SOUTHEAST JOURNAL OF

TRENCHLESS TECHNOLOGY 2017

OFFICIAL PUBLICATION OF THE SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY

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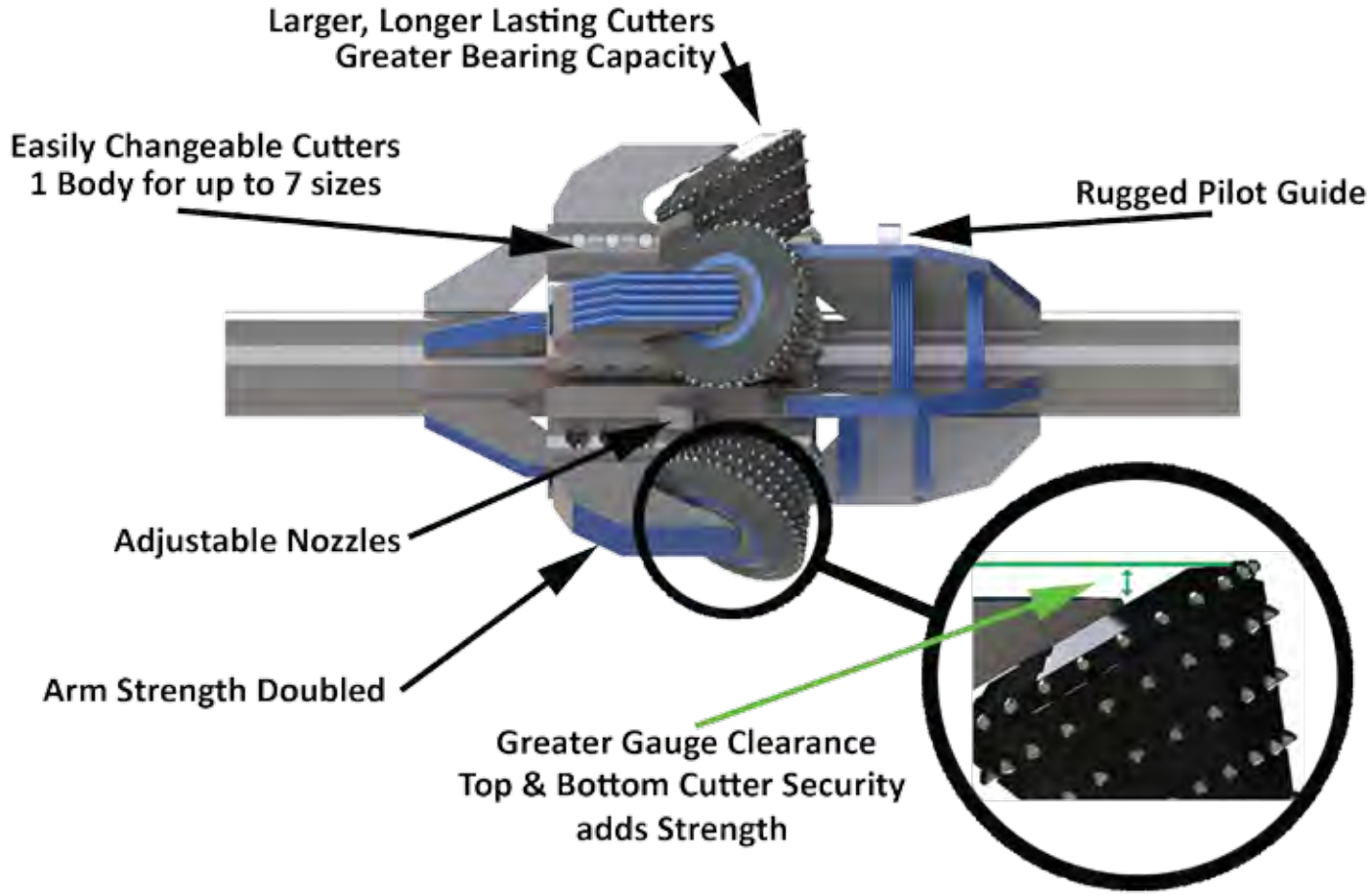

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NASTT SOUTHEAST CHAPTER

SESTT CHAIRMAN MESSAGE 2017

Moving Trenchless Technology Forwards

Jerry Trevino, SESTT Chairman

Welcome to our fourth annual edition of the *Southeast Journal of Trenchless Technology*. This new magazine is a fresh opportunity to reflect on the progress that has been made in the Trenchless Technology industry over the last 16 years, since the Southeast Society for Trenchless Technology (SESTT) was founded as a NASTT Chapter in 2000.

SESTT was formed shortly after a very motivating and convincing meeting headed by Dr. Tom Iseley and Leonard Ingram in Atlanta, Georgia, in 1999. A handful of people from the corporate and municipal sectors were also present. I remember very keenly Dr. Iseley presenting the case that there was a need to create a Southeast Chapter of NASTT to share information and promote trenchless technology at the local level.

Per the Charter & Bylaws, the primary objective of SESTT is to "promote Trenchless Technologies" by conducting training and education through seminars, short courses and field demonstrations. Since 2000, we have held numerous seminars in locations throughout the Southeast. Leonard Ingram, the Executive Director of SESTT, has been the muscle pushing through many obstacles to schedule, organize, and conduct these seminars.

The seminars continue to be an important forum to educate decision makers on the Trenchless Technologies available to rehabilitate and to increase the capacity of our infrastructure. The broad spectrum of challenges presented by the aging infrastructure and by urban population growth has spurred innovations in technologies, materials engineering, installation equipment development and better asset condition data from which municipality managers can make more informed decisions. Organizations such as SESTT, NASTT and the other regional chapters are important education and training providers helping select the best methods and processes to meet these challenges.

"The seminars continue to be an important forum to educate decision makers on the Trenchless Technologies available to rehabilitate and to increase the capacity of our infrastructure."

Moving forwards, the trenchless technology industry must continue highlighting the need to not only to maintain our infrastructure but also to upgrade it to the next level for future generations in order to maintain a healthy nation. One of government's foremost obligations is to provide its citizenry with clean and safe drinking water and an efficiently functioning infrastructure. It will challenge us all to the core to create the necessary new materials, processes, and technologies to achieve this.

We all look forward to next year and encourage everyone to attend the upcoming NASTT No-Dig Show March 25 - 29 at the Convention Center in Palm Springs, California. In addition, next year there will be a full slate of planned single day Trenchless Technology seminars by SESTT, MSTT, and MASTT. A full schedule of these 2018 seminars will be posted to www.sestt.org in the New Year. Happy New Year and best wishes to all.

Sincerely,

Jerry Trevino
SESTT Chairman

SESTT SITE

GREETINGS FROM THE SESTT EXECUTIVE DIRECTOR

Leonard E. Ingram, Sr., PWAM, Executive Director, SESTT

Welcome to the 4th annual publication of the *Southeast Journal of Trenchless Technology 2017*. This magazine highlights some of the many trenchless projects performed around the Southeast region. It shows the successes and continued rapid growth in demand for trenchless projects and presents some of the new ideas, products and innovations coming from SESTT members. Please help me thank the journal advertisers, the SESTT Board of Directors and their companies for their support throughout the year and for their effort in making this Journal a reality. The SESTT Board of Directors is listed on page 11. The list of journal advertisers is on page 47.

Since its foundation as a NASTT Chapter in 2000, the SESTT purpose has been to "promote education and development of Trenchless Technology for public benefit". I became Executive Director of SESTT in 2001 and, since then, SESTT has presented a total of 48 seminars in 25 cities throughout the Chapter's ten state area. Through this active education outreach, SESTT has engaged over 2,000 classroom attendees. Public officials, engineers, utility company personnel, designers, manufacturers and contractors involved in underground construction have all benefitted from past SESTT Trenchless Technology, SSES and Buried Asset Management seminars.

"Thanks for the support!"

For professionals who are responsible for design, installation and maintenance of underground infrastructure, certainty is paramount and risk has to be minimized. Up to date knowledge and information on our buried assets is vitally important. As trenchless technology leaders it is our mission to educate these professionals with case studies, experiences and demonstrations showing the environmental and social benefits of using trenchless methods. This is why SESTT and NASTT conduct seminars conferences and trade shows, and why continuing education is so important. I want to thank all our exhibitors, food sponsors, presenters, guest presenters and ASCE co-sponsor members for their support. SESTT could not have had such an active successful program without them.

Recently we began a new initiative and changed the seminar format from two days to a single day event. This makes it easier for a greater number of people to be able to take time away from their busy schedules to attend these valuable learning and networking sessions, while reducing travel and accommodation expenses. To avoid schedule conflicts, the MASTT, MSTT and SESTT Proposed 2018 Seminar Schedule will be released in January once the larger shows have established their show dates. Watch for further details on the SESTT website, www.sestt.org.

Thanks for the support!

Leonard E. Ingram, Sr., PWAM
Executive Director, SESTT

NASTT SOUTHEAST CHAPTER TM

MESSAGE FROM NAST

Frank Firsching, NASTT Chair

Hello Southeast Chapter Members! We are well into the year, I'm excited for the future during my term as Chair of the Board of Directors. Plans are under way for NASTT's 2018 No-Dig Show which will be held in Palm Springs, California next March 25-29. We received a record number of abstracts for the technical program and the exhibit hall is set to sell-out yet again!

NASTT exists because of the dedication and support of our volunteers and our 11 regional chapters. There are many Southeast Chapter Members that serve on our No-Dig Show Program Committee and volunteer their time and industry knowledge to peer-review the abstracts. We're looking forward to the upcoming Show in Palm Springs and these 2018 committee members from the Southeast chapter will ensure that the technical presentations are up to the standards we are known for: Shaurav Alam, Erez Allouche, Alan Ambler, Will Craven, Don Del Nero, George Kurz, Bill Moore, Kalyan Piratla and Kaleel Rahaim. The Southeast Chapter is also home to some of our Session Leaders. Session Leaders are Program Committee members that have the added responsibility of managing a session of the technical program and working with the authors and presenters to facilitate excellent presentations. I would like to extent a special thank you to the Chapter Members that will also serve as Session Leaders in 2018: Shaurav Alam, Alan Ambler, Will Craven, George Kurz, Bill Moore, Kalyan Piratla and Kaleel Rahaim. In addition, NASTT's 2018 No-Dig Show Program Chair is Don Del Nero from the Southeast Chapter. Don is leading the charge on an amazing technical program for 2018!

Beyond the annual No-Dig Show, NASTT provides many trenchless training courses. We are focused on trenchless education and our highly-experienced instructors and presenters are dedicated to trenchless education, providing their expertise strictly on a volunteer basis. They donate personal time to travel around North America to provide high quality training on a host of trenchless technologies. I would like to thank Chapter Members Alan Ambler, Kaleel Rahaim, Ed Saxon and Dr. Ray Sterling for their instructor volunteerism this year. Alan taught our Pipe Bursting Good Practices Course at the 2017 No-Dig Show, Kaleel Rahaim taught our CIPP Good Practices at No-Dig, Ed Saxon presented our Municipal Contracts webinar and Dr. Ray Sterling taught our Laterals Good Practices Course at No-Dig. Thank you, gentlemen!

The North American Society for Trenchless Technology is a society for trenchless professionals. Our goal is to keep our finger on the pulse of our industry and provide beneficial initiatives. To do that, we need the involvement and feedback from our professional peers. If you are interested in more information, please visit our website at nastt.org/volunteer. There you can view our committees and learn more about these great ways to stay involved with the trenchless community and to have your voice heard. Please consider becoming a volunteer – we would love to have you get more involved.

NASTT has a very promising future because of our amazing volunteers. Thank you again for your continued support and dedication to NASTT and the trenchless technology industry.

Frank Firsching

Frank Firsching
NASTT Chair

NASTT SOUTHEAST CHAPTER TM

MEMBERSHIP IN NASTT

Molly Margosian, NASTT Membership Coordinator

Are you getting the most out of your NASTT membership? Taking advantage of all NASTT has to offer? As your membership coordinator, I'm happy to guide you to resources so that you can fill your trenchless toolbox with up to date industry information, webinars, events, and so much more!

Did you know NASTT has the world's largest online trenchless library, filled with technical papers focusing on a wide variety of trenchless topics? All papers are all available for download to our members compliments of NASTT. We sell industry books too!

Does your organization exhibit at NASTT's No-Dig Show? Members can enjoy discounts on training and registration at our annual No-Dig Show.

Are you hiring or searching for a new position? Being a society member allows you to view and post career opportunities on the job board on nastt.org. This complimentary membership tool houses industry specific jobs and gives members the opportunity to search for potential jobs or post positions that are needing to be filled.

Are you interested in getting to know the next generation of trenchless champions? NASTT also offers membership to students! We are proud of our 18 NASTT Student Chapters with three that have just joined us in 2016. These student members are given the opportunity to attend the No-Dig show and learn about the trenchless world while networking with potential employers. Student chapters fulfill critical roles as not only volunteers at NASTT's No-Dig Show, but are the next generation of trenchless professionals.

Does your NASTT membership also make you a member of your Regional Chapter? Yes! Take the opportunity to work your local network and get involved with your Regional Chapter. Regional Chapters offer trainings and meetings, providing you the chance to expand your regional network. NASTT Regional Chapters encourage community outreach, and are a great tool to expand your knowledgebase and meet other individuals within your industry too!

