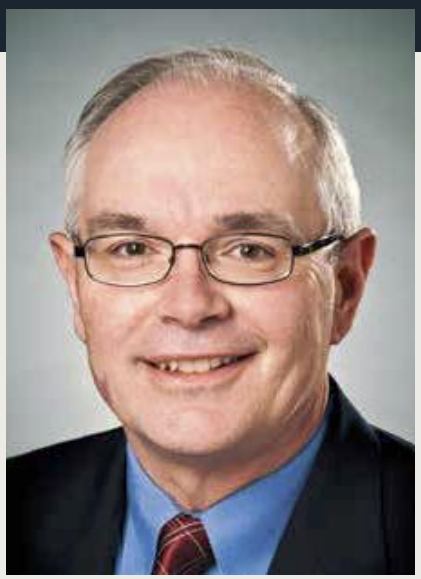
Patching Up or Replacing Water Transmission Pipelines: A Conversation With Richard Mielke of Northwest Pipe Company



As water transmission pipes and other infrastructure systems age, they eventually need to be repaired or replaced. However, many water entities struggle with the financial, logistical, and time investments required to complete that work. Total replacement of water pipelines can be time consuming and expensive, but there are alternative options that give water authorities more options. One of the companies manufacturing innovative repair and rehabilitation solutions is Northwest Pipe Company, which manufacturers structural upgrades for aging systems that cannot be completely excavated or replaced.

Northwest Pipe's director of engineering, Richard Mielke, recently sat down with Municipal Water Leader*'s editor-in-chief, Kris Polly, to discuss the challenge of maintaining outdated water transmission systems, the options Northwest Pipe is providing to local water authorities to upgrade their infrastructure, and the reasons why water managers should explore creative ways to modernize their pipelines.*

Kris Polly: Can you define what a large-diameter water transmission pipe is?

Richard Mielke: Potable water transmission pipes are usually 24 inches or larger in diameter and are high pressure, while lower-pressure, smaller-diameter distribution lines move water from transmission pipes into individual homes. Diameter aside, there is a significant difference in risk management between transmission and distribution lines. In the context of drinking water, water transmission lines are the primary high-pressure arterial lines for most water systems. There are typically two primary components. The first is the raw water system that brings water from the reservoir, well field, or water source to the water treatment plant. The second and most critical component is the water transmission system that takes treated or potable water to storage facilities and various pressure zones within the system. These water transmission pipes are the primary means of moving large quantities of drinking water to where it is needed, and they typically maintain the highest operating pressures in the system. Wastewater systems also use transmission lines, which convey untreated wastewater from a low point in the collection system to a treatment plant. Failure of a distribution line obviously can be a serious issue, but it is rarely something that would leave a utility unable to provide service to a limited area. Loss of a transmission line, however, can be catastrophic, leaving large portions of a water system inoperable.

Kris Polly: When a water entity has an aging or leaking water transmission pipe, what are the factors that must be considered when deciding whether to replace or structurally rehabilitate the pipe as opposed to simply repair the pipe as failures occur?

Richard Mielke: The key factor to be considered is what level of risk an entity is willing to take on. Water managers have to determine whether they are comfortable with the probability that a high-risk pipeline could result in catastrophic failures and the subsequent property damage, bad press, or worse. Location of the pipeline is a factor. A suspect transmission line in a downtown street next to a school presents a high risk. Redundancy also adds to the risk evaluation. If the line fails, will the system still be able to provide needed pressure levels and fire flow? Pipe material also affects level of risk; for example, prestressed concrete cylinder pipe (PCCP) has history of unexpected catastrophic failure. Social costs associated with failures and construction activities related to repair, rehabilitation, or replacement are typically considered. In the case of wastewater transmission, the corrosive nature of the wastewater is a factor. And of course, cost is always a factor to consider. Some owners elect to assess their pipelines and, based on those assessments, do spot repairs to keep systems going. There is growing evidence that these methods may only marginally lower the inherent risk of failure in problem pipelines despite the significant costs of the assessments and spot repairs. In some instances, one may be simply kicking the can down the road a bit. Long-term structural repair or replacement is the only sure way to lower risk to acceptable levels.

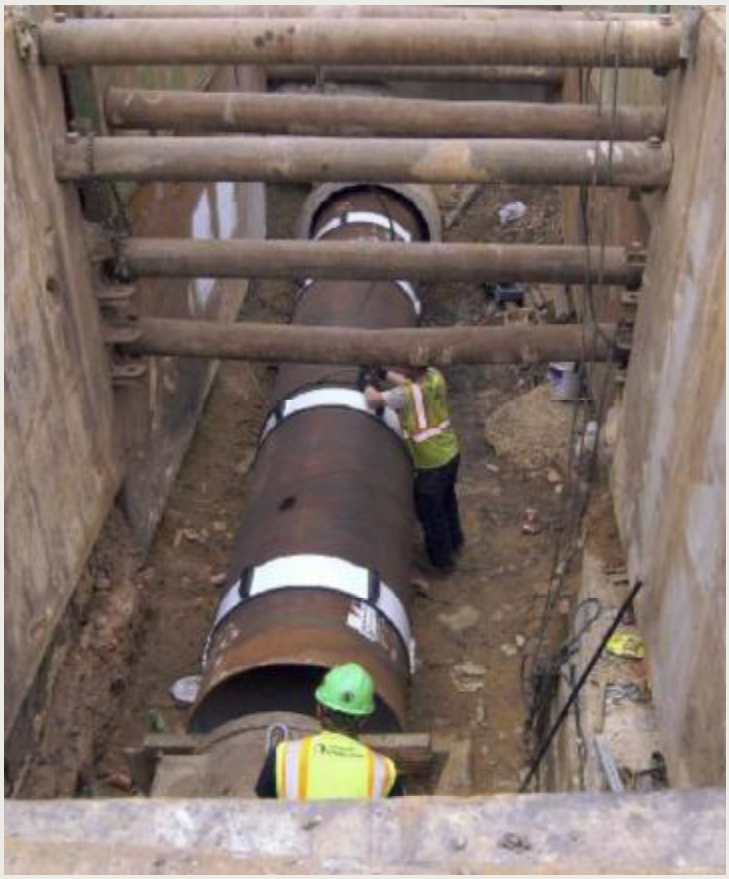
Kris Polly: Once the decision has been made to replace or rehabilitate a pipe, how does a water entity decide between the two options?

