NORTHEAST JOURNAL
OF TRENCHLESS TECHNOLOGY PRACTICES

NASTT-NE 2018
"Paper of the Year"

"Saving the Coastline, Protecting Our Resources..."

2018 NASTT-NE Conference

2018 FALL EDITION

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Phone: (301) 909-7799

Waldorf, MD
48 Industrial Drive | Waldorf, MD 20747
Phone: (301) 870-1438

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FEATURES:

ALSO:

Departments:

NASTT NORTHEAST REGIONAL CHAPTER

Chair – Ian Mead
imead@tighebond.com

Vice Chair – Babs Marquis
marquis@mcmjac.com

PUBLISHER

A TO B Publishing Inc.

662 Dudley Avenue
Winnipeg, MB Canada
R3M 1R8

EDITORIAL
Andrew Pattison
204.275.6946
marcomap@shaw.ca

ADVERTISING SALES
Bert Eastman
204.997.6371
bert@atobpublishing.com

Ronald Laurie
519.895.5095
ronald@atobpublishing.com

PRODUCTION TEAM

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700 - 200 Main Street
Winnipeg, MB
R3C 1A8

DIRECTOR
Aaron Harper
204.318.1121 xt. 101
aharper@harpermedia.ca

LAYOUT & DESIGN
Joel Gunter
204.318.1121 xt. 108
joel@harpermedia.ca

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MESSAGE FROM NASTT-NE CHAIR

Ian W. Mead, P.E., BCEE, NASTT-NE Chair

Welcome to the fall 2018 edition of the NASTT Northeast Regional Chapter's *Northeast Journal of Trenchless Technology Practices*. We are very excited to introduce our **NASTT-NE 2018 "Paper of the Year"** annual initiative in this edition. Please join me in congratulating Nicholas Rystrom and Jonathan Kunay on the recognition of their paper: **"Tying Up Loose Ends: Rehabilitating the Downstream End of an Egg-Shaped Brick Interceptor Near Boston"** (p. 18). They will also be recognized at our Fall 2018 conference in Mystic, CT, November 12 - 13. I hope you will join us.

Our chapter is very fortunate to be represented by a wide variety of trenchless professionals working on great projects, and many of them are represented here. In this edition we showcase an HDD project replacing the Westport CT Pump Station No 2 Force Main, and present Part 2 of Understanding Geology When Selecting Trenchless Installation Methods. Other articles include a unique CIPL repair of a 12-inch cast iron gas main in Philadelphia and rehab of a vintage egg-shaped brick sewer in a coastal New England community. The articles in this edition reflect the Fall Conference theme **"Saving the Coastline, Protecting Our Resources…"**

Our UMass Lowell student chapter has been busy, as another new school year has brought new members to the chapter. In this issue the student chapter describes an experiential learning site visit to a microtunneling project in Randall's Island, NY. (p. 50). **Please take a moment to engage with our student chapter members when you see them at our conference, as they represent the next generation of trenchless professionals.**

We are grateful for the generous support of our sponsors and vendors who make both this publication and our annual conference possible. When you see them, please take a moment to thank them for their support and learn about their services and solutions. As always, we hope the time you spend reviewing the articles and information in this fall edition will encourage you to get involved in the chapter. The Northeast Chapter has been quite successful in establishing a strong voice for trenchless in the region, and we need your support to ensure that the Chapter succeeds and grows.

In addition to looking forward, the Board of Directors has also been working to reconnect with our roots. The Executive Committee recently met with many past presidents and founding members of the Northeast Trenchless Association, an independent group that led to the formation of our Northeast Chapter. Reinforcing connections and relationships with these trenchless professionals will broaden the representation in our Chapter and contribute to new initiatives and learning opportunities for our members. Stay tuned for more on this initiative.

"PLEASE GET INVOLVED."

Thank you to our past Chair, Executive Committee, and Board of Directors, and thanks to all of our chapter members, for participating and supporting these initiatives. Please get involved!