But wait, there's so much more! NASTT offers a weekly eNewsletter, blog, archived webinars on trenchless topics, and committee and volunteer opportunities for you. Now that you know a little more about what NASTT Membership has to offer, it's time to join us! Visit nastt.org and get your membership started today!

Sincerely,

Molly Margosian

SOUTHEAST SOCIETY FOR TRENCHLESS TECHNOLOGY
BOARD OF DIRECTORS 2017

Jerry Trevino - *Chairman*

Jerry Trevino is President of Protective Liner Systems, Inc., and principal owner of other construction and consulting companies. Jerry is an engineering graduate from the University of Texas in Austin. Before specializing in infrastructure rehabilitation, he worked as a project engineer and in research and product development for Procter and Gamble and Mobil Oil. He now specializes in the development, manufacturing and installation of all types of polymeric and cementitious coatings, liners and FRP composites used to rehabilitate infrastructure for municipalities and the industrial sector. He strongly believes that trenchless technologies offer numerous methods to maintain and upgrade aging infrastructure.

Ed Paradis - *Vice Chairman*

Ed Paradis is Sales and Market Development Manager, Injection Systems - North America, Underground Construction for BASF. Ed has served the industry in various positions over 20 years and is highly regarded as a leading resource on chemical grouts. His dedication to the specialty field of chemical grouts has been proven by his involvement in some of the country's highest profile projects, such as the design and placement of chemical grout on the Port of Miami Tunnel. Ed attended Boston College while serving in the U.S. Army. He has been involved in the construction and rehabilitation industry since 1989, and further contributes to and advances industry growth through active membership in various associations such as NASSCO, NASTT, SESTT, UCT, ICRI, and DFI (Deep Foundation Institute). His 20 plus years in the chemical grout market both as a contractor, salesman and manager has provided countless useful knowledge for the industry.

Chris Ford - *Secretary*

Chris Ford is Principal and Vice President of Operations at Highfill Infrastructure Engineering, PC, a Carolinas engineering consulting firm specializing in community and municipal water and wastewater infrastructure engineering. With 28 years of experience, Chris serves as a leading trenchless technologies resource for public utilities in the Carolinas. Over the last 12 years he has focused on the use of trenchless technologies for condition assessment, evaluation, renewal, and replacement of both pressure and gravity pipelines. His experience includes large diameter ductile iron pipe splitting, pipeline renewal with high pressure liners, various methods of gravity sewer rehab, and new installations via horizontal directional drilling. A graduate of NCSU with a BS in Civil Engineering-Construction, Chris regularly presents at conferences including NC AWWA-WEA, NASTT No-Dig, and UCT.

Brent Johnson - *Treasurer*

Brent Johnson has over 25 years of experience in the planning, design and construction of water and wastewater facilities. Since 2000, he has focused on the use of trenchless technologies for pipeline construction and rehabilitation. For the last ten years he has focused on the inspection and condition assessment of water and wastewater pressure mains and is the current chair of the NASSCO Pressure Pipe Committee. He has published magazine articles and presented papers at multiple conferences. He is located in the CDM Smith Raleigh, North Carolina, office and is the firm's technical leader for pipeline condition assessment and rehabilitation in the Southeast Region.

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2018 UPCOMING TRENCHLESS EVENTS

January 9, 2018
NASTT CIPP Good Practices Course
7:30 AM – 5:00 PM
Crowne Plaza
Anchorage, Alaska
Information:
www.nastt.org/training/events

January 30, 2018
NASTT Forum: Inspection and QA/QC for Trenchless Projects
10:00 AM – 11:30 AM
Underground Construction Technology Expo (UCT)
Ernest N. Morial Convention Center
New Orleans, Louisiana
Information:
www.nastt.org/training/events

February 7, 2018
NASTT HDD Good Practices Course (in partnership with NEGDC)
8:00 AM - 5:00 PM
PSE&G Training and Development Center
Edison, New Jersey
Information:
www.nastt.org/training/events

March 25 - 29, 2018
NASTT 2018 No-Dig Show
Palm Springs Convention Center
Palm Springs, California
Information: www.nodigshow.com

March 25, 2018
NASTT Introduction to Trenchless Technology - Rehabilitation
8:00 AM - 12:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 25, 2018
NASTT Introduction to Trenchless Technology – New Installations
8:00 AM - 12:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 25, 2018
NASTT Introduction to Trenchless Technology - Rehabilitation
8:00 AM - 12:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28, 2018
NASTT Gas Good Practices Course
2:30 PM - 5:30 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28 – 29, 2018
NASTT Pipe Bursting Good Practices Course
March 28 2:30 PM - 5:30 PM
March 29 8:00 AM - 12:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28 – 29, 2018
NASTT New Installation Methods Good Practices Course
March 28 2:30 PM - 5:30 PM
March 29 8:00 AM - 1:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28 – 29, 2018
NASTT CIPP Good Practices Course
March 28 2:30 PM - 5:30 PM
March 29 8:00 AM - 1:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28 – 29, 2018
NASTT Laterals Good Practices Course
March 28 2:30 PM - 5:30 PM
March 29 8:00 AM - 12:00 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

March 28 – 29, 2018
NASTT HDD Good Practices Course
March 28 2:30 PM - 5:30 PM
March 29 8:00 AM – 2:30 PM
Palm Springs Convention Center
Palm Springs, California
Information:
www.nastt.org/training/events

May 17, 2018
NASTT HDD Good Practices Course
7:30 AM – 5:00 PM
LOCATION TBD
Montreal, Quebec
Information:
www.nastt.org/training/events

March 17 - 21, 2019
NASTT 2019 No-Dig Show
Donald E. Stephens Convention Center
Rosemont, Illinois
Information: www.nodigshow.com

April 5 - 9, 2020
NASTT 2020 No-Dig Show
Colorado Convention Center
Denver, Colorado
Information: www.nodigshow.com

SESTT FOUNDER DR. TOM ISELEY INDUCTED INTO 2017 NASTT HALL OF FAME

Dr. Tom Iseley accepts NASTT 2017 Hall of Fame Induction at NASTT No-Dig Show in Washington D.C. (l-r): Mike Willmets, NASTT Executive Director, Frank Firsching, NASTT Chair, Dr. Tom Iseley, 2017 NASTT Hall of Fame, Bernie Krzys, Trenchless Technology Magazine, Enrico Boi, Chairman ISTT

At the NASTT 2017 No-Dig Show in Washington D.C., April 9 – 13, SESTT Chapter member Dr. Tom Iseley was formally inducted into the 2017 NASTT Hall of Fame.

Dr. Iseley is a founding director of both the North American Society for Trenchless Technology (NASTT), and his home SESTT Chapter. Dr. Iseley is also Chairman of the Buried Asset Management Institute – International (BAMI-I) and motivating force for the delivery and creation of the important Certificate of Training in Asset Management (CTAM) program, which has enrolled individuals from 14 countries (see page 44).

Dr. Iseley holds a B.S. in Civil Engineering, an M.B.A. from the University of Alabama in Birmingham and a Ph.D. in Civil Engineering from Purdue University, and has over 35 years of experience in the planning, design, and construction of underground infrastructure systems. From 1982 until 1995, he served on the faculty of Mississippi State University, Purdue University, Louisiana Tech University, and as chairman of the Department of Construction Technology at the Purdue University School of Engineering and Technology in Indianapolis.

In 1989, Dr. Iseley established the Trenchless Technology Center (TTC), an industry/university cooperative research facility, at Louisiana Tech University and served as Director for 5 ½ years and as Director of Development for 2 years. After serving as a senior advisor to the commissioner of the Department of Watershed Management for the City of Atlanta, he returned to Louisiana Tech & TTC on July 1, 2014. He has since established a strong program for TTC in China and was recently appointed to a 3-year adjunct professorship at the Xi'an Jiaotong University.

In 1993, Dr. Iseley was selected as the *Trenchless Technology* magazine Person of the Year. He received the ASCE 1995 John O. Bickel Award and the 1999 Stephen D. Bechtel Pipeline Engineering Award. He was elected as a Distinguished Member in the American Society of Civil Engineers (ASCE) at the annual ASCE convention in October 2015. At the 2016 Underground Construction Technology (UCT) annual conference in Atlanta Dr. Iseley was honored as the 2016 UCTA MVP (Most Valuable Professional) in a special luncheon ceremony.

Congratulations Dr. Iseley on this most recent honor: your induction into the NASTT Hall of Fame in recognition of your lifetime contributions to the advancement of the trenchless technology industry, nationally and internationally.

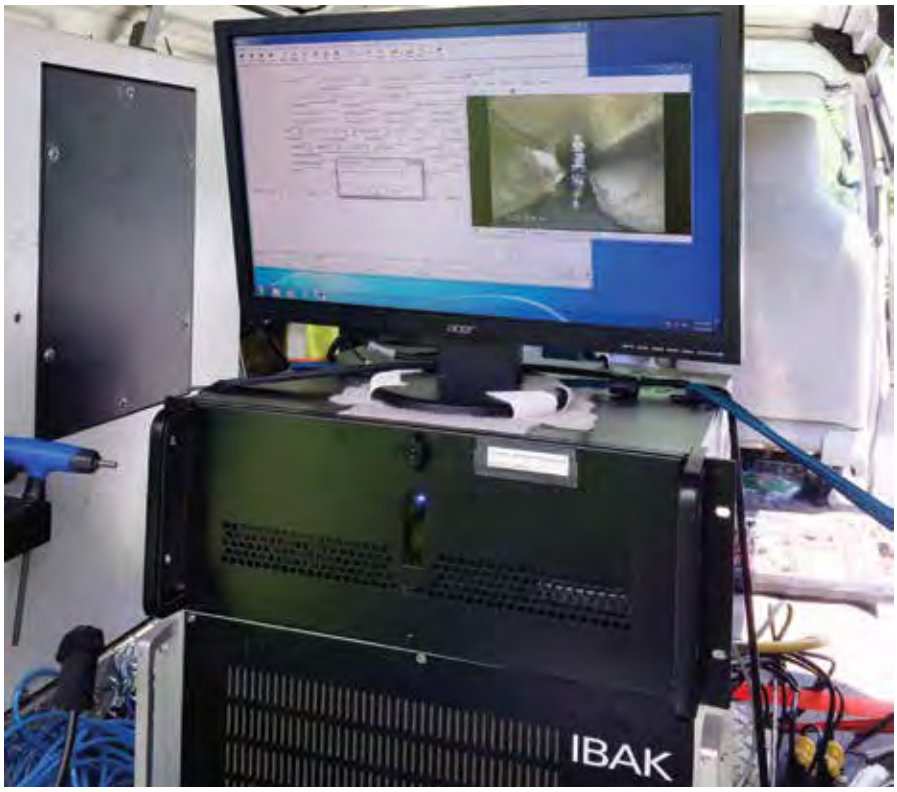
CITY OF RALEIGH NEUSE RIVER 72-INCH PARALLEL INTERCEPTOR CONDITION ASSESSMENT AND REHABILITATION

Old School Man-Entry Inspections of RCP Gravity Sewer

By: Brent Johnson, CDM Smith

The City of Raleigh, NC has nearly all their wastewater flowing through twin 72-inch sanitary sewer interceptors that follow the Neuse River. These parallel Reinforced Concrete Pipe (RCP) gravity sewer pipes are approximately 4.5 miles long running through neighborhoods and a golf course before terminating at the Neuse River Resource Recovery Facility. The purpose of this project was to assess the condition of the twin 72-inch sanitary sewer pipe system and to design rehabilitation or replacement methodologies. CDM Smith teamed with a local SSES firm to perform manned entry inspection of the pipes. This old-school approach was backed by a high definition camera which captured all data including PACP defect coding, wall penetration tests, and wall loss measurements.

The city of Raleigh completed construction of the South interceptor in 1973 and the North interceptor in 1998. The interceptors transport more than 40 million gallons of wastewater a day. The pipe material is Class III and Class IV RCP with a coal-tar epoxy liner. Parts of the South and North interceptors are installed in land bridges (culverts laid in a cut section, backfilled to desired elevation, pipe laid in concrete cradles, backfill over the pipe to minimum cover) and there is a reclaimed water line installed directly between the two interceptors.



CCTV Camera for Safety Oversight & Data Collection

In 2014 pole camera inspections were conducted on portions of the North and South interceptors. Results from the inspections showed exposed rebar in several of the pipes connected to the manholes. This indicates that the structural integrity of the pipe is

Manned entry inspection with soundings and wall penetration tests would more accurately identify areas that would otherwise pass the visual test but have structural issues lurking beneath the surface.

Pipe Wall Penetration Test

deteriorating and further efforts of condition assessment and ultimately rehabilitation were needed. The CDM Smith project team conducted the inspections from August 2016 to November 2017 of the pipes and associated manholes along each interceptor.

Corrosion and wall loss of RCP sanitary sewer pipes is one of the most common and early signs of an aging and deteriorating piping system. The corrosion and wall loss is typically concentrated above the flow line (unsubmerged portion of RCP), where hydrogen sulfide chemical attack is most common. Often it will be greatest at the crown and taper off at the flow line of the pipe. In addition to chemical attack, erosion of the pipe due to high velocities or debris can occur in the pipe invert. Corrosion and subsequent wall loss combined with pipe stresses can result in the eventual failure of RCP sewers.

