Pipe Bursting: The Preferential Method for Replacing Existing Asbestos Cement Pipelines

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The City of Casselberry (City) has designed and constructed the largest asbestos cement (AC) pipe bursting project in the United States by replacing 35 mi of AC pipe with high-density polyethylene pipe (HDPE).The project was funded with $10.5 million from the American Recovery and Reinvestment Act (ARRA) as distributed and managed by the Florida Department of Environmental Protection (FDEP) State Revolving Fund (SRF) program. This project was constructed over a four-year period, and staff at the City became intimately familiar with the regulations governing AC pipe bursting and many of the common misnomers surrounding it.

First and foremost, coupling the words *asbestos* and *bursting* in the same sentence provides active imaginations with a dramatic vision of an explosion of existing AC pipe and the aboveground release of deadly asbestos fibers. In reality, all of the construction activity in well over 85 percent of most typical pipe bursting occurs under 2.5 ft or more of soil. If avoidance of asbestos-fiber release is the desired result, rehabilitating the pipe in-situ, without exposing anything aboveground, sounds like it would be a preferred method of handling the AC pipe material. However, many people require considerable education with regard to asbestos regulation and its governance over pipe-bursting AC pipe, and rightfully so, as the governing regulations are over 40 years old and pipe bursting is a relatively newer technology.

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The Beginning of Asbestos Pipe

Asbestos fibers began being used in combination with cement to manufacture pipes between 1906 and 1913 in Genoa, Italy. It was first brought to North America in 1929 when the Johns-Manville Corporation installed an AC pipe manufacturing machine. The AC pipe was a common choice for potable water main construction during the 1940s, 50s, and 60s (Hu et al, 2013). Communities that experienced infrastructure growth during the 1940s through the 1960s may have higher percentages of AC pipe than the national average because of the popularity of installing AC pipe during that time. The existing predicted service life of AC pipe varies between 50 and 100 years, with a significant amount of failure due to installation procedures, existing ground conditions, and many other factors. Logically, studies have shown that the failure rate for AC pipe increases dramatically with age (Von Aspern et al, 2012). The Water Research Foundation (WRF) has performed much work in an effort to collect and analyze data surrounding AC pipe. The WRF has produced the report, "Guidance Manual for Managing Long-Term Performance of Asbestos Cement Pipe," to assist utility owners in managing their AC pipe. There are widely varying estimates as to the amount of AC pipe installed within the U.S. and Canada, but some estimates conclude there could be as much as 630,000 mi installed (Von Aspern, 2009).

Water Infrastructure in Casselberry

The City of Casselberry is a medium-sized town in suburban Orlando that is considered to be 95 percent developed. Much of the City has been developed for many decades, with a significant amount of the development occurring between 1950 and 1980. Prior to 2009, the City was appropriating $300,000 per year to replace exist-

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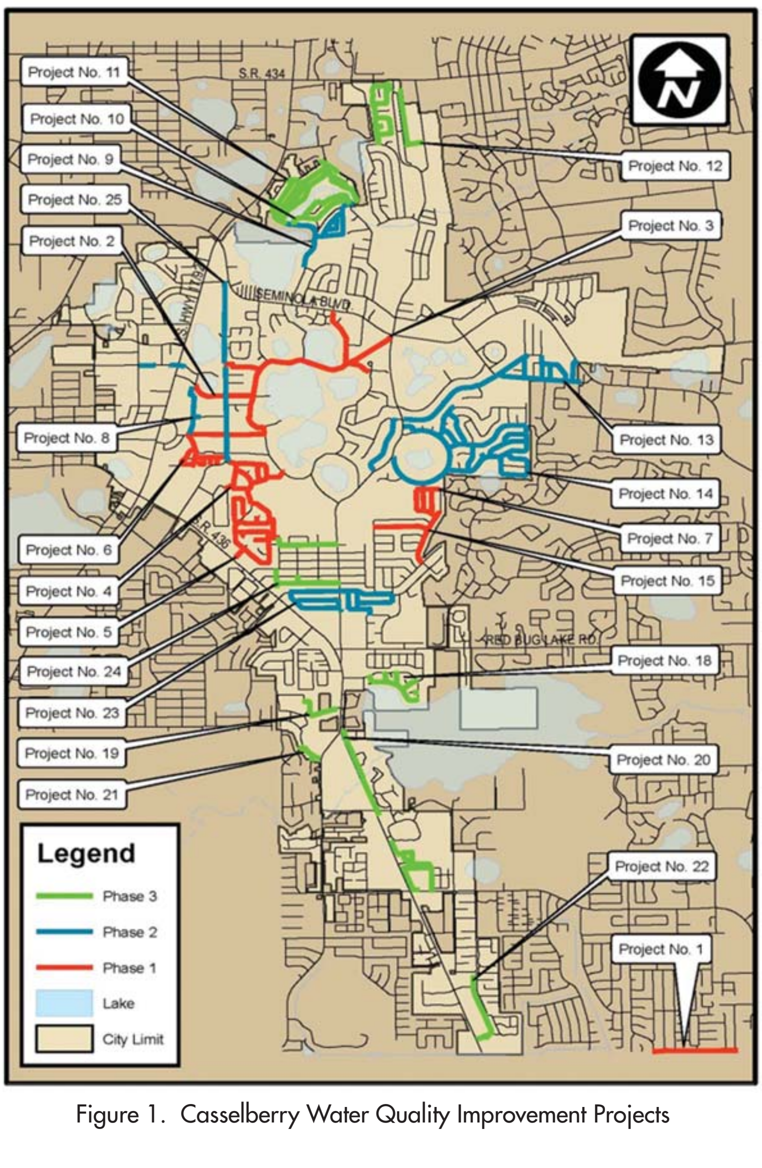