Ian W. Mead

Ian W. Mead, P.E., BCEE
Chair, NASTT-NE

NASTT-NE SITE

NASTT NORTHEAST REGIONAL CHAPTER TM

MESSAGE FROM NASTT EXECUTIVE DIRECTOR

Michael J. Willmets, NASTT Executive Director

The trenchless industry continues to grow and expand our reach to more and more communities every year. 2018 has seen this growth and as we've talked with our membership we've heard many good news stories about trenchless project successes. As evidenced by this growth, NASTT's 2018 No-Dig Show held in Palm Springs this past March was a superb success and a highlight of the year. We welcomed over 2,000 attendees from all over the world. We presented a top notch technical program and completely sold out our exhibit hall, once again! None of this would be possible without our dedicated volunteer membership including your Northeast Chapter members.

Looking ahead to November, I am particularly excited to be able to join you at the upcoming 2018 Northeast Trenchless Conference in Mystic, Connecticut. This conference promises to offer excellent learning and networking opportunities for trenchless industry professionals. The event includes many technical presentations covering a wide variety of trenchless topics plus, an exhibit hall bringing you industry innovations for trenchless products and services. You will want to make sure that you attend the networking event prior to the conference at the famous Mystic Pizza restaurant!

As you can imagine, plans for NASTT's 2019 No-Dig Show in Chicago, Illinois, March 17-21, are well under way. The 2019 technical paper program will have over 160 informative and innovative presentations. Of course, our exhibit hall will be full of new products and services to support the trenchless industry as well. We will also host our Good Practices training program which includes seven different specialized full and half-day courses. This is an event you simply cannot miss! If you are a municipal or public utility employee, be sure to apply for NASTT's Municipal & Public Utility Scholarship Program Award. You can find all the details at nastt.org. The application deadline is November 1.

The Northeast Chapter is home to many trenchless advocates that serve on our 2019 Program Committee including Dennis Doherty, Brian Dorwart, Tony Hranicka, Abhinav Huli, Johnathan Kunay, Sahar Hasan Kunay, Carrie Layhee, Gerry Lundquist, Babs Marquis, Nick Strater and Rick Trieste. They are sure to help bring you an excellent technical program in 2019.

Again, I cannot thank our Northeast Chapter volunteers and members enough for your dedication and support. Your Chapter embraces the mission and vision of NASTT and we value you all as true Trenchless Champions. I look forward to joining you in Connecticut for the regional conference as well as seeing you in Chicago next March.

Michael J. Willmets

NASTT Executive Director

MEMBERSHIP IN NASTT

All in the Family: NASTT is pleased to present new opportunities to join the NASTT Family!

Attention Students! *Available now:* Student Non-Affiliated Membership

NASTT proudly engages 19 official Student Chapters, and now we are branching out to all students throughout North America! The NASTT Student Non-Affiliated Membership ($50 USD per year) is available to any student actively enrolled full-time in a North American university that doesn't currently have an official Student Chapter on campus.

Overseas Opportunities! *Available now:* International Individual Membership

The NASTT International Individual Membership ($250 USD per year) is available to any individual residing outside of North America.

Stay Engaged! *Available now:* Retiree Membership

The NASTT Retiree Membership ($40 USD per year) is open to NASTT members after they retire from the industry.

Now that you're officially in the family, are you getting the most out of your NASTT membership? Taking advantage of all NASTT has to offer? As your membership manager, 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 19 NASTT Student Chapters and 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 the NASTT family, join us! Visit nastt.org and get your membership started today!

2018-2019 NASTT-NE BOARD

IAN MEAD – CHAIR

Ian Mead, P.E., BCEE is a Senior Project Manager with Tighe & Bond in Worcester MA, and has over 20 years of experience working as design engineer, project manager and construction coordinator. His varied experience includes work on drinking water, wastewater, pipeline, site and civil, energy and other municipal infrastructure projects. His more recent focus is on development and delivery of projects for municipal clients across New England. Born and raised in the construction industry, Ian has spent his entire lifetime on and around heavy equipment on various construction sites. While working for a private engineering company doing survey and site design work, Ian studied civil engineering at the University of Massachusetts Amherst. His first job after graduation was doing site inspection work on pipeline projects throughout MA and RI. He was quickly introduced to trenchless technology as many municipal clients were then expanding sanitary sewer collection systems, and some of this work involved trenchless applications such as HDD, bursting, and CIPP. More recently his experience has also included comprehensive pressure pipe condition assessment and rehabilitation, and the incorporation of this information into enterprise asset management programs. Ian thinks that increasing owner acceptance, and convincing local decision makers that trenchless methods should be part of any utility's asset management plan, are important keys to future growth of the industry. Education and information provided to municipalities and utilities will help spread the word that trenchless is a viable and proven option. Ian feels there is a great opportunity to generate more interest in trenchless technology with mid to smaller sized utilities across the Northeast. Another major goal he has is building general awareness of the NASTT-NE Chapter, and coordinating its resources and activities, such as website, publications and conferences, with the parent NASTT organization and other regional chapters across North America.

