1. **ABSTRACT**

AM Trenchless has worked with the Dufresne Group, Bellows Falls/ Town of Rockingham, the Ted Berry Company and the Vermont Department of Health (VDOH) to prepare an Alternate Work Procedure to approve asbestos cement (AC) pipe bursting to rehabilitate a large AC potable water transmission main under Route 5 in Bellows Falls, Vermont. This project is designed to replace 6,600 linear feet of 10” AC pipe used for potable transmission main purposes. The design team presented initial project discussions with multiple VDOH staff concerning the application of pipe bursting for AC pipe for this specific project and the VDOH regulations that apply to pipe bursting of AC pipe. AM Trenchless worked closely with the Dufresne Group and the Ted Berry Company to present all the existing regulations, including the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) and Occupational Safety and Health Administrations (OSHA) requirements covering AC pipe bursting to VDOH staff. The project team then openly engaged VDOH staff in the appropriate way to handle AC pipe bursting since it wasn’t explicitly covered in the Vermont Regulations for Asbestos Control. VDOH staff suggested that the project team appeal to VDOH for an Alternate Work Practice Procedure to cover AC pipe bursting and VDOH staff would evaluate the submission. The project team successfully addressed all of VDOH staff’s concerns over AC pipe bursting and VDOH issued the first permit to perform AC pipe bursting in the State of Vermont.

2. **BACKGROUND**

The Bellows Falls / Town of Rockingham (Town of Rockingham) identified potential problems with an existing 10-inch AC pipe transmission main located immediately adjacent to a major Vermont Department of Transportation (VTrans) Highway. The Town of Rockingham (see Figure 1) worked with the Dufresne Group, a consulting engineering firm based in Vermont to evaluate the existing 10-inch AC pipeline and identify rehabilitation options, if necessary. The project involving the 10-inch AC potable water transmission main pipeline was called the Route 5 Water Main Improvements Project which would become a kickoff for open communication with the Vermont Department of Health (VDOH) on handling and rehabilitation of AC water mains. This project was part of a larger work effort the Dufresne Group was performing for the Town of Rockingham evaluating the overall system water mains and designing a comprehensive replacement project.

The Route 5 Water Main Replacement project includes the replacement of approximately 6,600 linear feet of 10-inch AC water main with new 12-inch water main. The entire project is funded by the Drinking Water State Revolving Fund, which also entailed a grant component to the funding. The 10-inch AC transmission main included for rehabilitation in the project was identified for potential replacement by Town of Rockingham for concerns over structural integrity of the existing transmission main. The 10-inch AC transmission main transmitted treated potable water from three separate storage tanks throughout the
Town of Rockingham’s potable water distribution system to customers and residents. Because of the transmission mains consistent use from three separate storage tanks, it was considered to be a high priority transmission main.

The 10-inch AC transmission main was the primary pipeline that provided potable water from the Main zone of the distribution system to the North End zone of the distribution system. The 10-inch AC transmission main actually had thirteen potable water services that came off the main but they were primarily concentrated in two areas. Rehabilitation options considered for this transmission main would have to consider service outage times for the thirteen water services directly off the transmission main as well as outage periods for the North End zone of the distribution system. Subsequently, future demand within the Main and North End zones were evaluated for any additional capacity needs. It was anticipated to have some potential growth within the North End zone and hydraulic analysis was performed. Hydraulic evaluation of the existing distribution and transmission systems were conducted and it was anticipated that the 10-inch AC transmission main would need to accommodate potential future demand within the North End zone.

The AC transmission main was also located along Route 5, a heavily travelled trucking route highway owned and operated by VTrans. The 10-inch AC transmission main was located under the edge of pavement on the south bound lane of Route 5. The consequence of failure of the 10-inch AC transmission main can be severe since failure could blowout the highway and cause significant impact to residential and commercial traffic on a primary road. Similar to many major highways, there were many other utilities within close proximity of the limited access highway. Preliminary data collection for the other utilities located within the project area indicated a major fiber optic duct bank was located directly above the water main. Additionally a sewer force main was located on the opposite of the highway, directly under the edge of pavement of the north bound lane of Route 5. This section of Route 5 was also located near an environmentally sensitive wetland adjacent to the Connecticut River (see Figure 2.) Impact from failure of the transmission main or construction footprint to these two water bodies would be severe and a rehabilitation method that maintained the alignment of the existing 10-inch AC transmission main was preferred.