The manholes and pipes along each interceptor were inspected by manned entry inspection. For the manned entry inspection of manholes and pipes a Field Health and Safety Plan was utilized that was developed in conjunction with CDM Smith and the City of Raleigh. The plan called for oxygen sensors, forced air, and backup oxygen while inspecting pipes. The inspection crew also utilized real time safety oversight using a CCTV camera in the pipe. In addition to these measures the local fire department and confined space rescue team was notified of start and finish time each day, along with the location they would be working.

As part of the inspection process CDM Smith initially inspected the manholes on each interceptor to verify the condition and ensure the pipes were in adequate condition to allow for manned entry inspection. They also verified whether there was substantial debris or sediment buildup in the pipe that would need removal. Following inspection of the manholes, CDM Smith inspected each interceptor by manned entry and recorded all data with a CCTV camera that followed the inspection crews throughout the inspection process. Upon completion of the inspection CDM Smith performed analysis of the manhole inspection reports and a database with pipe parameters and pipe defects in NASSCO PACP format.

Reinforcement Visible on Pipe Wall

Tool Cart with Emergency Oxygen, Handheld Laser, Sounding and Probing Equipment

Manhole Inspection

The inspections included collecting manhole dimensions, materials, defects, corrosion, and manhole wall loss due to corrosion. The interior manhole walls were sounded with a hammer at various clock positions during the inspection to check for deteriorated pipe. Any locations where wall loss was experienced, the diameter was measured to quantify the degree of wall loss. During the sounding process, if any soft concrete was observed, a penetration test was performed by tapping a penetration device into the concrete at varying clock positions.

Interceptor Inspection

During normal operations flow is conveyed by both interceptors, each flowing one-third full, from the Walnut Creek Pump Station to the Neuse River Resource Recovery Facility. Bypassing was accomplished by placing all flow in one interceptor while the other was being inspected. There are three force mains that feed into the interceptors along their length and each can be directed

> ***The plan called for oxygen sensors, forced air, and backup oxygen while inspecting pipes.***

to either the North or South interceptor. Small diameter gravity sewers from neighborhoods also feed into the system and depending on the amount of flow where either plugged and bypassed to the appropriate interceptor or just allowed to enter the pipe as normal during the inspection.

During the inspection process the diameter was measured at each manhole and then subsequently every 25 feet along the pipeline. In addition to collecting the diameter the pipe was sounded every 10 feet at various clock positions with a hammer to check for deteriorated pipe. A handheld laser was used to measure the diameter to determine the amount of wall loss. During the sounding process, if any soft concrete was observed, a penetration test was performed by tapping a penetration device into the concrete at varying clock positions. The measurements from the inspections were compiled along with PACP defects into a database for review and analysis by CDM Smith. The inspections also included CCTV inspection of the manned entry and defect coding was performed along each interceptor.

Evaluation

During the condition assessment, defect codes from the pipe inspections were compiled along with additional pipe parameters that were needed to assess the condition of each interceptor. The primary defects noted were structural defects, which consisted primarily of corrosion defects. Prior to inspections, CDM Smith developed a few modifications to the standard PACP coding process to capture the amount of corrosion present in each pipe. This was accomplished by recording the linear and circumferential limits of corrosion. To accomplish this, clock positions with a start and finish component were used to identify the circumferential limit of corrosion. Additionally, the limits of linear corrosion were recorded by using a start and finish code along with the CCTV station length to record the linear limits. The wall loss due to corrosion was determined by measuring the pipe diameter utilizing a hand-held laser. In addition to the visible wall loss due to corrosion, the inspections included pipe sounding and penetrations to measure pipe material that had become soft. When the pipe wall has become soft and could be penetrated using a hammer this section of pipe wall had lost its structural strength. The penetration measurement was added to the diameter measurement to formulate the total compromised wall material. The amount of wall loss ranged from none to nearly 2 inches of missing concrete.

The manhole and pipe inspection results were compiled and analyzed to assess the condition of each manhole and pipe segment for each interceptor. The condition assessment was combined with a structural analysis of the existing pipe condition, assumed installation conditions, and known pipe stresses to develop rehabilitation recommendations. The evaluation process consisted of two analyses. The first analysis included a condition assessment of each pipe segment, which consisted of a review of the inspection data to identify the defects on each interceptor. The second analysis was a structural analysis, which evaluated the structural condition of the pipes based on existing conditions and existing pipe stresses. After the condition of each inspected sewer segments was assessed, priorities for rehabilitation were established based on the likelihood of failure.

Structural Analysis

Per as-built drawings of the interceptors, ASTM C76 Classes III and IV pipes have been used along the alignment depending on the depth of cover and special conditions prevailing at those locations. Wall type was not noted on the available as-built drawings for both interceptors, therefore smallest available thickness wall type was assumed conservatively for the structural evaluation. In other words, wall type A was assumed for Class III pipes and wall type B was assumed for Class IV pipes. ASTM C76 requires minimum 1-inch protective cover over reinforcement. EPA (1985) guidelines define expected life of deteriorated concrete pipes as the estimated time remaining to expose the reinforcements. According to this EPA (1985) approach, the pipe segments identified with one inch or more of continuous wall loss have no remaining expected life.

Based on the as-built and known existing conditions along the pipeline

Forced Air Ventilation

alignment, the maximum cover on all pipeline segments were established for both interceptor pipelines. While the minimum cover and traffic load combination can also be a critical factor, this possibility was not considered for road crossings as the existing pipeline was installed through casings. The bending moments and thrust forces at the crown and springline locations were estimated from the external soil load and HS-20 live loads acting on the pipeline considering the known installation conditions. By considering the remaining pipe wall thickness at the crown as well as at the springline, the requirements for inner and outer reinforcement steel were estimated for the factored load conditions. These reinforcement requirements were compared with the provided steel, assuming no significant deterioration of the steel reinforcement has occurred.

Conclusion

In 2011 the CDM Smith project manager, along with City of Raleigh personnel, performed manned entry inspection of several sections of the 72-inch interceptors near the plant during upgrades being performed there that provided easy access to the interceptors. During the walk through it was noticed that many portions of the pipe had the coal tar epoxy layer intact, however, when a penetration test was performed in the crown of the pipe, plate sized chunks would spall off the pipe wall. The liner had become compromised in places and allowed the hydrogen sulfide to attack the concrete substrate underneath the coal tar epoxy liner. Since corrosion of the concrete walls was the main driver for this inspection, it was determined that manned entry inspection would be selected for this project over multi-sensor data platforms. Multi-sensor data such as laser profiling would only be informative in areas where the liner had completely failed and the concrete was eroded away. Manned entry inspection with soundings and wall penetration tests would more accurately identify areas that would otherwise pass the visual test but have structural issues lurking beneath the surface.

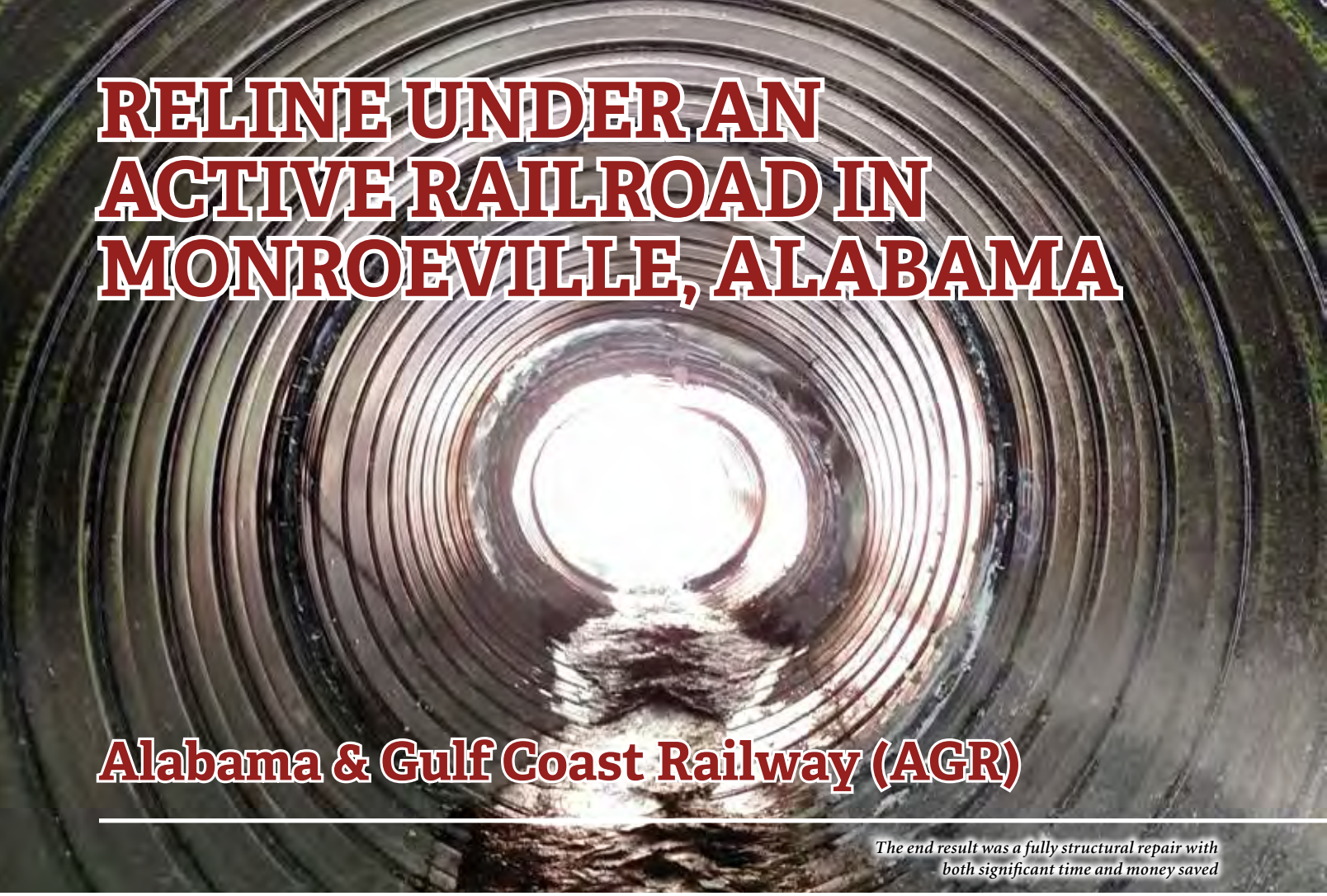
Following structural analysis CDM Smith provided rehabilitation recommendations and associated costs to the City for consideration. A meeting to discuss those recommendations concludes the first phase of this project effort. The guidance received from City staff will kick off the second phase of the project which is rehabilitation design. It is anticipated that the bulk of the interceptor rehabilitation will be segmental sliplining with some interceptors being replaced via open cut.

ABOUT THE AUTHOR:

***Brent Johnson** is focused on the condition assessment and rehabilitation of water and wastewater pressure mains and is current Chair of the NASSCO Pressure Pipe Committee. He is the CDM Smith technical leader for pipeline condition assessment and rehabilitation in the Southeast Region. Brent serves as the SESTT Treasurer. His full bio is on pg. 10.*

RELINE UNDER AN ACTIVE RAILROAD IN MONROEVILLE, ALABAMA

Alabama & Gulf Coast Railway (AGR)



The end result was a fully structural repair with both significant time and money saved

By: Don Herbert, Contech Engineered Solutions

- **Owner:** Alabama & Gulf Coast Railway (AGR)
- **Engineer:** Alabama & Gulf Coast Railway (AGR)
- **Contractor:** Chase Plumbing & Mechanical, Inc.
- **Technical Description:** ***Product:*** Smooth Cor™ double wall CSP, 14 GA ALT2 outer shell w/ 18 GA smooth, polymer-coated liner, 106 LF of **108-inch** ***Additional Product:*** **2-Flange Tunnel Liner Plate, 10.5 LF of 102-inch**
- **Installation:** April 2015

Alabama & Gulf Coast Railway (AGR), a Class II railroad owned by Genesee & Wyoming Company, began operations in Monroeville, AL in 1997 from Kimbrough, AL to Pensacola, FL. In 2003, AGR expanded from Kimbrough, AL to Columbus, MS with operations from Mobile, AL via BNSF Railway where major commodities expanded to include: lumber, paper products, chemicals, wood chips, metal and crude oil. They now operate a total of 442 miles of track through Mississippi, Alabama and Florida.

While the formation of AGR is relatively recent, many of the original track lines date even further back to the mid-1900s. As a result, there have been continual improvements, enhancements and updates made to keep the track lines safe and efficient throughout the years.

During a courtesy inspection along one of the tracks, AGR engineers noted that a 132-inch culvert running directly under the track had failed due to age, degradation, and poor installation methods used. The deteriorating culvert had experienced major encroachment along the toe of the slope after a major rain event and catastrophic washouts. Given this advanced degradation, AGR consulted three local contractors for proposed solutions and cost. AGR preferred a method that would allow the railroad to remain in operation while construction took place. Not only would this allow the line to continue unimpeded but would also provide substantial cost savings. However, they realized, with approximately 20 to 25 feet of cover above the deteriorating structure, finding a structural reline solution to address these issues could prove difficult.