BABS MARQUIS – VICE CHAIR

Babs Marquis is presently the Trenchless Practice for the East Coast and Construction Manager with the Burlington, Mass., office of McMillen Jacobs Associates. He previously worked for Jacobs Engineering Group for 10 years and Stone & Webster for 11 years. During his extensive career in the trenchless industry, Babs has been involved in major tunneling and trenchless projects in the Northeast for clients such as the Massachusetts Water Resources Authority, Boston Water & Sewer Commission, the Metropolitan District Commission (Hartford, CT), Narragansett Bay Commission (Providence, RI), NYC Dept. of Design & Construction and NYC Dept. of Environmental Protection. For the past 19 years, he has focused on underground construction management for tunnels and conveyance including water and wastewater pipeline design and construction projects, with emphasis on trenchless construction methods. He has worked on various pipeline projects utilizing microtunneling, pipe jacking, horizontal auger bore, pipe bursting and pipelines renewal methods. From 2009-2011 Babs was resident engineer on the pivotal Microtunneling, & Pipe Bursting components of the East Boston Branch Sewer Relief Project. His commitment to the trenchless practice includes co-author for revision and update of the ASCE Manual of Practice (MOP 106) for Horizontal Auger Boring Projects and is the chair leading the effort for review and update of ASCE MOP 112 for Pipe Bursting Projects. Babs was instrumental in the development of the Auger Boring School at the Louisiana Technical University where he continues to assist with the annual planning and teaching at the auger boring school. Babs views the NASTT-NE Regional Chapter as an important vehicle to promoting greater awareness and understanding of trenchless applications at the local level. He sees the level of interest and confidence in trenchless technology growing among owner groups based on the successful completion of many high profile projects across the Northeast. Drawn to the varied unique and innovative aspects of trenchless technology, Babs believes access to ongoing education is key to even greater owner acceptance and NASTT-NE Chapter is a key component towards achieving this acceptance by making information available at the grassroots level as well as attracting student chapters from the region and a robust local participation in the Chapter activities throughout the region.

ERIC SCHULER – TREASURER

Eric Schuler is the City Engineer for an upstate-New York community that is rich in history. As a Department Head, he oversees all of Public Works, Sanitary Sewer, Storm Sewer, Water Distribution, Water Treatment, Wastewater Treatment, Facilities, and Traffic departments. Mr. Schuler has over 8 years of experience as a consulting engineer for nationally-recognized firms prior to switching to the municipal world. He earned his Bachelor of Science in Civil Engineering degree from Clarkson University in Potsdam, NY and has primarily been involved in wastewater, drinking water, civil-site, and stormwater sectors. Eric is a licensed Professional Engineer in New York whose design, project management, and construction-related experiences have helped successfully execute many "trenchless" - focused projects. Early in his engineering

career he gained exposure to various trenchless technologies through utility evaluations and development of utility project design alternatives. He immediately started to envision great opportunities for communities plagued by utility deficiencies and construction constraints to utilize CIPP, HDD, among other trenchless technologies; and for them to be able to benefit from both social and economic perspectives. Eric has also stressed the importance for municipalities to incorporate asset management into utility system evaluations and system rehabilitation designs in order to aid development of capital projects and to determine the most suitable trenchless applications for implementation. In addition to NASTT-NE, Eric is also an active member of the American Public Works Association (APWA) and New York Water Environment Association (NYWEA); and is consistently pushes for growth of trenchless technologies in upstate-New York. Eric has previously presented on the use of hydraulic modeling methods for proper development of utility rehabilitation project design. He is an advocate for educating (designers & installers) of trenchless applications through proper training and increased accessibility of industry standards/guidelines to ensure successful project design and execution. The successful use and increased awareness of modern-day trenchless technologies that incorporate innovative equipment and materials are what Eric believes will continue to shape and drive the direction of the utility industry for the coming decades.