The Dufresne Group coordinated with Vtrans for potential options for rehabilitation of the existing 10-inch AC transmission main. Vtrans clearly indicated that they would prefer the water main be installed outside of the travel way. Since the available right-of-way was significantly limited (See Figure 3) within Route 5 and the corridor was mildly congested with other utilities, the available options of water main rehabilitation were limited. The Dufresne Group sought rehabilitation solutions that would replace the 10-inch AC transmission main in its current location and alignment. The Dufresne Group’s ultimate goal was to install.
a structurally sound transmission main that will accommodate the existing demand of the North End zone, occupy the location of the existing 10-inch AC transmission main and provide minimal disturbance to the traffic along Route 5.

The goal of the project is to install a structurally sound transmission main that will accommodate the existing demand of the North End zone. In addition, in order to avoid replacing the transmission main in a few years with a larger diameter pipe, a secondary goal is to install a transmission main that will accommodate potential future demand in the North End zone.

3. REHABILITATION ALTERNATIVES ANALYSIS

The Dufresne Group began to evaluate potential alternatives for in-place rehabilitation of the existing 10-inch AC transmission main. The Dufresne Group reached out to Ted Berry Company, a Maine based contractor that specialized in water and sewer main rehabilitation to inquire about rehabilitation feasibility for the 10-inch AC transmission main. The project team evaluated three primary rehabilitation methods, which included the options below:

1. Traditional open trench construction along Route 5 to remove the existing 10-inch AC transmission main and replace it with a new transmission main.
2. Utilize available pipe lining technologies to line the existing transmission main and further minimize potential handling of the existing AC pipe
3. Pipe burst the existing 10-inch AC transmission main to maintain a usable facility in the exact location of the existing transmission main and minimize the handling of the existing AC pipe

The project team worked together to identify how the potential rehabilitation options would be impacted by the various site restrictions, traffic impacts and environmental constraints. The first option to be evaluated was the typical open trench replacement method. It was anticipated the open cut construction method was to have construction duration of 120 calendar days to replace the section of 10-inch AC transmission main in question. The four month construction duration would have severe impact to the Route 5 residential and commercial traffic and would not likely be approved by VTrans. Additionally, the fiber optic conduit bank that was located directly on top of the existing 10-inch AC transmission main would have to be supported during construction or relocated entirely. The required work to protect the fiber optic conduit bank substantially increased the risk for the contractor during construction and extended the construction schedule. It was difficult to estimate the exact impact the fiber optic conduit bank had when utilizing the open trench construction method but efforts were made to make the Town of Rockingham aware of the extent of potential impact to the construction schedule and cost.

Hydraulic analysis of the transmission and distribution system evaluated the potential for growth in the North End zone of the distribution system. It was determined that the existing capacity of the 10-inch AC transmission main would be sub-standard for the projected growth in the North End zone. Structural lining of the AC transmission main would not provide a larger capacity of the existing 10-inch AC transmission main because AC pipe typically does not suffer from tuberculation or loss of internal area due to corrosion. Also, at the time of rehabilitation method evaluation, the structural capacity of available lining technologies did not compare to the provision of a brand new replacement pipeline. For these reasons, structural pipe lining was eliminated as a potential rehabilitation method as it did not achieve the primary goals of the rehabilitation project.
Pipe bursting the 10-inch AC transmission main was evaluated as the third potential alternative for rehabilitation. Pipe bursting was considered to be a proven method of replacing an existing pipe with a new pipe of the same or larger diameter in the exact location of the existing pipeline. Pipe bursting was accomplished by inserting a rod string in the inside of the existing pipeline (See Figure 4 for pipe bursting rods being inserted into 10” AC pipe). The rod string is then attached to an expander head and production pipeline (See Figure 5) that would be pulled inside the existing pipeline to simultaneously split and expand the existing pipeline while replacing it with a new production pipeline.

The pipe bursting method was expected to have construction duration of approximately 60 calendar days. This method typically reduces excavation by approximately 85% as excavation is only required at launching and receiving pits located every 400-600 feet, hydrant and valve locations and service connections. For this particular project, it was anticipated that the launching and receiving pits would be typically 6-foot wide by 16-foot long (See Figure 6.) Project controls would also limit the hydrant and isolation valve locations to be coordinated with the entry and exit pit locations to keep excavation areas to a minimum. As previously noted, there are only 13 water services in this project and VTrans has requested that services be installed across Route 5 via the jack and bore method. Support and protection of the fiber optic bank will still be required; however the risk of damage will be much lower due to the reduced excavation. The impact to traffic on Route 5 will be significantly lowered in comparison to the open trench replacement method as the construction duration will be shorter and the lane closures will be less frequent.