Ultimately, AGR accepted a proposal by Chase Plumbing to reline the host

High performance and economical option in difficult conditions like weak soils, poor subsurface drainage conditions, steep slopes, and high fills

AGR preferred a method that would allow the railroad to remain in operation while construction took place

culvert with 108-inch diameter Smooth Cor™, a double wall corrugated steel pipe with a polymer-coated smooth steel liner and Aluminized Type 2 (ALT2) shell as well as 102-inch Tunnel Liner Plate, both manufactured and supplied by Contech Engineered Solutions. The combined interior liner and exterior shell of Smooth Cor makes this particular corrugated steel pipe the economical and performance alternative to concrete in difficult situations such as weak soils, poor subsurface drainage conditions, steep slopes, and high fills.

The Smooth Cor pipe was inserted on

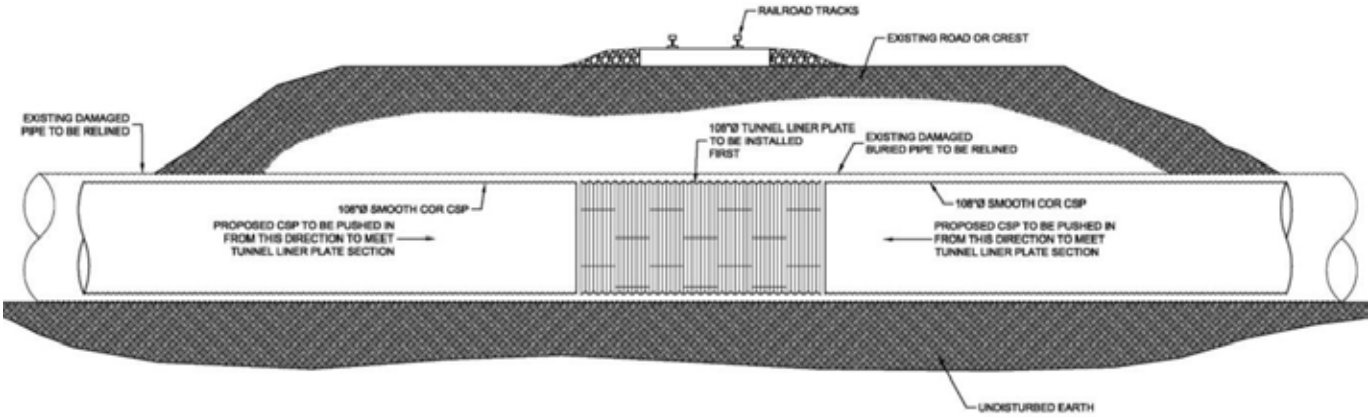


Figure 1. Detail of the Reline Process of the Existing Pipe with Smooth Cor™ and Tunnel Liner Plate.

struts from the south end. During this process, a partial collapse occurred directly under the rail which required an emergency hand lining with Contech's 7 gage, 2-flange Tunnel Liner Plate for roughly 10.5 LF. The full-length corrugations and lapped joints inherent with 2-flange Liner Plate provide more effective stiffness and ring compression and was ideal for relining this portion of the culvert. Smooth Cor was then used to line the rest of the length of the host pipe for a total of 117 LF installed.

Once the host was relined, the entire structure was grouted in multiple stages with a non-shrink grout while a low maximum grouting pressure of < 5 PSI was maintained. The end result was a fully structural repair with both significant time and money saved. The original pricing for open cut and replacement was upwards of $500,000. AGR was extremely pleased with the outcome of relining the host pipe which cut the original estimated cost by roughly 40 per cent.

ABOUT THE AUTHOR:

Don Herbert *is the Director for Rail Markets at Contech Engineered Solutions. He joined Contech in June of 1991 and has held many positions within Contech including sales engineer, regional sales engineer, area technical manager and most recently – area manager drainage. Don has a B.S. in Civil Engineering from Manhattan College and M.S. in Civil Engineering from Texas A&M University.*

There have been continual improvements, enhancements and updates to the track system

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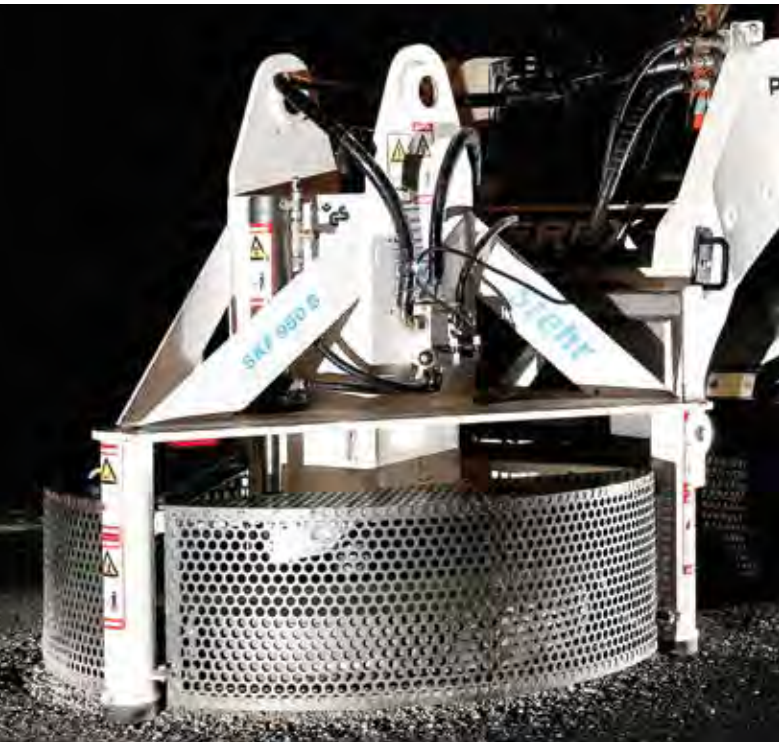
CUTTING CORNERS AND MAKING THE GRADE

By: Jerry Trevino, Protective Liner Systems, Inc.



The Stehr manhole cutter, develops 8000 to 9000 ft-lbs of torque

Manholes are located in roads, outfalls by creeks and rivers, in private yards, swamps and just about anywhere the sewer collection systems runs through to end up at its final journey, the waste water treating facility. The location of manholes does not affect people as negatively as much as the deteriorating or failed manhole pads on roads. Everyone has experienced driving their cars over steel plates and on very bumpy manhole covers and pads. In many cases drivers avoid driving over uneven manhole adjustment pads to avoid damaging their vehicles' suspension or to avoid the risk of a vehicular mishap.

For many years, we encountered damaged manhole chimneys located in roads. The leveling materials inclusive of bricks and mortar eventually fatigues and fails. Some manholes were previously internally rehabilitated only to find that over time, the chimney portion of the manholes located in roads had been impacted by vehicular traffic, from wear and tear of the road surface. This was primarily due to the poor quality of construction and materials that were used during the adjustment to grade after road repaving. In all cases, the manhole castings and lids had been adjusted vertically to grade in order to approximate the level of the adjoining street surface. In almost all cases, the manhole castings were encased in a square or rectangular concrete pad. In most cases, the concrete pad was damaged, cracked, and uneven.

While manhole adjustment pads look good for a few months, many fail prematurely and they disrupt traffic both while being adjusted, and after they break and fail.

Cutting the Corners

Approximately 15 years ago we worked with a company from Colorado to introduce to the manhole industry a new method for adjusting manholes located in roads. By using a circular core cutter and coring the streets to a minimum of 11 inches deep, we drastically changed the quality, aesthetics and longevity of the manhole pads by via this process.

A circular cut core removes the potential concentrated stresses that are developed in the corners of square cut pads thus "cutting corners". It also has other advantages.

Paved roads are resurfaced every 7 to 15 years. The frequency of repaving varies and is dependent on many factors and conditions inclusive of funding, weather and traffic conditions. In the process, the top layer asphalt is removed via an asphalt milling machine. The milling machines mill or grind off the asphalt to a certain depth and convey the tailings onto a conveyor and then into dump trucks. The top of the manhole frame castings and covers, along with other utilities, may be in the path of the milling machines. Should the milling machine's grinding drums encounter a manhole frame casting and cover, it tears up a lot of carbide teeth, teeth holders, and it may also damage the drum. In the past, the milling machines would mill around the manhole castings and pad, then later grind the area around the manholes with smaller grinders. When the asphalt is applied, many manhole covers were asphalted over which making impossible to access the sewer at those points of entry. In addition, the manholes would be difficult to locate.

About 12 years ago we introduced the idea of lowering the manholes pads before milling. Using a skid steer attachment, we cored the manhole pads, remove the castings, shims and other leveling materials including wood, rocks, and at times squashed beer cans. We placed a steel plate over the opening, then placed low strength concrete on top of the plate to grade. After the milling and asphalt paving was complete, we would locate the buried manhole, re-core the street again, install a new manhole ring and cover to grade.

Often the concrete pad is damaged, cracked, and uneven

A circular cut core removes potential concentrated stresses and has many other advantages

Many concrete pads can fail prematurely and disrupt traffic

Making the Grade

Placing the manhole castings to grade with minimal impact on the road surface requires a lot of attention to detail. It involves placing a concrete pad with high strength fast setting concrete and designing the manhole pad so that the weight and impact of traffic is not solely received by the manhole chimney and walls but more supported by the ground surrounding the manhole. The new pad will also serve as a new chimney seal and prevent infiltration and inflow into the manhole. These are some of the extra benefits achieved by this manhole adjustment method.

This process provides a higher quality level of manhole rehabilitation, which facilitates better trenchless repair and rehabilitation approaches.

Available Equipment

After introducing this manhole core cutter, other companies have offered similar and different equipment to core or cut the manhole pads. These type of cutter can cut through asphalt readily, however take a much longer time to cut through concrete. There are some sensitivities to consider in selecting a manhole cutter such as:

- **Safety.** The cutter should have a built in safety guard so that workers do not come in contact with the rotating cutting blade or core saw.

- **Core cutter attachment.** The cutting of the asphalt or concrete requires a skid steer tractor. In the case of the Stehr cutter, it develops 8000 to 9000 ft-lbs of torque. Therefore, a 10,000 pound dual hydraulic flow skid steer works more effectively.

- **Stability.** The cutter must stable enough to cut through asphalt independently without requiring the cutter blade to support and center itself to the existing manhole chimney or frame casting. Centering the cutter to the manhole damages the manhole.

- **Wear Parts.** Determine the cost of the sacrificial wear parts. In some cutters only the cutting carbide teeth wear out. In some machines the entire cutting blades wear out.

- **Long term investment.**

ABOUT THE AUTHOR:

Jerry Trevino *is President of Protective Liner Systems, Inc., specializing in infrastructure rehabilitation since 1984. As longtime SESTT Chairman, Jerry strongly believes that Trenchless Technologies offer numerous methods to maintain and upgrade aging infrastructure. His full bio is on pg10.*

VIPER SETS NEW HOLE OPENING STANDARDS

Features Improve Production, Lower Costs

By: Malloy Akston

Enlarging a horizontally drilled hole is usually the most expensive cost of an HDD rock project. From bid to pull back, hole opening decisions often determine the difference between a profit or a loss. HDD has never been more competitive and there is nothing successful about failing to make a profit. It starts and ends with drilling skills. The most efficient rock contractors know how to maximize margins by minimizing risks. The most experienced HDD veteran understands the value of the right tools and a good service company. That's where the Viper and HTI come into play.

"It's a long-term mission", states John English, founder of HTI. "HDD is tough on tools and we produce the strongest tools possible. There are basically two styles of HDD hole opening tools, oilfield and split-bit. Split-bits are historically water well tools, easy to build and available from just about any suppliers who knows where to buy bit-thirds. Not only is there is a difference between Oilfield style hole openers and split-bits, there is a difference between supply companies and a good HDD service company. It is a combination of experience and quality. Why does Horizontal Technology Inc. continue to lead the way in HDD hole opening technology where other HDD service companies continue to try to build standard hole openers yet fail, resorting back to the split-bit? Experience is the answer and the difference.

"The features of the Viper hole opener were developed after hundreds of wells and thousands of feet of vertical hole opening. After decades of oilfield experience our team started building tools for river crossings back in the 1980s. Roller cone hole openers allow the contractor to apply more weight with less torque. This provides improved penetration rates. We combine our drilling experience with our manufacturing experience and produce tools that improve the HDD industry. Others have tried and other have failed, yet Horizontal Technology continues to raise the standards. The Viper Hole Opener provides features and benefits designed to save contractors time and money."

Not just HDD contractors, the Viper style tool is used by Oil and Gas drillers around the world. In fact, the toughest Oil & Gas drilling takes place in the cap-rock of storage wells. The Viper style tool is a primary choice of oilfield storage well experts. Think about it. Competent oilfield exploration companies would never use a split-bit style tool. Why? They have too much invested. Split-bits can't take the weight and too easily lose cones. They are far too risky. Split-bits, regardless of who welds them together, are equally susceptible to drop a cone, or cones, down-hole. In just the last year, HDD contractors have wasted untold down time building and dragging fishing baskets through existing holes or, in too many cases, re-drilled the pilot hole, due to lost cones. Sadly, records of lost cones are not kept, but, just counting the last few months, the costs of lost split-bit cutters is well into the millions. In the same period, there has not been one lost Viper cone. The most experienced rock drillers not only know the best tools, they know how to use the best HDD service companies.

> ***The Viper had an immediate impact on our production rates, it lasted, and continues to last longer, than any hole opener we had previously used***
>
> Billy Cleveland, President, Delta Directional.