MARSHALL GASTON – SECRETARY

With more than 40 years of experience in the construction industry, Marshall Gaston's diverse background and experience bring a unique perspective to trenchless project development. Marshall has always maintained a foot in both the academic and practical fields. Earning a Bachelor's Degree in Construction Technologies from Purdue, he was heavily influenced by his father's job as a contactor. This duality of education and hands-on experience has been evidenced throughout his career. After graduation, Marshall went back to work for his father, literally learning from the ground up. His career then shifted to work in smaller consulting firms, where he was first introduced to trenchless technology. Marshall currently serves as a Senior Project Manager in the Water and Natural Resources Department at Fuss & O'Neill.
Marshall's current focus is design and construction of major sewer extension and roadway projects. He sees trenchless technology as a useful component to his work, as there is increased demand for less invasive technology. He believes that trenchless technology is fast becoming mainstream as the demand for less intrusive construction techniques will drive both improvement in technology and costs downward. As Secretary, Marshall looks forward to a deeper understanding of the industry and translating that knowledge to his clients. A problem solver by nature, amplified by a lifelong interest in construction, Marshall's devotion to his clients is evidenced by the numerous facility planning, gravity and low pressure wastewater collection systems, pump station design and commissioning, and on-site decentralized renovation systems changing the landscape of New England.

DENNIS DOHERTY – PAST CHAIR

With over 30 years of experience in the trenchless technology industry, Dennis Doherty has developed a unique understanding of the full scope of trenchless techniques and risk management as it relates to trenchless design. He earned his BSCE in Civil Engineering from the University of Massachusetts at Lowell, and M.S in Management of Projects and Programs from Brandeis University. Dennis began his career in in trenchless in 1989 at Bryant Associates, moving to Metcalf & Eddy in 1996, and later for Jacobs Engineering in 2000, where he spent 10 years. Since 2010, his focus as a Senior Consultant and the National Practice Leader, Trenchless Technologies, at Haley & Aldrich has been applying a total trenchless approach, from feasibility through construction, utilizing microtunneling and HDD on projects primarily for private sector energy clients. Throughout his career Dennis has worked on a variety of innovative trenchless projects around the greater Boston area, including the New St. James Avenue Interceptor Project for the Boston Water & Sewer Commission - the first and only project to win the Trenchless Technology Magazine's Project of the Year award in both New Installation and Rehabilitation categories. Dennis has been a long-time proponent of the benefits and value of trenchless technology. He believes regional education and outreach activity is the foremost priority for the new NASTT-NE Chapter. In his view, another positive step forwards is the formation of the new U. of Massachusetts at Lowell Student Chapter which will help draw more young engineering professionals into trenchless practice. Dennis currently serves on the NASTT No-Dig Show Program Committee and teaches the NASTT HDD Good Practices course. He is involved in ASCE Standard Design and Construction Guidelines, and Pilot Tube and Other Guided Boring methods Manual of Practice. His passion for all things trenchless is exemplified by his Twitter handle: "@TrenchlessGuru".
professionals into trenchless practice. Dennis currently serves on the NASTT No-Dig Show Program Committee and teaches the NASTT HDD Good Practices course. He is involved in ASCE Standard Design and Construction Guidelines, and Pilot Tube and Other Guided Boring methods Manual of Practice. His passion for all things trenchless is exemplified by his Twitter handle: "@TrenchlessGuru".

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Town of Wareham MA
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Bill Jeffery
TT Technologies Inc.
bjeffery@tttechnologies.com

Jonathan Kunay
CDM Smith
kunayje@cdmsmith.com

Gary Munroe
Liberty Utilities
gary.munroe@libertyutilities.com

Tom Perry
Multi Utilities Ventures
tomperry4@comcast.net

Jean Rivard
Progressive Pipeline Management
jrr@progressivepipe.com

Charles Tripp
Kleinfelder Inc.
ctripp@kleinfelder.com

2018-2019 UPCOMING TRENCHLESS EVENTS

November 1, 2018
Rocky Mountain Chapter 8th Annual Regional Conference
Denver PPA Event Center
Denver, Colorado
Information: www.rmnastt.org

November 2, 2018
NASTT HDD Good Practices Course
Denver Broncos Stadium
Denver, Colorado
Information:
www.nastt.org/training/events