The depth of the existing 10-inch AC transmission main was enough that pipe bursting did not appear to have a substantial impact on the existing fiber optic conduit installed directly above the existing transmission main. Since the hydraulic capacity analysis indicated a reduction in internal diameter would not accommodate future development of the North End zone of the transmission and distribution system, slip lining was eliminated as a potential rehabilitation method. The project team evaluated the prime distinctions between traditional open cut construction and pipe bursting and evaluated the dramatically reduced social, environmental and economic costs of pipe bursting versus traditional open cut. Subsequently, pipe bursting was selected as the preferred alternative to rehabilitate the existing 10-inch AC transmission main.

Pipe bursting of AC pipe had not yet been performed in the State of Vermont as of the preliminary planning and design of the project. The project team was in tune with technological and regulatory developments within the pipe bursting industry in the United States and were tracking developments for pipe bursting AC pipe within the State of Florida. Recent projects within the State of Florida were executing AC pipe bursting projects and incorporating local regulatory staff members to help identify the governing regulations and how they applied to AC pipe bursting. The project team decided to enlist the assistance of of AM Trenchless to approach the State of Vermont’s Department of Health to openly communicate about the regulations of AC pipe bursting and how the team could work with the regulators to construct the preferred alternative.
4. **ASBESTOS CEMENT PIPE BURSTING**

Much documentation has been collected to date concerning the applicability of the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) to AC pipe bursting. Significant data has been collected by the Water Research Foundation (WRF) in conjunction with the City of Casselberry and published in multiple technical documents including WRF Project #4465. In particular, during the summer of 2013, the Battelle Memorial Institute was onsite in Casselberry, FL to observe the renewal of a section of AC pipe and to collect air, soil, and water samples during the process. Over the course of a week, five (5) bursting runs were conducted to replace AC pipe. Six air samples were collected during all major activities using two personal air sampling pumps. Six soil samples were collected from the side walls of access pits following excavation of the pit but prior to any pipe related activities. Six post-renewal soil samples were collected from the same pit wall locations months after the completion of the renewal work and compared to the pre-renewal soil samples. A total of four water samples were collected – two pre-renewal and two post-renewal – from a residential water service line and fire hydrant. Note that all samples were only analyzed for asbestos and no other contaminants (Ambler, et al., 2014).

In summary, the WRF Project #4465 collected air, water and soil data on AC pipe bursting projects, before during and after and detected no basis for asbestos fiber release. “Based upon the results from the air, soil, and water samples collected from the Casselberry site there is no evidence to support that the bursting of AC pipe has any negative impacts on the environment or the workers performing the work” (Ambler, et al., 2014). A table of the collected results is shown below.

**Table 1. Summary of Asbestos Sampling Results for Air, Soil, and Water**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>No. of Samples</th>
<th>Analytical Sensitivity Range</th>
<th>Sample Result Range</th>
<th>Analytical Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>6</td>
<td>0.0036 - 0.0042 s/cc</td>
<td>BAS</td>
<td>ISO Method 10312</td>
</tr>
<tr>
<td>Soil (Pre-renewal)</td>
<td>6</td>
<td>NA</td>
<td>ND - Trace (&lt;0.25% visual estimate)</td>
<td>EPA Method 600/R-93/116</td>
</tr>
<tr>
<td>Soil (Post-renewal)</td>
<td>6</td>
<td>NA</td>
<td>ND - Trace (&lt;0.25% visual estimate)</td>
<td></td>
</tr>
<tr>
<td>Water (Pre-renewal)</td>
<td>2</td>
<td>0.17 - 0.35 million structure/L</td>
<td>0.87 - 20.07 million structure/L</td>
<td>EPA Method 100.2</td>
</tr>
<tr>
<td>Water (Post-renewal)</td>
<td>2</td>
<td>0.08 - 0.09 million structure/L</td>
<td>0.09 - 0.94 million structure/L</td>
<td></td>
</tr>
</tbody>
</table>

$s/cc = \text{structure per cubic centimeter (mL)}$

BAS = below analytical sensitivity
NA = not applicable

Additional research performed by experts within the pipe bursting industry outline the steps required to comply directly with NESHAP when performing AC pipe bursting projects. There are five steps required to comply with NESHAP and those are summarized below:

- File a Notice to EPA or Its Designee (61.145(b))
- Provide for Emission Control during Renovation and Disposal (61.145(c)) / 61.150)
- Comply with Inactive / Active Waste Disposal Site Requirements (61.151 / 61.154)
- Comply with Inactive Waste Disposal Site Deed Notation and Alternative (61.151(e))
- Notice Prior to Digging Up Site 45 days before digging up the site (61.154(j) / 61.1(d))
The project team initiated conversation with the State of Vermont’s Department of Health (VDoH) to discuss AC pipe bursting and how the regulations within the VDoH applied to the technology. The project team arranged an in person meeting with all regulatory personnel at the VDoH, the Town of Rockingham, Dufresne Group, Ted Berry Company and AM Trenchless on May 15th 2014. The project team prepared a summary of the applicable VDoH regulatory document “Vermont Regulation for Asbestos Control (VRAC).” Within the regulatory document, the State regulatory document allowed for consideration of an “Alternate Work Practice Procedure.” The project team researched the requirements of such a submittal and prepared a package with significant backup documentation for presentation to the VDoH. The project team assembled a presentation with technical support documentation and prepared to meet with VDoH.

5. VERMONT DEPARTMENT OF HEALTH REQUIREMENTS

In July of 2014, the project team requested guidance on how to submit an “Alternate Work Practice Procedure” from the VDoH. In response, VDoH provided the following information.

“This project is subject to the applicability jurisdiction of VRAC because the proposed process will physically impact and change non-friable rigid AC pipe to friable conditions due to cracking and busting the pipe. Due to the physical impact, this project is considered an asbestos abatement activity, even though non-typical practices are being utilized. It is the Department’s understanding that this project is a drinking water main replacement project that will involve bursting the existing pipe, and inserting a new synthetic water line that will cracked and shattered in-place and that this material will be primarily left underground during this process, with the exception of excavated pits for the service connections. The Department anticipates that this project will have multiple water line service connection points along the main line that will need to be excavated to facilitate service connections to the new water main and this will involve direct connection with the AC pipe fragments and waste handling.”

1. A statement of reasons and explanations as to why this project cannot be carried out by a Vermont Licensed Asbestos Abatement Contractor Entity along with a description of the specialty contractor who will perform primary project objectives.

2. A Vermont Licensed Asbestos Abatement Supervisor must be onsite at all times during project activity and this individual will be responsible for making and documenting asbestos related competent person decisions, exposure assessment and asbestos waste handling in accordance with VRAC.

3. A completed Vermont Department of Health – Notification of Asbestos Abatement Project Form – VDH 104 along with payment of a permit fee.

4. A copy of the completed USEPA NESHAP Notification Form that will be sent to USEPA.

5. A written work plan (or project specification) describing the project.

6. A copy of sample analysis for the asbestos content determination.

7. A project specific Health and Safety Plan (including personnel protective equipment usage, personnel decontamination/hygiene procedures and demarcation of restricted work area) as specified in VOSHA Construction Standard for Asbestos in accordance with 29 CRF Part 1926.1101.

8. Identification of service line connection excavation pits for corporations that will connect to the water main.

9. Narrative description of how any excavated soil with asbestos wastes will be handled and processed for disposal. Please note any exposed asbestos cement, burst/cracked or intact must be
handled and disposed in accordance with applicable state and federal asbestos regulations.

10. A description of asbestos and lead (if applicable) decontamination procedures.

11. A description of how any lead service lines connected to the main line will be handled and/or disposed of.

12. An exposure assessment plan for personnel and any work tasks where the fragments of cement asbestos pipe will be dug out and physically handled.

13. Identification of all contractor and subcontractor entities along with roles and functions on this project.

14. Procedures for deed or right-of-way notification, annotated as-built drawings and subsurface demarcation identifying asbestos warning marker tape where the shattered asbestos materials will be left underground.

15. Procedures for establishing a daily log of all personnel and job functions involved in this project.

16. Contingency plan for any potential conditions or extenuating circumstances requiring remedial action or elevated asbestos exposure risk requiring compliance with applicable state and federal asbestos regulations.

The project team was initially overwhelmed by the extensive requirements proposed by VDoH. It appears that typically, most asbestos demolition / abatement projects do not involve underground pipelines. Therefore, the typical pipe bursting construction process was not familiar to VDoH. Pipe bursting of buried pipe lines requires specialty contractors that understand the limitations of the technology and how to construct the project. The project team was not aware of any current “Vermont Licensed Asbestos Abatement Contractor Entity’s” that performed or even knew about pipe bursting work. The argument that a currently licensed asbestos abatement contractor could not perform the work was an easy argument to make. The project team worked together to create project specification for pipe bursting and asbestos fiber detection, which included the required exposure assessment plan.