As the Viper was unveiled, Horizontal Technology, Inc. purposely limited its use to only the most experienced rock drilling contractors and the toughest jobs. "We drill as much rock as any anyone and have tried a lot of different hole openers. The Viper had an immediate impact on our production rates, it lasted, and continues to last longer, than any hole opener we had previously used" says Billy Cleveland, Delta Directional President.

Today the Viper is used by HDD contractors around the world, and its reputation grows daily. Drill after drill and project after project, the new Viper Hole Opener continues to outperform all competitors. Without question, the Viper is the strongest, most durable HDD hole opening tool ever built.

The Viper's unique features lower costs and improve production:

- From 8 ¾ inches to 72 inches, MT or TCI, the Viper can be ready to ship in less than an hour.
- It can be pushed or pulled and performs for longer hours with far less risks than any split bit design.
- The cutter design allows for larger, oversized, bearings and the cutter itself is secured on both ends. This allows the driller to apply the appropriate weight to maintain the best penetration rates.
- Each body can be used to open a variety of different size holes. This flexibility can prevent down time and freight charges.
- Often, the same cutters can be taken from one size tool and used on the next size. For example, 30-inch to 36-inch. This can save the cost, many thousands of dollars, of purchasing an additional hole opener body.
- You only pay for what you use.

It's a long-term mission... Experience is the answer and the difference

JOHN ENGLISH, FOUNDER, HTI.

There is always a possibility that a hole opener may not complete the footage required. Split bit hole openers are bought the moment ordered. If you think you need one tools, you probably need to order two. What is the cost of opening the hole? With the Viper, you do not pay for hole openers not used. The backup can be there, on site, ready if needed. When the first Viper hole opener completes the pass, return the back up at no charge. This is a matter of costs vs. savings.

In HDD conditions can change quickly and dramatically. What happens if you gear up for a TCI hole opening project and once drilling starts you discover that MT style cutters are needed. If you have already purchased TCI split bits,

Hard rock but Viper finishes the job

V10 Viper. Pilot hole straight to 32 inches. 22,000 PSI Rock (104 hours)

that money is gone. Not to mention the down-time wasted having the correct tools manufactured and shipped.

That exact scenario happened on a large project in Canada. The contractor was told by the split bit manufacturer that the local formation would require their "special" TCI split bit hole openers built specifically for the area. As with all split-bits, the high dollar hole opener purchase had to be completed upon ordering tools. Once drilling started, it was obvious the geological information had been incorrect and MT style cutters, not TCI, were needed. This could have been a catastrophe but luckily, the management had decided to go with the Viper. Quickly and at no cost, the Viper cutters were changed from TCI to MT, saving the contractor millions.

A great success, even if the story ended there. But it didn't. The same cutters used on that project have been used to complete numerous additional projects. With every foot drilled, the savings continues to increase. Best of all, even with the used cutters, there is far less danger of losing a Viper cone in the hole than from a new split-bit.

Horizontal Technology Inc. takes pride in raising the HDD hole opening bar. Used around the world, even HTI's competitors sell their hole openers. Today, overall HDD knowledge is at an all-time low and HDD experience is at an all-time premium. Take advantage of HDD's most experienced service company next time you need to plan a project.

ABOUT THE AUTHOR:

Malloy.Akston@gmail.com

Malloy Akston *is currently a freelance writer residing in Houston Texas. With a 30 plus year career in Oil & Gas exploration and development, he has written numerous product manuals and industry magazine articles. He has also written for sports magazines.*

ADDING PIPE BURSTING TO YOUR TOOLBOX OF REHABILITATION ALTERNATIVES

By: Chris Ford, P.E., Highfill Infrastructure Engineering, P.C.

Pipe bursting down the center of Queen Street, Kinston, NC

If you are excavating to replace more of your sanitary sewers these days, it's time to add a trenchless replacement alternative to your rehabilitation program.

Traditional sewer rehabilitation programs have typically included the following alternatives:

- Point repairs
- Renewal by cured-in-place pipe (CIPP) lining
- Slip-lining
- Open-cut replacement

A typical program uses point repairs to resolve isolated defects. CIPP lining is used to address multiple, or continuous, defects that meet certain criteria. Where a few of these criteria cannot be met, a limited number of point repairs (typically 2-4) may be performed, followed by CIPP lining. Slip-lining may be used where capacity reduction is acceptable. Where numerous CIPP criteria cannot be met, the sewer is replaced by open-cut excavation.

With this approach, CIPP lining criteria dictate whether a cost-effective trenchless alternative is appropriate, or if potentially costly open-cut replacement is required. The CIPP criteria may include some or all of the following:

- Pipe slope in relation to minimum grade.
- Volume of point infiltration/inflow (I/I).
- Distance of offset at joints.
- Amount of joint settlement.
- Percentage of pipe deformation.
- Degree of longitudinal and circumferential cracking and fracturing.
- Degree of root intrusion.
- Debris and blockages.
- Size of holes and voids visible.
- Degree and length of sags.
- Degree of horizontal deflection.
- Condition of previous point repairs.

The alternatives in a traditional rehabilitation program can be sufficient where sewers are relatively shallow and not in proximity to existing utilities, structures, and property lines/right-of-ways, where excavation and replacement costs are relatively low. These alternatives can also be sufficient where open-cut replacement does not require costly restoration, such as paved roadways. However, where these conditions do not occur, pipe bursting typically provides a much more cost-effective solution than open-cut replacement.

Sewer Replacement by Pipe Bursting

Pipe bursting is a trenchless method of pipe replacement in which a bursting head is pulled through an existing (host) pipe, fragmenting (or splitting) the host pipe, displacing the broken pipe and soil, and replacing it with a new pipe that is pulled behind the bursting head and expander. Where feasible, pipe bursting is often a more cost-effective means of pipeline replacement than open-cut excavation because it:

- Minimizes excavation requirements.
- Reduces the removal and restoration of pavement.
- Reduces conflicts with existing utilities.
- Results in a smaller disturbed footprint with reduced restoration.
- Reduces social impacts, including disturbance of personal property, local traffic impacts, and reduced access to businesses and properties.

Pipe bursting pipe insertion pit in the center of Queen Street

- Minimizes permitting requirements due to less disturbed and area.
- Reduces environmental impacts.
- Often proceeds more quickly.

Pipe bursting also provides the option of using fusible pipe which eliminates joints that can deteriorate over time and allow infiltration. This is most beneficial in saturated soils with high or perched water tables. Pipe bursting can be performed with a variety of replacement pipe materials including high density polyethylene (HDPE), fusible polyvinyl chloride (FPVC), ductile iron, and some segmental pipe materials.

Pipe bursting machine pit in the center of Queen Street

Pipe bursting suitability is evaluated based on the same criteria as CIPP lining, though the criteria are more lenient or have no impact at all. Pipe bursting is not impacted by I/I and can correct defects to some degree, such as offset joints, joint settlement, pipe deformation, cracking and fracturing, and holes with voids visible.

Case Study: Queen Street Sewer Rehabilitation Phase 1, Kinston, North Carolina

As with many municipalities across North Carolina, the City of Kinston is faced with aging and deteriorating infrastructure. In the downtown area, most of the sanitary sewer is more than 60 years old, with some sewers dating back to 1914. Queen Street, which is also US 258 Business, US 70 Business, and NC 58, extends in the north/south direction through the heart of downtown Kinston. The downtown area consists of a mixture of land uses including commercial, office, institutional, and residential. Banking and financial institutions, the Lenoir County Courthouse, business establishments, retail outlets, restaurants, and residential units are located along Queen Street.

The sanitary sewer along Queen Street through downtown collects sewer from cross streets and increases in size as it extends south. The vast majority of the sanitary sewer downtown lies in the center

of the roadway, where excavation and replacement is costly and impacts business and commerce. The deeper sewers along Queen Street are below the water table, requiring costly and time-consuming well pointing to prevent running sand conditions.

In November 2013, what started as a routine sewer repair on Queen Street, turned into a three-day sewer replacement, resulting in the partial closure of the street. The unplanned closure inconvenienced and aggravated local business owners and patrons. This experience raised the level of concern among City staff about the condition and criticality of the sewer along Queen Street, and the cost and social impacts that would result from future failures.

The City desired to develop a condition assessment and repair program to identify defective sewers and restore the structural integrity. This would enable the City to:

- Provide reliable sewer service
- Decrease the possibility of sanitary sewer overflows (SSOs)
- Minimize future disruption along Queen Street.

Well pointing for deep excavations in Queen Street

To accomplish this task, the City solicited a study to:

- Assess the condition of the Queen Street sanitary sewer and tributary side street sewers,
- Develop trenchless alternatives for rehabilitation or replacement of deficient sewers where possible,
- Provide recommendations for rehabilitation or replacement, and
- Provide an implementation plan for the recommended improvements.

Condition Assessment

The condition assessment included review of CCTV to identify structural and maintenance defects, and a manhole survey for evaluation of pipe grade. Review

Maintaining service to businesses along Queen Street

of the CCTV indicated a wide range of conditions, from Stage 1 Deterioration, with cracks, minor infiltration, and minor offset joints; to Stage 3 Deterioration, with fractures, major offset joints, deformation greater than 10%, major sags, major infiltration, and broken and collapsed pipe. The condition assessment methodology followed the NASSCO PACP Condition Grading System Process.

Rehabilitation Strategy

To select the appropriate method of rehabilitation for each sewer, criteria were presented to the City that defined the acceptable parameters for each of the rehabilitation methods. These criteria were adapted to meet City objectives and preferences. The method of rehabilitation was selected for each sewer segment based on the results of the condition assessment and the rehabilitation method selection criteria. Sewers that met all the criteria for CIPP lining were designated to be lined. Sewers that could be lined with minimal point repairs were also designated to be lined. The remaining sewers that met the criteria for pipe bursting were designated to be burst. Sewers that did not meet the criteria for pipe bursting were designated to be excavated and replaced.

Installing service laterals along Queen Street

Cost Comparison of Pipe Bursting versus Open-Cut Replacement

The Queen Street Sewer Rehabilitation Phase 1 project was bid as a pipe bursting project with open-cut replacement where the sewers did not meet the pipe bursting criteria. Typically, this was the minimum grade criterion. The quantities and cost for the various components of the project are provided in Table 1.

To evaluate the cost-effectiveness of pipe bursting for this scenario, the unit prices from the bids were used to approximate the cost of open-cut replacement of all sewer in the project. The revised quantities and cost are also provided in Table 1.

The cost for open-cut replacement was $1.4 million, or 40% more than the cost for pipe bursting; a substantial savings. Note that $1.1 million of the cost difference was removal and restoration of asphalt roadway.

Murphy's law

Concrete encasement around 15-inch clay sewer

Unfortunately, the City was not able to fully recognize these savings. The larger sewers were found to be encased in concrete and could not be burst, thus leaving two alternatives:

- Open-cut replacement.

TABLE 1:

Pay Item	Unit	Pipe Bursting		Open-cut Replacement		Difference	
		Qty	Cost	Qty	Cost	Qty	Cost
Mobilization (maximum 3% of Bid)	LS	1	$88,235	1	$143,078		$54,843
Saw Cut, Demolish, and Remove Asphalt	SY	7,922	$118,830	18,088	$271,320	10,166	$152,490
Pipe Burst Sanitary Sewer	LF	8,770	$833,200	0	$0	(8,770)	($833,200)
Excavate and Replace Sanitary Sewer - 8"	LF	2,489	$170,019	7,918	$540,865	5,429	$370,846
Excavate and Replace Sanitary Sewer - 10" to 21"	LF	369	$50,582	3,710	$423,179	3,341	$372,597
New Sanitary Sewer Lateral Connection	EA	162	$400,205	162	$496,410	0	$96,205
Pavement Restoration	LS	1	$731,377	1	$1,713,908	0	$982,532
Replacement of Unsuitible Soils	CY	1,396	$120,176	3,641	$319,322	2,245	$199,146
Other Pay Items	LS		$1,004,263		$1,004,263	0	$0
Total Cost (millions)			**$3.52**		**$4.92**		**$1.40**

• Multiple point repairs and CIPP lining.

Due to the costly and time-consuming removal of the concrete encasement, the more cost-effective approach was determined to be performing multiple point repairs and lining with CIPP.

The First Steps

If you want to add pipe bursting to your rehabilitation program:

- Establish criteria that define the acceptable parameters for pipe bursting.
- Identify locations that are representative of sewers where pipe bursting is projected to provide a cost-effective solution and then perform a pipe bursting feasibility evaluation. The feasibility evaluation should investigate the factors that can impact the feasibility and cost-effectiveness of pipe bursting and confirm that pipe bursting is a viable, cost-effective rehabilitation alternative.
- Proceed with a test project.

Adding pipe bursting to your toolbox of rehabilitation alternatives will provide the benefits of a trenchless replacement solution, resulting in a more cost-effective and less invasive rehabilitation program.