November 8 – 9, 2018
2018 TAC/NASTT-NW Tunnelling and Trenchless Conference
Fantasyland Hotel, West Edmonton Mall
Edmonton, Alberta
Information: www.tt2018.ca

November 13, 2018
2018 NASTT Northeast Trenchless Conference
Mystic Marriott Hotel & SPA
Groton, Connecticut
Information: www.nastt-ne.org/seminar-2018.html

November 15, 2018
MSTT Trenchless Technology, SSES & Buried Asset Management Seminar
Minneapolis/St. Paul, Minnesota
(Date may change)
Information: Leonard Ingram, mstt@engconco.com

December 12, 2018
MASTT Trenchless Technology, SSES & Buried Asset Management Seminar
Virginia Beach, Virginia
(Date may change)
Information: Leonard Ingram, mastt@engconco.com

February 5, 2019
NASTT CIPL 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 17, 2019
NASTT Introduction to Trenchless Technology - Rehabilitation
8:00 AM - 12:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

March 17, 2019
NASTT Introduction to Trenchless Technology - New Installations
8:00 AM - 12:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
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

March 20 – 21, 2019
NASTT Pipe Bursting Good Practices Course
March 20 2:30 PM - 5:30 PM
March 21 8:00 AM - 12:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

March 20 – 21, 2019
NASTT New Installation Methods Good Practices Course
March 20 2:30 PM - 5:30 PM
March 21 8:00 AM - 1:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

March 20 – 21, 2019
NASTT CIPP Good Practices Course
March 20 2:30 PM - 5:30 PM
March 21 8:00 AM - 1:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information: www.nastt.org/training/events

March 20 – 21, 2019
NASTT Laterals Good Practices Course
March 20 2:30 PM - 5:30 PM
March 21 8:00 AM - 12:00 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

March 20 – 21, 2019
NASTT HDD Good Practices Course
March 20 2:30 PM - 5:30 PM
March 21 8:00 AM – 2:30 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

March 20, 2019
NASTT Gas Good Practices Course
2:30 PM - 5:30 PM
Donald E. Stephens Convention Center
Rosemont, Illinois
Information:
www.nastt.org/training/events

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

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for the

Northeast Regional Chapter Trenchless Conference

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Register Today at NASTT-NE.org

Monday, November 12 Schedule

	Event	Location
6pm-9pm	NASTT Northeast Chapter Social Event	**Mystic Pizza** 56 West Main Street, Mystic, CT
9pm-TBD	NASTT Northeast Chapter After Hours Social	**Mystic Marriott Hotel & Spa** 625 North Road, Groton, CT

Tuesday, November 13 Schedule

Morning Technical Sessions				
6:00 - 7:30	**Exhibitor Move-In and Set Up**			
7:30	**Registration Desk Opens**			
7:30 - 8:15	**Breakfast and Networking - Vendor Area Open**			
8:15-8:45	**Opening remarks:** Ian Mead (NASTT-NE Chair), Michael Willmets (NASTT Executive Director), Dr. Raj Gondle (UMASS Lowell)			
	Track 1 - Rehabilitations	Speaker	**Track 2** - New Installations	Speaker
	Moderator (Tom Perry)		**Moderator (Babs Marquis)**	
9:00 - 9:25	World Record CIPL Renewal of a Natural Gas Main	*George Ragula (PSE&G)*	Westport's Pump Station No. 2 Force Main Replacement Using HDD: A Case Study	*Lori Carriero (Tighe & Bond), Bryan Thompson (Westport CT), Abhinav Huli (H&A)*
9:30 - 9:55	Sliplining New York City's Trunk Water Main System	*Mario Valenti (DDC), Thomas Leung (DDC)*	Construction of 5,550 Linear Feet of 30 & 40-inch Relief Sewer using Trenchless and Conventional Technologies in Connecticut	*John Ososkie (Jacobs)*
9:55 - 10:35	**Break - Vendor Time**			
10:35 - 11:00	Narranganset Bay (RI) Commission Rehabilitation of Large Diameter Brick Sewer	*James Fleming (NWMCC), NBC*	Installation of New Culverts for VTA Using Two Pipe Ramming Methods	*Jason Klaus (Hammerhead), Tom Loyer (ECI)*
11:05 - 11:55	Pipe Spinning & Manhole Lining Demo	*Dan Warren(Warren Environmental)*	Pneumatic Pipe Bursting Demo	*Jon D'Allessandro (D'Allessandro Corp)*
12:00-1:00	**Lunch & Keynote Speaker** Scott W. Jellison, CEO - The Metropolitan District Commission (MDC)			
1:00 - 1:25	**Vendor Time**			