A Negative Exposure Assessment (NEA) sampling the air for asbestos fibers and submitting the results for analysis by the NIOSH 7400 or NIOSH 7402 method would be required during construction. An absence of asbestos fibers in this analysis would clearly indicate that AC pipe bursting using the handling procedures established by Ted Berry Company would not yield asbestos fibrous release. These handling procedures would then satisfy OSHA requirements and no further Negative Exposure Assessments would have to be conducted unless requested by the owner.

6. PROJECT TEAM DESIGN PROPOSAL

The project team submitted the required information to VDoH and received preliminary acceptance of the procedures outlined and moved forward with the design of the project needed for the permit. The project team had not received a complete environmental permit for the project as the project had not been bid but were told by VDoH that all the answers and requirements were provided and they would not have any issues when the permit was submitted. The project team continued progression of the project.

The Town of Rockingham had identified this potential project for grant funding from the Drinking Water State Revolving Loan Fund. As the Dufresne Group finalized the design of the project they also began preparation of the documents required for the grant / loan approval process. The project would be required to be competitively bid before being constructed. The design documents were complete and the project was bid in spring of 2016. Bids were received and the contractor was awarded the project. The project team then worked together to submit for the environmental permit for the project. VDoH reiterated requirements that “Vermont Licensed Asbestos Abatement Contractor Entity” should be on site during all construction activities even though the contractor would not be performing any actual work on the project.
Also, VDoH requested a NEA be performed on the pipe bursting activity to observe any asbestos fiber release. The project team already had those two specific requirements in place in the bid contract and received the environmental permit. The project team was ready for construction.

7. CONSTRUCTION OF THE PROJECT

Construction of the project began in fall 2016. Ted Berry Company was hired as a sub-contractor by the general contractor Zaluzny Excavating Corp. Both contractors worked together to plan the project approach for construction. The existing 10” AC pipe was to be replaced by 12” fPVC pipe. Ted Berry Company was responsible for fusion of the fPVC pipe and conducting the pipe bursting activities. Zaluzny was responsible for all excavation activities and moving all equipment while on site. An example pipe insertion pipe is shown in Figure 7. The expander head is shown in Figure 8.

Figure 7 – Pipe insertion pit
Figure 8 – Expander head

Figure 9 shows the production pipeline adjacent to the temporary HDPE bypass piping.
A picture of the lay down yard and temporary bypass pipe is shown in Figure 10.

![Laydown yard and temporary bypass](image)

**Figure 10 – Laydown yard and temporary bypass**

Only half of the project was completed in the time frame available before winter weather arrived to stop all outdoor construction. The project team was not happy that the project was not finished but understood that waiting for weather conditions to improve would resolve in a higher chance for successful completion of the project. The contractors completed 1,300 linear feet of AC pipe bursting with three separate pipe bursting pulls.

The NEA that was performed required the employees working directly with AC pipe removal take safety precautions until the results of the NEA were returned. The pipe handling practices observed on the pipe bursting project were in line with standard AWWA AC Pipe Handling practices. The results of the NEA were not immediately available but will be published at a later date. An example of AC pipe handling precautions as taken prior to receipt of the results of the NEA is shown in Figure 11.

![AC pipe handling precautions](image)

**Figure 11 – AC pipe handling precautions prior to NEA results**
8. CONCLUSION

Pipe bursting was the only applicable trenchless technology method to rehabilitate a failing 10” asbestos cement (AC) pipe transmission main after significant alternatives evaluation was performed. The team of Town of Rockingham, Dufresne Group, AM Trenchless and Ted Berry understood that it was necessary to openly discuss AC pipe bursting and the regulations that govern working with AC pipe in explicit detail with the Vermont Department of Health (VDoH) to solicit approval of the pipe bursting method to perform the project. The project team worked extensively to provide detailed answers to all of the VDOH’s questions and information requests to continue moving the project forward and receive approval of the project and process. After receipt of the applicable environmental permit that required significant up front coordination, the project team continued on to deliver a successful project. The upfront effort and close coordination with VDoH has now paved the way for asbestos cement pipe bursting to occur in the State of Vermont and potentially be utilized as a case study example for the North East United States.

9. REFERENCES