ABOUT THE AUTHOR:

Chris Ford P.E. *is the Trenchless Technology Specialist, Vice President and Principal at Highfill Infrastructure Engineering, P.C. With 28 years of experience, Chris provides a leading trenchless technologies resource for public utilities in the Carolinas. A proponent of the benefits of trenchless methods, Chris serves as Secretary on the SESTT Board of Directors. His bio is on pg. 10.*

RALEIGH SEMINAR MARCH 29 – 30, 2017:

GUEST PRESENTATION

"Trenchless Technology in Raleigh"
Mr. Aaron B. Brower, P.E., Assistant Public Utilities Director, City of Raleigh

PRESENTATIONS

Welcome Address and "Liquid Assets" Overview Video,
Leonard Ingram, PWAM, SESTT Executive Director

Overview of Trenchless Technology & NASTT Education Efforts,
Dr Tom Iseley, P.E., Louisiana Tech University

Sealing the Collection System with a Focus on Main to Lateral Connections,
Jason Mathey, LMK Technologies

Underground Gyroscopic Mapping Tool,
Mac McGarry, CUES

The Trenchless Technology Center (TTC),
Dr Tom Iseley, P.E., Chairman & Executive Director, TT Center

Multi Sensor Inspection,
Ed Diggs, Pipeline Inspection Partners Corp

Guided Boring Using Pilot Tube,
Steve Matheny, Logan Clay Products

The Versatility Of 100% Solid Epoxies Systems,
Phil Warren, Warren Environmental

Rehabilitation of Underground Structures,
Jerry Trevino, Protective Liner Systems

Geotechnical Investigations & Risk Factors for HDD/Direct Pipe Trenchless Methods,
Trevor Hoyles, GeoEngineers, Inc.

The Evolution of the Cored In Place Process for Pipe Line Remediation,
Kaleel Rahaim, Interplastic Corp.

Conquering Microbial Induced Corrosion,
Scott Kelly, AP/M Permaform

Rehabilitation Of Large Diameter Infrastructure Using 100% Solids Epoxy,
Max Silva, Warren Environmental

Design & Installation Of PE4710 For Water Systems Per ANSI/AWWA C906 & AWWA M55,
Camille Rubeiz, P.E., Plastic Pipe Institute

CIPP 2.0: Force Main And Water Line CIPP QA/QC Processes,
Jake Crowe, Inland Pipe Rehabilitation

BAMI-I Asset Management Training Initiatives,
Kurt D. Wright, SDG Engineering, Inc.

Crabtree and Upper Pigeon Interceptor Tunnels Project
Mike Wanhatalo, Bradshaw Construction

TRENCHLESS TECHNOLOGY EDUCATION & NETWORKING!

SESTT Seminars Promote Trenchless Technology across the Southeast

SESTT Trenchless Technology seminars are great networking and educational opportunities

Trenchless Technology, SSES and Buried Asset Management Seminars hosted by SESTT in locations across the Southeast have a solid reputation as premier educational events, with knowledgeable industry presenters on a wide range of trenchless technology topics.

As part of the SESTT mandate to "promote Trenchless Technology through education for the public benefit", the seminar programs are designed to inform public officials, engineers, utility company personnel, designers, and contractors involved with the construction, rehabilitation, and management of underground infrastructure assets, in the Southeastern U.S.

SESTT **Trenchless Technology, SSES and Buried Asset Management Seminars** are

> ***Everyone is focussed on networking and learning in a small classroom setting. Being together in the same room for a full day promotes informal networking"***
>
> LEONARD INGRAM, PWAM, SESTT EXECUTIVE DIRECTOR

excellent opportunities to learn about the latest trends and technologies in trenchless underground construction. With educational and informative trenchless presentations, product demonstrations, networking and ideas, the seminars provide relevant technical knowledge with immediate value and application. Adding a little fun and excitement to the seminars, at the end of each session there is a draw for two fresh 100 dollar bills, and draws for door prizes donated by the exhibitors.

Jointly sponsored with the local ASCE section and/or branch, registration fees for the SESTT seminars include program materials, all day refreshments, breakfast pastries, lunches, networking, and a PDH Certificate. Special thanks go out to 2017 food sponsors ***Akkerman, CUES, Hammerhead Trenchless, Interplastic Corporation, LMK Technologies, Pipeline Inspection Partners Corp, Plastic Pipe Institute,*** *and* ***Warren Environmental***.

SESTT Executive Director Leonard Ingram believes the seminar programs are essential in fulfilling the SESTT mission to promote the growth of trenchless technology in the Southeast:

"Everyone is focussed on networking and learning in a small classroom setting. Being together in the same room for a full day promotes informal networking. We've seen SESTT seminars have really helped grow the business of trenchless technology across the Southeast over the years. They promote greater understanding and acceptance of different trenchless applications, and underline the critical importance of systematic buried asset management"

Recently the seminar format has been changed into a more compact and accessible single day event.

Mr. Pablo San Martin, Public Works Superintendent, Jefferson Parish, took a short break from weather-related work and visited the New Orleans seminar to give a short informative talk on the Jefferson Parish Trenchless Technology program. It was a great presentation.

For information dates and locations of the proposed 2018 SESTT Trenchless Technology, SSES and Buried Asset Management seminars planned for the Southeast, visit:

www.sestt.org

NEW ORLEANS SEMINAR OCTOBER 24, 2017:

PRESENTATIONS

Welcome Address to the Trenchless Technology Seminar
Leonard Ingram, PWAM, SESTT Executive Director

Trenchless Technology Center,
Dr. John Matthews, TTC

Inspection Tools for Determining Remaining Useful Life,
Ed Diggs, PIPC

Manhole Rehabilitation Options and Alternatives,
Spencer Tuell, Gulf Coast Underground

The CIPP Process – Is It Safe?,
Kaleel Rahaim, Interplastic Corporation

Controlling I&I for the Greater Good of the Collection System,
Britt Babcock, Avanti International

Structural Polyurethane,
Chip Johnson, Sprayroq

Pilot Tube Microtunneling,
Troy Stokes, Akkerman

Slipline Rehabilitation of Large Diameter Sewers,
Kirk Eager, Hobas Pipe

CIPP Lateral Rehabilitation,
Tommy Trapp, BLD Services, LLC

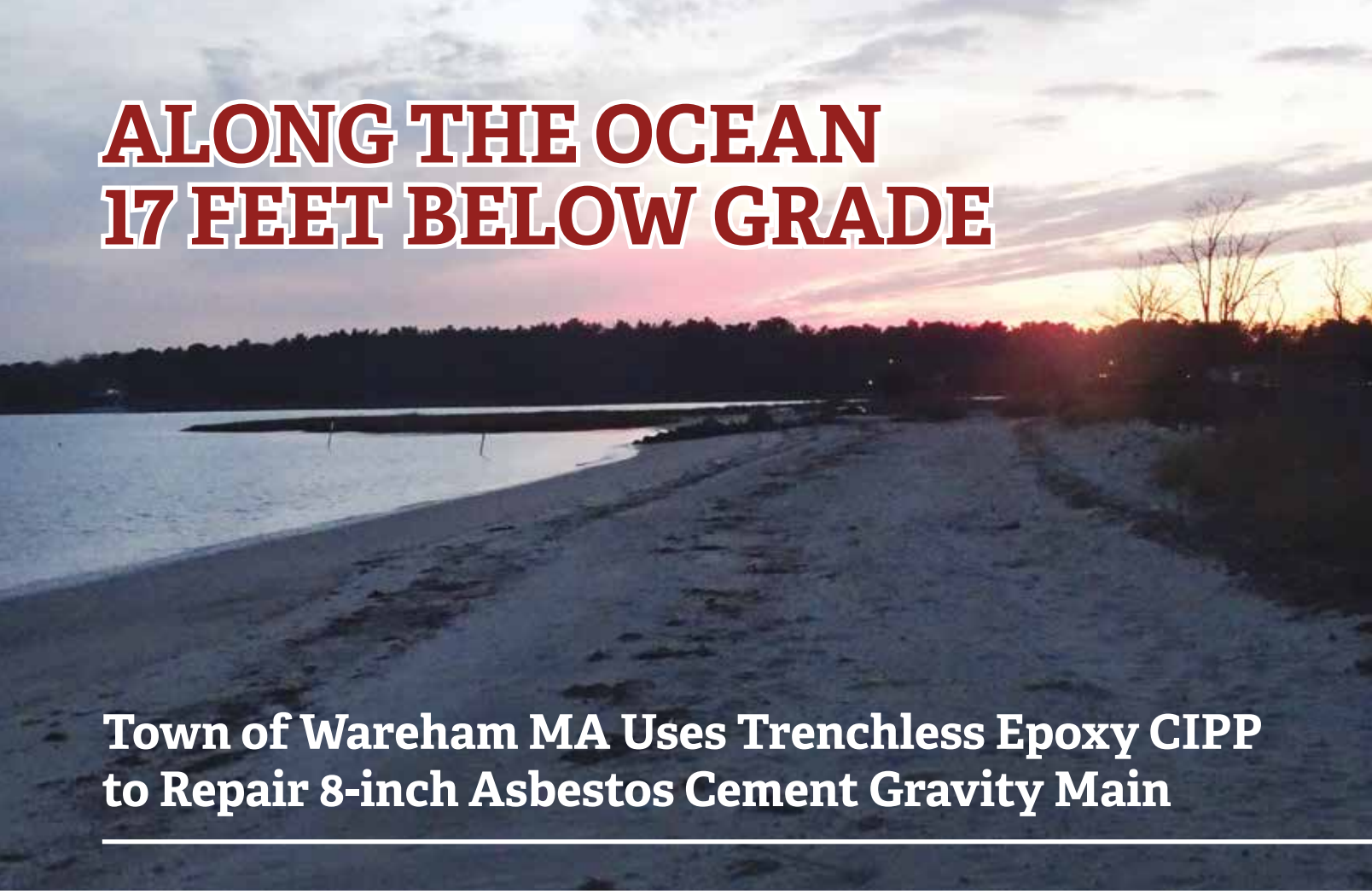
Fold and Form PVC Liners for Culvert Rehabilitation,
David Ohayon, IPEX USA LLC

Why Standards Matter - The Importance of Adhering To ASTM F2561 Standard,
Bruce Tobey & Bevin Beaudet, LMK Technologies

Rehabilitation of Underground Structures,
Jerry Trevino, Protective Liner Systems

Biogenic Corrosion and Cementitious Materials,
Joe Talley, Kerneos Inc.

NASTT SOUTHEAST CHAPTER



ALONG THE OCEAN 17 FEET BELOW GRADE

Town of Wareham MA Uses Trenchless Epoxy CIPP to Repair 8-inch Asbestos Cement Gravity Main

By: Guy Campinha, Town of Wareham;
Garrett Keegan, P.E., Green Seal Environmental Inc.;
Danny Warren, A&W Maintenance Inc.

Introduction

With an approved contract in place between the Town of Wareham and Warren Environmental to begin CIPP rehabilitation of a challenging 1600 foot length of severely deteriorated 8-inch Asbestos Cement (AC) gravity main, there was a sudden unexpected complication. A displacement of over 18 inches was discovered at a break in the pipe that was previously repaired by excavation and replacement in 2013.

Already a challenging job, the difficulty factor was raised to a whole new level with this find. The 8-inch AC gravity main was at 17 feet below grade under Wankinco Avenue along the ocean in Swifts Beach. The water table was only at 6 feet, so even with the strong tidal flux this section of main was permanently below the water table. The original project goal had been to stop the major infiltration entering into the main while re-establishing the pipe's structural integrity. Now, in addition to the wet pipe and inclination issues, we had to wrestle with a tough choice between digging up and replacing the deflected section, or attempting an in situ CIPP repair to bridge and reduce the pipe separation.

After all available options were researched, weighed and discussed, our group (Danny Warren - Warren Environmental, Guy Campinha - Director Wareham WPCF, and Garrett Keegan - Green Seal Environmental), decided to present to the Board of Sewer Commissioners for approval of a change order, the idea to use CIPP as a repair for the more than 18-inch separation in pipe.

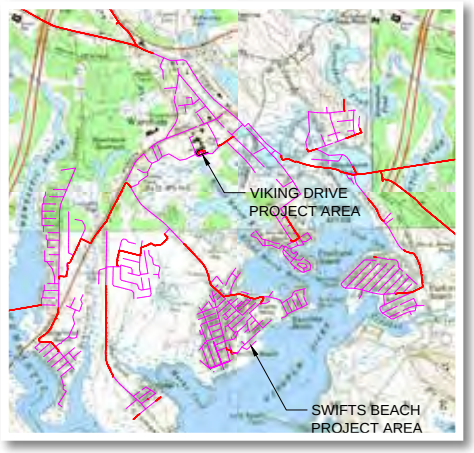
At the same time, there was another unexpected event on the other side of town. A 21-inch reinforced concrete pipe (RCP) interceptor sewer running under newly constructed tennis courts at Wareham Middle School was found to be in need of immediate repair following a CCTV inspection. Again trenchless Epoxy CIPP repair was selected as the best option, the project was put to bid, and Warren Environmental was awarded the contract.

This article details the considerations and collaborative efforts which led to the selection and use of epoxy cured in place (CIPP) liners in these projects: the rehabilitation and repair of the deteriorating 8-inch AC gravity main at Swifts Beach, and the repair of the 21-inch RCP interceptor sewer along Viking Drive near Wareham Middle School.

Both projects give ample and

> ***There is an estimated 630,000 miles of AC pipe in the United States and Canada. Most of these pipelines are nearing the end of their design life.***

8-inch AC Pipe at Swifts Beach is permanently under water table at 17 feet depth



Epoxy CIPP repair was selected for both locations

convincing demonstration of the efficacy and cost benefits of utilizing Epoxy CIPP for rehabilitation and repair of AC, and also RCP sewer pipe. They provide great encouragement for the Town of Wareham to use trenchless technology as the go-to approach for pipe repairs.