Afternoon Technical Sessions				
	Track 1 - Investigations	Speaker	**Track 2** - Risk Management & Lessons Learned	Speaker
	Moderator (Raj Gondle)		**Moderator (Jean Rivard)**	
1:30 -1:55	Assessment of Large Diameter Sewer in the City of Hartford	*Jason Waterbury (MDC)*	How You Spray May Delay the Day	*Roy Richardson (B&L)*
2:00 - 2:25	Great Hill Tunnel Inspections	*Larry Marcik (South Central CT RWA)*	Bypass Pumping	*Presenter Being Finalized...Stay Tuned!*
2:30 - 2:55	Structural Health Monitoring of Underground Infrastructure	*Susom Dutta (UMASS-Lowell)*	Assessment of Soil and Bedrock Abra-sivity for HDD Projects	*Nicholas Strater (Brierley)*
3:00 - 3:55	Roundtable: Trenchless Technologies in the Northeast (Saving the Coastline, protecting our resources)			
3:55 - 4:10	**Closing Remarks - NASTT-NE Chair and Vice Chair**			

NASTT-NE CHAPTER MEMBER CHARLES TRIPP, KLEINFELDER, HONORED WITH 2018 NASTT TRENT J. RALSTON AWARD

NASTT-NE Board Member Charles Tripp accepts 2018 NASTT Trent J. Ralston Award

Charles Tripp, P.E., Kleinfelder, was awarded the **2018 Trent Ralston Award for Young Trenchless Achievement**, at the NASTT 2018 No-Dig Show in Palm Springs, March 25 – 29. Since 2010, this prestigious annual award has recognized a young individual demonstrating excellence in the early stages of his or her career who is making a notable contribution to the trenchless technology industry. Volunteer service to NASTT, a NASTT Regional Chapter, or NASTT Student Chapter, is a key criterion for this award.

Charlie has been involved in NASTT-NE Chapter activities since it was founded in 2016. He currently serves on the NASTT-NE Board of Directors, and published the article "Sectional CIPP of Sanitary Forced Main Preserves Historic Hull Waterfront" in the Spring/2017 edition of the *NASTT Northeast Journal of Technical Practices*.

Charlie Tripp, P.E., is a project manager with over 12 years of experience working in the management, design, and oversight of municipal infrastructure rehabilitation and construction projects. His experience spans a variety of disciplines, specializing in collection systems design and trenchless rehabilitation, water resources, wastewater treatment, and site-civil design. As a past Field Engineer for a major cured-in-place pipe construction company, Charlie has specialized knowledge in various trenchless utility rehabilitation technologies. He currently works out of the Kleinfelder Westborough office, applying his knowledge of trenchless technology to collection systems projects for a variety of municipal clients.

(l-r): Michael Willmets, NASTT Executive Director, Ralston Award winner Charles Tripp, Frank Firsching, NASTT Chair

Congratulations Charlie on being honored with the Ralston Award, and thank you for your service to the NASTT-NE Chapter. Best wishes and continued career success!

GEORGE RAGULA, NOTED TRENCHLESS AUTHORITY, INDUCTED INTO 2018 NASTT HALL OF FAME

George Ragula thanks audience members at 2018 NASTT No-Dig Show in Palm Springs

At the NASTT 2018 No-Dig Show in Palm Springs, March 25 - 29, NASTT-NE Chapter member George Ragula, Distribution Technology Manager at Public Service Electric & Gas, was inducted into the 2018 NASTT Hall of Fame after an extensive career encompassing 40 years of experience in gas industry engineering, operations, construction, research/development/deployment and management.

George is a noted authority on trenchless technology applications for the gas industry, with 30 years specifically focused on the development and application of various trenchless technology methods for use in the gas industry. Responsible for evaluating cutting-edge technologies that increase efficiency and effectiveness of gas operations and construction, George has been directly involved in the development and implementation of numerous innovative technologies now utilized by the gas industry.

