made to postpone the lining until the following day to ensure that the project was completed in a safe and proper manner.

The next morning, the PPM technicians began preparing the adhesive and liner for the job. The wet-out prep process was completed in roughly 2 hours, and the inversion cone was secured to the fitting that had been installed on the host



Photos taken from the inspection after the liner had cured in the pipe over the weekend. (Photos courtesy of PPM)

pipe the day prior. PPM then proceeded to pressurize the annular space causing the liner to begin inverting and adhering to the inside of the 6-inch pipe. The entire lining process was completed in 2 days, which helped us prove why lining was the correct choice for this project.

After the segment of pipe was lined, the liner was left in place under pressure to allow the adhesive to properly cure before the final pressure test is conducted. Following the successful completion of the pressure test, the lined pipe was ready to be gassed in. Eversource crews completed the tie-ins/activations on Monday night. The pipe was back online less than a week from when the excavations on Route 140 began.

The project was a success in the eyes of Eversource. Even with the challenges of scheduling and the occurrence of inclement weather, thanks to the coordination and communication between Eversource and PPM and the hard work of all the technicians involved, the project was still able to be completed within a week.

ADJUSTMENTS AND POTENTIAL FOR FUTURE PROJECTS

From an operational point of view, the Route 140 Bridge lining in Mansfield was a success. Director of Maintenance at Eversource, Dan Henry, had some ideas for future lining projects such as planning to use engineered timber shoring as opposed to the shoring boxes seen in the pictures above. The benefits of using the timber shoring over shoring boxes is to keep the center of the trench open. If shoring boxes are used, the entry and exit pits will be split in two, hindering the movement of the technicians and the alignment of the inversion tube. Timber shoring can also be adapted based on depth of main and location to be made flush with the road. This will allow crews to lay plates over the pits overnight making the project easier operationally and saving time otherwise required for backfill and paving.

Although Dan Henry does not see CIPL taking the place of pipeline replacement,

he does see it continuing to fill a niche in future work. It will be a useful tool for remediating pipe that would require significant work and expenses otherwise, such as rail and bridge crossings. CIPL saves the utility company in permitting expenses, as most permit costs are directly related to the paving area for the restoration of the road or sidewalk. The excavated pits required for lining are significantly smaller than the excavated area for direct replacement, therefore the permitting costs are significantly smaller.

CONCLUSIONS

Since the completion of the project in Mansfield, Eversource has held discussions with PPM to discuss future projects. Eversource has found potential projects ranging from 4 to 18 inch diameters of various metallic pipes for lining. We have determined that pipe lining is a great solution for projects like bridge and railroad crossings as it reduces the work in railroad Right of Ways, lowers the amount of work and time required to complete the project in comparison to direct replacement and is more cost effective in some cases. Utilizing CIPL technology, Eversource will have the ability to rehabilitate more pipelines that may have been postponed if thought to be more difficult and expensive to remediate.

Innovative Technology Benefits

By: Progressive Pipeline Management

The PPM Starline 2000 system can line pipelines from 4 to 42 inches with a MOAP to 180 PSI. Our technology has also been independently tested by NYSEARCH/PHMSA and Cornell University. The case study determined a 100+ year viability of field-aged Cured-in-Place pipe as alternative to full pipeline replacement. The tests also determined that CIPL provides substantial pipeline renewal and is a viable option to conventional replacement methods for cast-iron and steel distribution pipelines. Our product meets ASTM 2207-02 and 2207-06. Due to further advancements in our operating procedures and equipment, PPM now has the capability to line segments up to 1,300 feet with only two excavations.

One of PPM's most innovative trenchless techniques is the use of using Carbon Fiber Structural Reinforcement Sleeves (SRS) to secure the integrity of damaged pipelines. High strength carbon fiber material in the form of a "sleeve" is inserted robotically into the pipeline. Carbon fiber is light, with high-tensile strength, high temperature tolerance, and low thermal expansion, properties which make carbon fiber ideal in diverse applications, from aerospace and engineering, to motorsports and sailing.

PPM's robotic devices and method of installing carbon fiber sleeves, have been part of our ongoing effort to improve the efficiency of CIPL. The proprietary process was developed in 2011 and is used effectively to reinforce bridge abutments, reinforce corroded high-pressure gas mains, and to span gaps in pipelines (for example, where drip pot standpipes must be removed). PPM can design, develop and test custom robotics to install carbon fiber sleeves in pipelines safely and effectively. Robotics with extendable reach features can cut away the existing drip standpipes, allowing the carbon fiber sleeve to create a "bridge" across the drip cavity. The carbon fiber bridge allows for seamless lining without incurring costs for unnecessary and costly excavations.

ABOUT THE AUTHORS

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Mingqi and Dan joined Eversource as part of the Gas Engineering Cohort Program where they completed a capstone project on the rehabilitation of large diameter cast iron pipe.