Town of Wareham

A beautiful community in Plymouth County, with 54 miles of sandy beach coastline, the Town of Wareham has 22,000 year- round residents, and doubles to 44,000 residents in the summer months. Every day, approximately 1 million gallons per day (MGD) is directed to the Water Pollution Control Facility (WPCF) through a network of 70 miles of gravity pipe and 45 pump stations, where it is subjected to biological nutrient removal extended aeration process, and eventual water body discharge.

Significantly 15 miles of the Town's gravity sewer network is AC pipe running along the coast mostly under the tidally influenced water table. Because of aging and corrosion many sections of this AC pipe are beginning to deteriorate and experience infiltration issues.

History of AC Water and Sewer Pipe

Asbestos cement (AC) pipe has been used world-wide for water supply and sewer piping since its invention in Genoa, Italy in 1906. In the United States AC pipe was installed primarily from the mid-1930s to early 1980s , when the potential health risks were discovered for both the manufacturers and installers of asbestos materials, as well as the public at large. Airborne asbestos fibers were discovered in the manufacturing and installation processes of asbestos materials, and it was found that as AC pipe deteriorated and corroded it released asbestos fibers into the water supply.

Asbestos cement pipes remain in use in many locations today; in fact there is an estimated 630,000 miles of AC pipe in the United States and Canada. Most of these pipelines are nearing the end of their typical design life of 50 years. AC pipe

Lining & curing pipe into the night. The neighbors could not have been more hospitable

gradually superseded cast or ductile iron and vitrified clay pipe in a large number of applications because asbestos cement is relatively resistant to corrosion, resistant to electrolytic action when buried, light weight, strong, economical to install, and unaffected by temperature changes.

However, asbestos was later found to have significant adverse risk of health effects when fibers are released to the air or water, and as the pipes age they are more prone to failure or fiber release due to corrosion and physical wear. Asbestos cement water mains are not believed to represent a significant hazard to public health in normal use or even if broken into pieces during replacement. However, repair, rehabilitation and removal of AC pipes which involves cutting, polishing, and demolition can release asbestos fibers into the air, posing risks to public health. (see facing page: **Regulatory Overview: AC Pipe**)

History of AC Pipe Renewal Alternatives

As with the 2013 repair to the 8-inch AC pipe at Swifts Beach, open excavation dig and replacement is often used, particularly for point repairs for breakages. A trench is dug to expose the existing pipe, which is then cut into manageable-sized pieces, placed into containers or wrapped in plastic and disposed at a landfill that accepts asbestos waste. The process is regulated under NESHAP so precautions to prevent fiber release during cutting operations are required. In the case of sewer replacement the process is complicated by the need to reestablish connections with the manholes and service laterals. Since gravity sewers are typically deeper than water lines there is often a need to dewater the trenches and manage the pumped groundwater.

Cured-In-Place Pipe (CIPP) has been widely used for wastewater sewers in the US since the 1980s and has been demonstrated to be safe and effective. However some types of CIPP may release chemical agents such as styrene utilized in the reaction process resulting in water contamination downstream of rehabilitated pipes or an off-gas emission to the air that is can be a significant air pollution problem for workers and local residents. Due to the low toxicity zero VOC epoxy CIPP products used at both the Swifts Beach and Viking Drive worksites there was no residual odor present at either site.

Polymeric Spray-In-Place Pipe (SIPP) is widely used for water main rehabilitation, manhole rehabilitation and person-entry tunnels. It is also used for some small-

Tee Liner with inflatable packer assembled and ready for insertion

Regulatory Overview: AC Pipe

The USEPA regulates asbestos under the NESHAP section of the Clean Air Act that governs hazardous air pollutants. NESHAP recognizes two types of asbestos-containing material, friable and non-friable. Friable, or Regulated Asbestos Containing Materials (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.

EPA has determined that backfilling and burial of crushed asbestos cement pipe would cause these locations to be considered active disposal sites and therefore subject to the "Standard for Active Waste Disposal Sites" (40 CFR 61.154).

Non-friable ACM is any material containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure. Although there is some controversy and disagreement about whether AC pipe fragments are friable RACM, many jurisdictions have declared that disturbance by excavation and replacement or by pipe bursting is likely to create pipe fragments that are Regulated ACM. This includes Massachusetts which explicitly bans pipe reaming or pipe bursting or crushing AC pipe in place when replacing with new pipe. Massachusetts allows undisturbed and unexcavated AC pipe to be left in place during a replacement.

A recent study sponsored by the Water Research Foundation, USEPA and the Water Environment Research Foundation investigated the performance, environmental impact, and cost of both cured-in-place pipe (CIPP) and pipe bursting on AC water mains. The results showed that neither pipe bursting nor CIPP lining of AC pipe was found to have a negative impact on the surrounding air environment or the heath of the workers. Overall, soil samples collected at each site indicated only trace amounts of asbestos in the soil surrounding the pipe. No increase in asbestos was found 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 water samples collected from each site showed that the renewal technologies had no negative impact on the water quality.

Although the USEPA sponsored the Environmental Impact study, to date it has not decided modify or rescind the NESHAP rules or issue an EPA Administrator Approved Alternative (AAA) for pipe bursting that would allow the use of pipe bursting on AC pipe when proper procedures are followed.

diameter gravity sewer main applications, however special provisions for adequately preparing the surface in a non-person-entry sewer environment have to be made in order to obtain a dependable bond.

Benefits of CIPP Trenchless Solutions

CIPP trenchless solutions reduce cost and time risks because they are relatively unaffected by the materials they are rehabilitating or the polluted soils and ground water they contact via relining. Specifically, AC pipe can be relined without removal or remediation.

The engineering, lead time, construction time and disruption of normal traffic and street use required for trenchless solutions is much less than excavation and replacement projects. The engineering is simplified and generally only requires project scope and location, preparing and reviewing sewer video files and/or other techniques such as pipe penetrating radar, surveying and documenting on plans and profiles the manholes/access points with invert elevations, any required/known point repairs, pipe lengths & diameters and lateral connections to reinstate. There are no bedding details, tap connections or specification of alternative systems required.

Liner inversion and curing worked very well at pipe deflection

Re-lined Manhole on Wankinco Avenue

Tee Liner Installation

Rock in pipe near area of deflection. A very challenging job

Selection of CIPP Technology

In addition to these known benefits, local factors ultimately determined the choice to select CIPP as the best pipe renewal technology for the rehabilitation/repair work at Swifts Beach and the reline job at Viking Drive. Reviewing these physical and regulatory aspects, the Town of Wareham selected a low toxicity epoxy CIPP technology for both locations.

Inflow and Infiltration flow studies and video inspection on the 8-inch AC gravity sewer had demonstrated significant problems with inflow due to defects at the laterals and residential sump pump discharge. There was also substantial infiltration occurring in the gravity sewer due to cracks, defective joints, and breakage in the sections below the water table elevation.

Regulations in Massachusetts prohibit use of pipe bursting technology for AC pipe rehabilitation. In addition, necessary surface preparation for polymeric spray-in-place pipe (SIPP) would be difficult in the relatively small diameter AC sewer several feet below the water table. Much of the sewer is 15-16 feet deep with a tidally influenced groundwater level of 6 to 8 feet deep and sandy soil with a high hydraulic conductivity, which would make dewatering for open excavation replacement difficult and cost prohibitive.

It was also essential that there was minimal impact on the residents and disruption to their daily lives. Swifts Beach is a very densely populated beachfront community with narrow streets, and the compact site footprint required for CIPP resulted in minimal impact upon the neighborhood. Similarly, the section of the 21-inch Viking Drive gravity sewer needing immediate repair was at 15-18 feet depth with shallow tidally influenced groundwater running directly underneath the new tennis courts built at Wareham Middle School. With minimal impact on the site, CIPP again proved to be the best option.

CIPP Construction: 8-inch AC Pipe Swifts Beach

Repair and lining of the 8-inch AC gravity main along the coastline at Swifts Beach by far presented the greatest set of challenges. The Bayview Street and Wankinco Avenue sewers at Swifts Beach consist of 8-inch AC pipe 742 feet in length on Wankinco, the deeper sewer at 9 to 16 feet depth, and 826 feet along Bayview, 7 to 9 feet deep. Both streets have a relatively shallow tidally influenced water table, with the Bayview sewer often below the water table at high tide and the Wankinco sewer usually 5-10 feet below the water table at all times. The tidal influence and high water table presented enormous challenges during construction. While curing the liner, it was sometimes difficult to maintain consistent temperature and pressure, especially during high tides. The Contractor was able to improvise solutions to remedy these issues on site.

The Wankinco Ave. sewer previously had a break that was repaired in 2013 by excavation and replacement. Before the CIPP lining commenced, this was found to have a significant deflection at the upstream end and high flow infiltration which had to be repaired prior to the CIPP lining process.

An 8-inch bladder was put inside the pipe and air pressure was added to gently align the pipe as close as possible without destroying the already fragile asbestos pipe. Once the maximum possible alignment was achieved grout was then inserted on both sides of the pipe deflection and infiltration point, using pressure injection through six ½-inch steel pipes driven down to the pipe depth by jet washing and hammering. Once the grout had set, the infiltration from the pipe deflection point was reduced to a very small amount. After epoxy CIPP lining was completed the separation was reduced to 6 inches and the pipe was structurally sound.

The CIPP system used was epoxy resin, Warren Environmental Cured in Place Liner, a 125 mil vinyl clad braided E Glass structural tube insert impregnated with a zero VOC 100 percent solids, non-toxic, solvent free, epoxy resin laminar system certified to NSF Standard 61 and passing aquatic organisms toxicity testing. The liner was inverted using air pressure and cured by injecting live steam for several hours.

The liner inversion and curing process worked very well at the pipe deflection

> ***Demonstrated the efficacy and cost savings of using an epoxy impregnated fiberglass or polyester felt liner for installing a structural rehabilitation of AC and RCP gravity sewer pipes at a significant depth and below a tidally fluctuating water table.***

location. Although it was not possible to pass the sewer camera though the 2-3 inch deflection it was possible to visualize the transition from both sides. Based on visual and flow observation we determined that the sewer hydraulic condition was adequate for the projected flows and that the sewer could be cleaned in the future by approaching the deflection from upstream and downstream ends.

After the laterals were reinstated, the lateral/main connections located below the water table were repaired by installing a tee liner connection using an inflatable packer. Any concerns the neighborhood residents had regarding disruption, inability to get around, and prevention of access of emergency vehicles did not materialize. In 2013, the 20 feet of 8-inch AC gravity main that was dug up and replaced disrupted the neighborhood for 3 weeks. The CIPP project lining 1,600 feet of the same pipe took a week, including the critical repair to the pipe separation. **Eighty times the length in linear feet, in one third of the time, at a fraction of the cost, compared to dig and replace.**

Liner Installation 21-inch RCP at Viking Drive near Wareham Middle School

Viking Drive 21-inch RCP: Wareham Middle School

The reline work on the 315 foot segment of the Viking Drive sewer between 2 manholes under the tennis courts at Wareham Middle School was a great learning opportunity for students in the engineering program, who were invited along with their instructor, to take part in this trenchless technology project. Learning how to repair a pipe without digging up the new tennis court amazed the students, and was a godsend for the school.

Conclusions

Both projects demonstrated the efficacy and cost savings of using an epoxy impregnated fiberglass or polyester felt liner for installing a structural rehabilitation of AC and RCP gravity sewer pipes at a significant depth and below a tidally fluctuating water table. The epoxies used are 100 percent solids, non-toxic and moisture insensitive with superior strength and chemical resistance properties.

Wareham has a total of five miles of AC gravity main pipe remaining along Swifts Beach to be rehabilitated. If the Town of Wareham were to complete this project removing pipe with traditional dig and replace methods, the cost would be astronomical, estimated at over

Engineering, lead time, construction time and disruption of normal traffic and street use required for trenchless solutions is much less than excavation and replacement projects.

Tight working conditions, narrow streets, minimal site impact

Grout was inserted on both sides of the pipe deflection

$100M, and taking more than 70 years to complete! Dig and replace methods for rehabilitation, based on time and cost parameters established for the Town of Wareham are simply not realistic, as summarized in Table 1.