He received his B.S. in Mechanical Engineering from Polytechnic Institute of Brooklyn in New York. George is a past Chair of NASTT and serves on the NASTT No-Dig Show Program Committee. He also teaches several NASTT courses on various trenchless technology topics, including CIPL for the Gas Industry. George has published over 50 papers and reports and has presented numerous papers, including several articles for the *NASTT Northeast Journal of Technical Practices*, most recently describing the important "World Record 36-Inch Gas Main Renewal in South Orange NJ".

George has also been honored with several American Gas Association awards including the 2000 Milton W. Heath Sr. Memorial Award for his contributions in the field of leak detection, the 2004 Distribution Achievement Award to recognize his outstanding contributions to the science and art of gas distribution, the 2006 Acker Medal and Award for his outstanding paper and presentation, "Robotics Technology Goes "Live" for Repairing Gas Mains"; and the 2009 John B. McGowan Sr. Research Award for his R&D contributions to the gas industry. These gas industry awards were all in recognition for the outstanding contributions George has made towards the utilization of various trenchless technology applications in gas distribution operations and construction.

George Ragula accepts NASTT 2018 Hall of Fame Induction (l-r): Frank Firsching, NASTT Chair, George Ragula, Distribution Technology Manager, PSE&G, Mike Willmets, NASTT Executive Director, Derek Potvin, Past NASTT Chair

In his spare time, George is an avid technical diver, enjoys skiing and is a corvette collector where he competes in amateur racing. Congratulations again George on your induction into the NASTT Hall of Fame in recognition of your lifetime contributions towards applying trenchless technology methods to the gas industry!

NASTT NORTHEAST REGIONAL CHAPTER TM

NASTT-NE 2018 PAPER OF THE YEAR

Tying Up Loose Ends: Rehabilitating the Downstream End of an Egg-Shaped Brick Interceptor Near Boston

Written by: Nicholas Rystrom of the City of Revere and Jonathan Kunay of CDM Smith

This year, the Northeast Chapter of NASTT formed a committee to select the Paper of the Year from the presentations published and presented at NASTT's 2018 Annual No-Dig Show that focused on projects or by contributors in the Northeast Chapter coverage area. The winner was selected based on the committee's rating of each paper in three categories:

1) readability and clarity of presentation;
2) presentation of technical content relating to the Trenchless Industry; and
3) how the paper's topic advances the Trenchless Industry. The winner of this year's award will be formally recognized during the luncheon held at November's Northeast Chapter annual conference.

ABOUT THE AUTHORS:

Jonathan Kunay has worked in the civil/environmental consulting industry for fifteen years on a variety of trenchless projects including infrastructure assessment and rehabilitation, facilities planning, leak detection and asset management. Jonathan has a Bachelor's of Civil/Environmental Engineering from the University of Cincinnati and has his Professional Engineer's License in Massachusetts. Jonathan currently works for CDM Smith in Boston, Massachusetts and is the Conveyance Market Leader for CDM Smith in the Northeast.

Nicholas Rystrom has worked as City Engineer for the past seven years and has helped the City of Revere navigate through the requirements imposed by a USEPA Consent Decree. Nicholas has a Bachelor's degree in Civil Engineering from Tufts University in Medford, MA and has his Professional Engineer's License in Massachusetts.

North American Society for Trenchless Technology (NASTT)
NASTT's 2018 No-Dig Show

Palm Springs, California
March 25-29, 2018

MM-T3-04

Tying Up Loose Ends: Rehabilitating the Downstream End of an Egg-Shaped Brick Interceptor Near Boston

Nicholas J. Rystrom, P.E., City of Revere, Revere, MA
Jonathan E. Kunay, P.E., CDM Smith, Boston, MA

1. ABSTRACT

The City of Revere, Massachusetts maintains and operates 99 miles of aging sanitary sewer pipes. After decades of neglect and deferred maintenance, the City embarked on a comprehensive rehabilitation program of their sewer collection system. The rehabilitation work included the lining of approximately 2,500 linear feet of a 100-year old, egg-shaped, brick interceptor that conveys 95% of the City's wastewater flow. A majority of the interceptor was rehabilitated in the first phase of the program in 2011, leaving only the three most downstream pipe sections remaining for rehabilitation. The rehabilitation of these three crucially important sections of 36" x 40" brick trunk sewer included challenging constructability issues such as bypass pumping, pipe size changes between manhole access points, permitting and coordination with the local regional sanitary sewer authority and the Department of Transportation, as well as bad weather and tide cycles.