Figure 1. Casselberry Water Quality Improvement Projects

Photo 1. Soil Samples

Photo 2. Asbestos Cement Pipe Bursting

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ing potable water mains throughout its jurisdiction, which replaced approximately one mi per year. The City owns and maintains 215 mi of potable water main in its distribution network, of which 95 mi is AC pipe. The assumed 50-year service life of the existing AC pipe was almost over and the current replacement schedule was not sustainable, requiring 215 years to replace the entire distribution network (Ambler et al, 2014). Luckily, the City received a substantial grant from FDEP through the ARRA to embark on a project focused on rehabilitation of 35 mi of asbestos cement pipe (Figure 1). This project pushed the city forward in making dramatic headway into positive rehabilitation of the city's buried pipeline infrastructure.

Pipe Replacement Technologies

Current technologies and methods available to rehabilitate or replace AC pipe are traditional open-cut and removal of the existing pipe, cured-in-place pipe (CIPP) lining, sprayed-in-place pipe (SIPP) lining, pipe bursting, and pipe reaming. Some prefer to deal with the existing AC pipe by abandoning it in-place or grouting the AC pipe. If the grouted AC pipe ever has to be removed in the future, a cut saw will have to be utilized to sever it. Unfortunately, use of a cut saw on AC pipe dramatically increases the potential for asbestos fibrous release.

The WRF has conducted Project #4465 to study the environmental impact of AC pipe renewal technologies. The City offered its AC pipe bursting project for extensive field study by the Battelle Memorial Institute, the agency hired to conduct the WRF project. Air, soil, and water samples were collected from each site and analyzed for asbestos by a certified laboratory. The results from the analyses (Matthews et al, 2015) showed the following:

- The level of airborne asbestos was always below the eight-hour time-weighted average (TWA) permissible exposure limit (PEL) of 0.1 fiber structures per cubic centimetre (cu cm) of air set by the Occupational Health and Safety Administration (OSHA) and posed no threat to the workers' health (OSHA, 2014)
- Soil samples (Photo 1) collected at each site indicated only trace amounts of asbestos in the soil surrounding the pipe. With no increase in asbestos following the completion of the renewal activities (especially in the case of pipe bursting), it was determined that neither renewal method adversely impacted the soil environment.
- The results from the water samples collected from each site showed that the renewal technologies had no negative impact on water quality (Matthews et al, 2015).

The WRF project concluded that no negative environmental impacts were observed as a result of either pipe bursting or CIPP lining of AC pipe, based on the results from the air, soil, and water samples that were collected during the demonstration testing. When proper procedures were followed, as in the City's pipe-bursting demonstration, the environmental impact was negligible and the requirements of the National Emissions Standards for Hazardous Air Pollutants (NESHAP) were met (Matthews et al, 2015). The WRF data collected on the City's AC pipe bursting have been the most data collected on an AC pipe bursting project to date (Matthews et al, 2015). Since no significant data have been collected on pipe bursting of AC pipe, except for this study, maybe it is time for the U.S. Environmental Protection Agency (EPA) to evaluate new data for recommended regulatory changes.

The NESHAP is a section of the Clean Air Act that governs hazardous air pollutants. At the time of adoption, there were no methods available to test the ambient air or manufacturing process for asbestos particles. Regulation of asbestos was limited to visible particle emission (Ambler, 2014.) Since adoption of the Clean Air Act, methods have been developed to improve testing for asbestos fibers, such as the National Institute for Occupational Safety and Health (NIOSH) 7400 and 7402 methods. These testing methods use phase contrast light microscopy and transmission electron microscopy to measure the presence of asbestos fibers in air samples to a detection limit of 0.1 fibers per cu cm of air (NIOSH Manual of Analytical Methods, 1994). For size comparison, a human hair is approximately 90 micrometres (µm) in diameter, while an asbestos fiber is 5 µm in diameter.