Richard Mielke: Replacement typically involves removing or abandoning the existing large-diameter transmission pipeline and replacing it with coated steel pipe. Fully structural rehabilitation options would use a limited number of access points or shafts and slipline or reline the existing pipe with a smaller-diameter steel pipe. This option has less of an effect on the public and provides a 100 percent structural rehabilitation of the transmission line, eliminating future operating risk. The decision to replace or rehabilitate involves the owner evaluating social, assessment, and repair costs against each other. Water entities sometimes determine that it is not socially viable to excavate and replace entire water transmission pipes, so instead they opt to slipline or reline existing pipelines. This method is effective and provides a permanent, long-term solution. Fully structural sliplining or relining can add hundreds of years to the lifespan of a transmission pipeline.

Kris Polly: Can you tell us more about the technology and processes available to rehabilitate large-diameter pipes?

Richard Mielke: In general, organic liners or coatings are used to line smaller leaking pipes used for water distribution in sizes 24 inches and smaller. This method places a nonstructural sleeve inside the pipe to seal the inside of the pipe to prevent leaking. If the pipe is severely corroded, this method may not provide a long-term solution. CFRP, or carbon fiber, has also been used to repair short sections of larger-diameter PCCP (man accessible) that are in danger of catastrophic failure. There has been considerable study and debate about this method of repair, and it is generally considered a short-term repair, not a permanent solution. Sliplining or relining with steel pipe is a permanent structural solution that maintains and also allows for increasing the allowable working pressure of the transmission line.

A recent Baltimore County, Maryland, project is a good example. The project involved a 48-inch PCCP that had blown out several times (once next to a high school) despite multiple condition assessment evaluations and repairs. Therefore, the county no longer trusted the PCCP integrity and did not want the risk associated with operating in its current condition. A permanent solution was needed, and after consideration of several options, the county decided



After failing a couple of times, the 48-inch Kenilworth Transmission Main in Baltimore County, Maryland, underwent a permanent structural rehabilitation using steel pipe sliplining.

to slipline with 41¾–inch shop-applied cement-mortar-lined steel pipe. Northwest Pipe produced the 41¾-inch-diameter steel cylinders in lengths of 20 feet and shipped them to the contractor, who jacked the pipe sections together inside the pipe. The joints were lap welded together for leak-proof finished carrier pipe. Casing spacers kept the new steel carrier pipe centered inside the existing 48-inch PCCP. Once complete, low-pressure grout was pumped in to fill the gap between the two pipes and provide corrosion protection.

One of the other options that Baltimore County considered was relining the 48-inch PCCP. This method is used when a loss of diameter and pipeline capacity cannot be tolerated. Relining is a more costly option as compared to sliplining. Relining is especially popular in areas of high water demand, such as Southern California. Relining involves making a collapsible pipe with nonwelded longitudinal seams collapsed over each other into a smaller diameter, which is held in place by steel strapping and transported into the host pipe, at which point the collapsed cylinder is released. The Baltimore County relined 48-inch PCCP would have resulted in a roughly 45-inch inside diameter pipe versus the 40-inch pipe installed by the slipline method. When the relined pipe is collapsed, it is smaller than the final finished diameter, which facilitates transporting it around most radii or bends in the existing pipe, limiting the need for access points or shafts. The collapsed pipe springs into place inside the existing pipe when the straps are cut. After the pipe is sprung into place, workers weld the longitudinal seams and all the circumferential joints. Spacer pads on the outside of the relined pipe maintain the spacing between the existing pipe and the new carrier pipe. After grouting, the inside of the pipe is then lined in place with a half-inch-thick layer of cement mortar to provide a smooth interior surface.

Kris Polly: Are the grout portals patched with steel or with grout?

Richard Mielke: They are typically threaded couplings with a furnished threaded plug that is screwed into the coupling once the grouting is finished. A weld bead is placed around the coupling threads as well to assure water tightness.

Kris Polly: What is your message to water managers and their respective boards of directors facing the potential replacement of a large-diameter pipes?

Richard Mielke: It is important for the water-using public to recognize there are issues facing water transmission infrastructure that can compromise the reliability of their systems. The risk of failure is real and something that owners by and large are actively trying to address. The need is great, and yet existing funds can only go so far, so it is likely that water rates will need to increase. Although new technologies and assessment options or repairs are always being developed, the proven methods for addressing high-risk pipelines are to replace with corrosion resistant steel pipe or to employ a fully structural slipline or reline option. Spot repairs on transmission lines are risky in and of themselves, from excavating the pipe to draining and even filling the lines. Surging already-distressed pipelines during repair or filling can have undesired consequences. Steel pipe has an excellent history in both replacement and fully structural slipline and reline. Yes, these long-term structural solutions are expensive, and we do encourage managers and owners to be well informed and look at all available permanent options. I suggest that you reach out to known suppliers and engineers—those with considerable experience and a proven track record in rehabilitating and replacing transmission lines—for they can provide valuable input in helping to solve your water infrastructure needs. They are an excellent resource.