Working in close collaboration with Green Seal Environmental and the Town of Wareham, the Epoxy CIPP trenchless technology application used by Warren Environmental at Swifts Beach and Viking Drive has already saved millions in rehabilitation costs for this coastal community, and is bound to save even more in the future. Along with saving money for the community, using the Epoxy CIPP trenchless approach to repair and rehabilitate pipe in the Town greatly minimized potentially harmful social impacts, and provided a great educational opportunity for tomorrow's trenchless

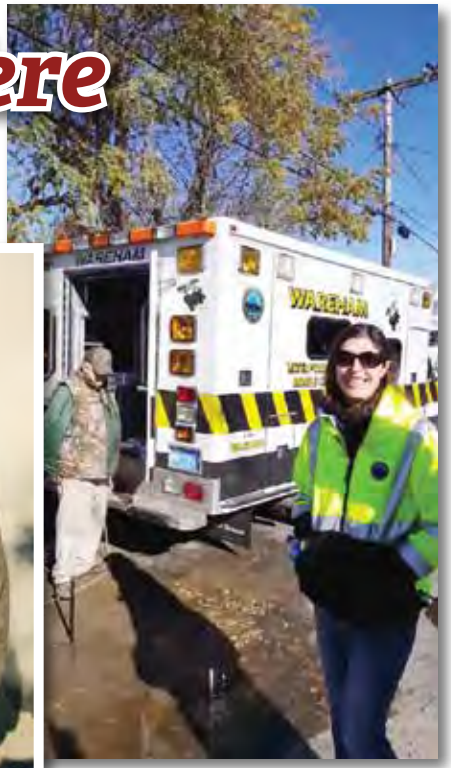
Table 1. Wareham Construction Experience

Technology	Length/ Duration	Cost/Foot	Feet/Day	Length & Duration Remaining	Remaining Cost	Social & Economic Impact
Dig & Replace	20 ft/21 days	$7,000/ft	1ft/day	26,400 ft (5 miles) **70+ Years**	**$100,000,000+**	Street closures, emergency vehicle restrictions, public safety & public health concerns due to open exposed trench. **Not economically feasible. Unrealistic given high cost/ time factor.**
Trenchless CIPP Technology	1,600 ft/ 7 days	$155/ft	228ft/day	26,400 ft (5 miles) **4 months**	**$6,000,000**	Cost & time savings unsurpassed. Minimal social impacts & health/ safety concerns. **Economically feasible for coastal community of Wareham**

The People Were Incredible

Danny Warren getting "steamed". Some people have all the fun

Danny Warren (left) brings his long-time friend and mentor Mr. Waldo Roby (right) to the Swifts Beach job site. Mr. Roby had originally questioned the use of AC pipe in underground installations



Alanna Sparagna, Pretreatment Coordinator, WPCF, served as on-site chemist during the grouting process

technology leaders at Wareham Middle School.

At every step in the process, the people were incredible, allowing Warren Environmental, Green Seal Environmental and the Town of Wareham to work together collaboratively finding solutions to unexpected challenges as they arose. Trenchless technology has proved to be very beneficial for the sea side community in Wareham.

ABOUT THE AUTHORS:

Guy Campinha Sr. *is Director of Water Pollution Control for the Town of Wareham. He has spent the past 20 years managing Wastewater facilities and was also Past Chair of the Wareham Board of Health. Guy is a NASSCO: LACP, MACP, PACP certified Member, and is a Certified Grade 7 Wastewater Operator in Massachusetts. He is a currently serving member of the NASTT-NE Board of Directors.*

Garrett Keegan, P.E. *is a project manager with Green Seal Environmental in Sagamore Beach MA with 35 years of experience as an environmental engineer. His work has included industrial and domestic waste water treatment and collection systems, the design and construction management of secure landfills and bulk petroleum and hazardous materials storage facilities. He has conducted groundwater investigations and modeling and performed well pumping tests, water quality evaluations and water treatment designs for public water supplies.*

Danny Warren *has over 30 years of experience in the mediation of corrosion, specializing in specialty 100% solids epoxy coatings and linings. He is the head of field research and development for Warren Environmental Inc., a company that specializes in epoxy restoration products and processes. In 1992, he developed and patented the first successful process for spraying plural component epoxies in their solvent free form, to distances up to 500 feet.*

Since that time, Mr. Warren has been awarded multiple patents in the epoxy application field and has received the prestigious NASTT Innovative Product Award for his Infusion Lining System.

FAST REAM FAST BACK HDD

Overall Lighter Construction Site Presence

By: Melfred Borzall, Inc.

Attaching cable and product to the swivel in preparation for a direct pullback with the FastBack System. The cutter on the FastReam housing will enlarge the bore to pull multiple pipe

With the steady growth of the fiber sector to city and suburban households and businesses, as well as small utility infrastructure installation and restoration, the need for trenchless construction with a minimal footprint and less disruption continues to grow.

In the mid 2000s the HDD industry began to rebound from the recession of 2000. By the late 2000s major telecommunication carriers were once again investing heavily in fiber deployment, HDD installation jobs were booming and drill manufacturers began to see a customer driven demand for mid-sized and compact drills. By 2015 sales began to shift from the larger 100,000+ lb. thrust/pullback drills for pipeline work to the smaller 20,000 lb. and under thrust/pullback drills for fiber work. This change was also reflected in the tooling being sold with a clear demand for the smaller HDD tool market.

About the same time Melfred Borzall (MB) engineers saw the need for a more efficient boring system suited to limited space and time constraints. Fiber and small utilities often called for a series of short bores less than 100 feet and pulling multiple pipe or ducts. "Drillers needed to get more bores done in a day. We were looking to design a system that did quick, efficient direct pullbacks by simply adding the swivel and product to the cutting tool," said Eric Melsheimer, Engineer and President of Melfred Borzall. "We designed our existing bits and blades to accommodate a specifically designed component that allowed a swivel and product to be attached to the cutting device immediately after the pilot bore, so within minutes of completing the pilot bore drillers were pulling back utility lines without removing the housing or cutting head."

> ***"The major idea behind the FR/FB SYSTEM® is a method for quickly installing service lines to homes and businesses"***

Once in the field, the FastBack® was an immediate success, however the need for larger bores in congested urban areas was still a concern for contractor but the constraints of limited space and small receiving pits remained. "A small receiving pit means less landscape or pavement being removed and replaced," Melsheimer said. "On some jobs there isn't the option for a pit large enough to remove the drill head and attach a backreamer. We decided to see if we could take the cutting blades from our best reamer and adapt them to a housing to give it reaming capabilities."

Using the same concept as the FastBack® for a direct pullback after the pilot bore, the transmitter housing was designed so cutters could be attached to both the front and/or back of the housing. The blades could also be set up in incremental sizes to enlarge the pilot bore

> ***We listen to the feedback and try to improve according to what the need is.***

in a two-step process up to 12 inches and adapt it to different soil types.

With the FastReam/FastBack System® (FR/FB) back out in the field together, drillers were finding the system to be extremely versatile. Not only was there a noticeable savings in time, but also fewer environmen-tal disturbances and restoration costs, and an overall lighter construction presence not having to excavate larger pits and haul in heavy equipment and tools.

Dana Villiere from HDD Parts Plus of the Rockies, Denver, CO is on the road about ten hours a day making deliveries and visiting job sites. Currently he has about 30 customers using the FR/FB System® and Villiere has seen the system in a variety of situations.

"They're a real efficient tool," said Vil-liere. "I have customers who use them for different types of jobs – some who are doing the smaller utility installation and multiple bores. Others use them on larger diameter and longer bores with the same benefit of the direct pullback."

Recently he had a customer doing a job where a short part of the bore went under several previously installed utility lines. The FR/FB System® was used because of the direct pullback feature.

Troy Tharp, owner of Hardcore Drilling, Inc. in Denver, CO was contracted by Xcel Energy to put in a six-inch Bore-Gard conduit and run electrical lines to a substation in Denver. The job consisted of multiple bores totaling 12,000 feet. Boring from the road they had to consider traffic and limited space conditions. One 560-foot bore crossed under several utilities including sewer, gas, storm drain, fiber and phone.

An example of the FastBack System boring close to existing utilities as well as in tight, closed-in conditions. In this instance it was a fiber installation next to a sewer main and a fence. The driller was able to pull his utilities without removing any structures or disrupting any existing utilities

After setting up for the pilot bore and subsequent direct pullback, Thorp's crew located each utility and dug a small pit at each one so they could have a visual to steer through during the pilot bore or without do any damage when pulling back. Using a Ditch Witch JT2720 they did the pilot bore, then set up the housing with 8 and 10-inch cutters on the housing for the direct pullback.

"Being able to attach the blades and do the direct pullback was an advantage," Thorp said. "It's quick and versatile. We were able to get in, get the job done and get back out with very little disruption."

Thorp uses FR/FB System® to do a few small, utility and single phase electrical or cable replacement bores, but typically does more of the larger diameter, longer bores of several hundred feet or more.

"The major idea behind the FR/FB System® is a method for quickly installing service lines to homes and businesses," says Melsheimer. "Our design concept is for a tool that addresses all of the contractor's requirements, so we continue to refine for different ground conditions and different drill sizes. We listen to the feedback and try to improve according to what the need is."

ABOUT MELFRED BORZALL INC.

Melfred Borzall Inc. *has been designing, developing and manufacturing directional drilling tools producing real results for our customers for over 70 years. We take a personal approach to service and believes customer service and product reliability take priority over cutting corners to cut costs. We guarantee our work because the work we do is right.*

BAMI-I CONDUCTS 4-DAY CTAM CLASSROOM PROGRAM IN COLUMBUS, OH

By: The Trenchless Technology Center (TTC)

On May 16 – 19, 2017, TTC in partnership with BAMI-I, conducted a 4 day "Asset Management Training for Water Infrastructure", Certification of Training in Asset Management (CTAM) session in Columbus, OH. The program was conducted in response to a request received by the TTC from Ms. Deb Martin, WSOS Community Action Development Director.

Headquartered in Fremont, Ohio WSOS Community Action serves as the regional management entity in Ohio and Michigan for the Great Lakes Rural Community Assistance Program (RCAP), which assists small rural communities in developing and maintaining infrastructure for drinking water, wastewater treatment, and other community services, thereby improving rural quality of life. Formed in 1980, the Great Lakes RCAP encompasses Illinois, Indiana, Kentucky, Michigan, Ohio, West Virginia, and Wisconsin.

This four day session held at The Westin Columbus was the second time all four CTAM courses were taught in a classroom format – the first was in Raleigh NC in 2015. As before, each day of the program was devoted to one level of training (i.e., level 100, 200, 300, and 400) and included quizzes for each chapter.

The program was attended by 35 professionals from around the US who are focused on utility management. Instructors for the course included: Dr. Tom Iseley (TTC Director of International Operations), Kurt Wright (President, SDG Engineering), Ronald Thompson (STRADA Engineering), George Kurz (Consulting Engineer), and Joe Crea (RFC). The course was also supported by Saleh Behbahani, Shijun Lu, and Huayuan Zhong, graduate students at Louisiana Tech University.

After completion of these 4 courses (CTAM 100-400), participants received designation as an Associate Water Asset Manager (AWAM) plus 30 hours of PDH credits. Attendees also received a complimentary one year BAMI-I membership.

Buried Asset Management Institute-International (BAMI-I)

The Buried Asset Management Institute - International (BAMI-I) is a non-profit corporation whose main purpose is to educate and assist those who have an interest in applying best buried asset management practices to extend the life and efficiency of their assets. Although BAMI-I has been mainly focused on water and wastewater systems, the principles of asset management apply to all different types of buried assets including for instance gas distribution pipes, electric cables.

Good buried asset management practices will:

- Maximize life-cycle value of assets
- Sustain economic development
- Protect public health
- Improve the environment
- Enhance the quality of life

The purpose of BAMI-I is to provide a center of excellence for owners of underground water infrastructure to join with industry and researchers, using sound science, to evaluate and/or develop buried asset management protocols for application worldwide.

Certification in Training of Asset Management (CTAM)

CTAM is an exclusive four part series in Asset Management coursework and certification. The CTAM program was developed by BAMI-I in conjunction with the TTC (Trenchless Technology Center) at Louisiana Tech and IUPUI (Indiana University-Purdue University at Indianapolis), in partnership with UIM: Water Utility Infrastructure Management, and is hosted by the Trenchless Technology Center at Louisiana Tech.

BAMI-I launched the first CTAM course (CTAM 100) in 2010. The CTAM 100 course provides a comprehensive introduction to Asset Management principles and concepts with special emphasis on their application to "buried assets" associated with water and sewer systems. The initial success of the CTAM 100 course created awareness of the need to broaden its scope and provide more detailed training in an expanded sphere of utility system concerns. This led to the release in 2013 of the CTAM 200 course level, which focused on the specifics of how to develop an Asset Management Plan. In July and August 2015, BAMI-I released the CTAM 300 and CTAM 400 course levels respectively. CTAM 300 & 400 focus on the ongoing management of the Asset Management Plan, as well as the financial aspects of funding Asset Management Plans.

CTAM is offered as 4 online courses and per request in classroom format. More than 850 individuals from 14 countries have enrolled in the CTAM program. There are three levels of certification available – Certificates of Completion, the Associate Water Asset Manager (AWAM) and Professional Water Asset Manager (PWAM) designations. To date 103 AWAM and 12 PWAM certifications have been awarded.

For more information, and application requirements, please visit http://bami-i.com or contact Dr. Tom Iseley: dtiseley@latech.edu.

ABOUT THE TRENCHLESS TECHNOLOGY CENTER (TTC):

The Trenchless Technology Center (TTC) is an industry/university/government research center at Louisiana Tech University. It has world-class research and testing facilities at the National Trenchless Technology Research Facility (NTTRF) in South Campus at Louisiana Tech. The TTC was established by Dr. Tom Iseley in 1989. It was created to promote research, development and technology transfer in the trenchless technology industry. For over 28 years TTC has served as a global leader for the development of technologies influencing almost every aspect of trenchless construction methods.

"The principles of asset management apply to all different types of buried assets including water and wastewater systems, gas distribution pipes, electric cables."

The program was attended by 35 professionals focused on utility management

Dr. Tom Iseley (TTC Director of International Operations) introduces the CTAM 300 course

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