The NESHAP provides for the distinction of asbestos-containing material (ACM). Friable, or regulated ACM (RACM) is defined as any material containing more than 1 percent asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. Nonfriable ACM is any material containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure. The EPA defines two categories of nonfriable ACM: Category I and Category II nonfriable ACM. Category I nonfriable ACM is any asbestos-containing packing, gasket, resilient floor covering, or asphalt roofing product that contains more than 1 percent asbestos; Category II nonfriable ACM is any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure (Sec. 61.141; Ambler et al, 2012). This essentially means asbestos products that can be crumbled by hand pressure to release asbestos fibers are considered to be hazardous and require special handling procedures.

The EPA has delegated enforcement and interpretation of NESHAP's applicability to AC pipe bursting to the state regulatory agencies. The state regulatory agencies, at a minimum, have to enforce the regulations created by EPA, but could create more stringent regulations. A survey of 50 state asbestos regulatory agencies conducted by Battelle found that the majority of states adhere to NESHAP regulations and concluded that any process that makes asbestos fibers friable would be regulated and requires either licensed contractors or should not be attempted at all. It appears as if asbestos remediation with regard to buried AC pipelines is not commonly understood by regulatory agencies. Many agencies are much more familiar with asbestos remediation in vertical construction, such as in schools and abandoned buildings, as more guidance has been provided for this type of asbestos, such as the report, "Managing Asbestos In-Place: A Building Owner's Guide to Operations and Maintenance Programs for Asbestos Containing Materials" (http://www.epa.gov).

As NESHAP was written and clarified by EPA in the 1990s, the area directly on top of AC pipelines that have been pipe-burst and remain in-place are considered to be inactive hazardous waste sites. These sites are required to be memorialized by recording the locations as an inactive hazardous waste site on the deed for the property; however, public right-of-ways do not maintain a property deed for this process to be implicitly met. This conflict brought industry and Casselberry project leaders to Washington, D.C., to meet with top EPA staff in 2010 to discuss pipe bursting and the applicability of NESHAP to pipe-burst AC pipe. The EPA officials embraced the environmental, social, and economic benefits of pipe-bursting AC pipe and understood that the risks of asbestos exposure due to pipe bursting would be mitigated over traditional pipe removal methods. While pipe bursting was met with a positive response, modification of the existing NESHAP regulations would require an act of Congress to complete. The EPA officials recommended that industry representatives present the EPA administrator with an administrator-approved alternate process that can cover AC pipe bursting (Ambler et al, 2012).

During construction of the City's project, the project team encountered significant opposition to the concept of pipe-bursting AC pipe. A right-of-way agent who controlled the construction activities within a neighboring agency's right-of-way expressed concern that residents would "crush up the remaining AC pipe fragments and sniff them." It is highly unlikely that residents would perform such an activity; however, this statement highlights some of the unfortunate misconceptions of the AC pipe-bursting activities. The AC pipelines generally maintain a depth of 2 ft or greater. If a property owner were to excavate to plant a new tree, the owner typically would not excavate greater than the 2-ft depth of cover. The linear footage of remaining AC pipe fragments (Photo 2) exposed would still fall under a 260-linear-ft (lin ft) exemption, as provided by NESHAP, that less than 260 lin ft of AC pipe can be removed as regular construction debris (Ambler et al, 2014).

Many engineers, contractors, and utility providers strongly disagree that pipe-bursting AC pipe converts the AC pipe into friable RACM. The extensive sampling described in the WRF project clearly indicates that pipe bursting does not release asbestos fibers into the air, creating a hazardous environment for pipe rehabilitation workers, residents, and others within the working area (Matthews et al, 2015). A working procedure has been developed in Florida that regulators and industry members are utilizing to successfully burst AC pipe and memorialize the locations of the remaining pipe fragments. Many other utilities, such as Miami-Dade Water and Sewer Department, City of Cooper City, and Port St. Lucie are using this procedure.

Summary

The City has successfully pipe-burst 35 mi of AC pipe with $10.5 million from the ARRA as administered by FDEP through the SRF program. City staff has tirelessly worked with regulators, scientists, and many within the community to fully understand which complex environmental regulations govern working with the AC pipe bursting project, and to collect significant data to appropriately analyze environmental impacts of AC pipe bursting, including emission of asbestos fibers. These efforts have proven that AC pipe bursting does not release asbestos fibers and these results have been independently validated by WRF, an independent scientific council that has been conducting extensive research since 1966. The AC pipe bursting should be recognized as the preferential method of replacing existing AC pipelines, since the majority of the force executed on the existing pipeline occurs underground and the existing pipeline stays there.

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