This paper will detail the significant challenges faced by the City and contractors during the rehabilitation of the brick interceptor including unique access issues at the suction manhole, bypass pumping discharge coordination with the Massachusetts Water Resource Authority (MWRA) at the downstream manhole located in the middle of a tidally influenced waterbody, and traffic management and planning within a heavily traveled, state-owned, parkway critical for commuters heading into the City of Boston. This paper will also discuss design challenges such as selecting the proper rehabilitation products, pipe size changes without manhole access, deteriorating brick infrastructure with active infiltration, and thickness requirements for an egg-shaped, 25-foot-deep brick sewer pipe.

2. INTRODUCTION

The City of Revere, Massachusetts (the City), is located five (5) miles north of the City of Boston and is home to a population of approximately 54,000 in a land area of 10 square miles. The City owns and operates 99 miles of gravity sewer pipe and force main along with 12 pumping stations. 98% of the wastewater flow in the city is conveyed thorough the main interceptor; a 36" x 40" egg-shaped brick sewer constructed in 1904, which flows through the City, into the City of Chelsea Headworks, and then to the Deer Island Wastewater Treatment Plant, both owned and operated by the Massachusetts Water Resource Authority (MWRA).

In 2010, the City of Revere entered into a Consent Decree (CD) with the U.S. Department of Justice (DOJ) and the U.S. Environmental Protection Agency (EPA) for violations of the Clean Water Act (CWA). The CD required an immediate evaluation of the sewer system to assess rehabilitation alternatives and produce a recommended program to eliminate sanitary sewer overflows. A detailed study recommended comprehensive rehabilitation of the public sewer system, including lining all mainline sewers, service lateral connections to the main, and all manholes, as well as Private Inflow removal in an effort to achieve a 40%-50% reduction of extraneous flow was also part of the

comprehensive approach. A multi-year, phased rehabilitation program was initiated in 2011, and since that time, approximately 45% of the sewer system has been rehabilitated at a cost of approximately $100,000,000.

Initial phases of rehabilitation work included cured-in-place pipe (CIPP) lining of a majority of the main interceptor, constructed in 1904, that runs through the center of the City, as shown in Figure 1 below. In 2011, rehabilitation was performed on the upper-most reaches of the interceptor, where it begins as a 24-inch vitrified clay pipe, and then increases in diameter to a 30-inch vitrified clay pipe. In 2014, additional rehabilitation was performed on portions of the main interceptor as it transitions into a 34″ x 36″ egg-shaped brick sewer, and then increases in size further to a 36″ x 38″ pipe, further downstream in the system, as more and more of the City's wastewater flow enters into it. The final three sections of brick interceptor, where the size increases to a 36″ x 40″ egg-shaped sewer, were not completed in early phases of construction due to the many complexities associated with rehabilitation including constructability issues such as bypass pumping, pipe size changes between manholes, site access, permitting and coordination with the local regional sanitary sewer authority, the MWRA, the Department of Transportation, Massachusetts Department of Conservation and Recreation, and local tide cycles. In 2016, the City elected to complete the rehabilitation work on the last three pipe sections of the main interceptor, then contracted with CDM Smith, Inc. to evaluate rehabilitation alternatives and develop design documents to perform trenchless rehabilitation of this critical piece of historic, but aging infrastructure.

Figure 1. City of Revere Main Interceptor

3. EGG-SHAPED BRICK INTERCEPTOR EVALUATION

The last three sections of interceptor sewer convey 98% of the City's total sanitary sewer flow, an estimated 7.5 million gallons daily. The 113-year old, egg-shaped brick sewer is located in the median, or center island, of a six (6) lane roadway known as Revere Beach Parkway, that is owned and operated by the Massachusetts Department of Conservation and Recreation (MassDCR). This extremely busy thoroughfare handles traffic from cities and towns on the densely populated North Shore of Massachusetts, and conveys it through Revere and into the City of Boston. Figure 2 below shows the location of the three sections of interceptor evaluated during this project.

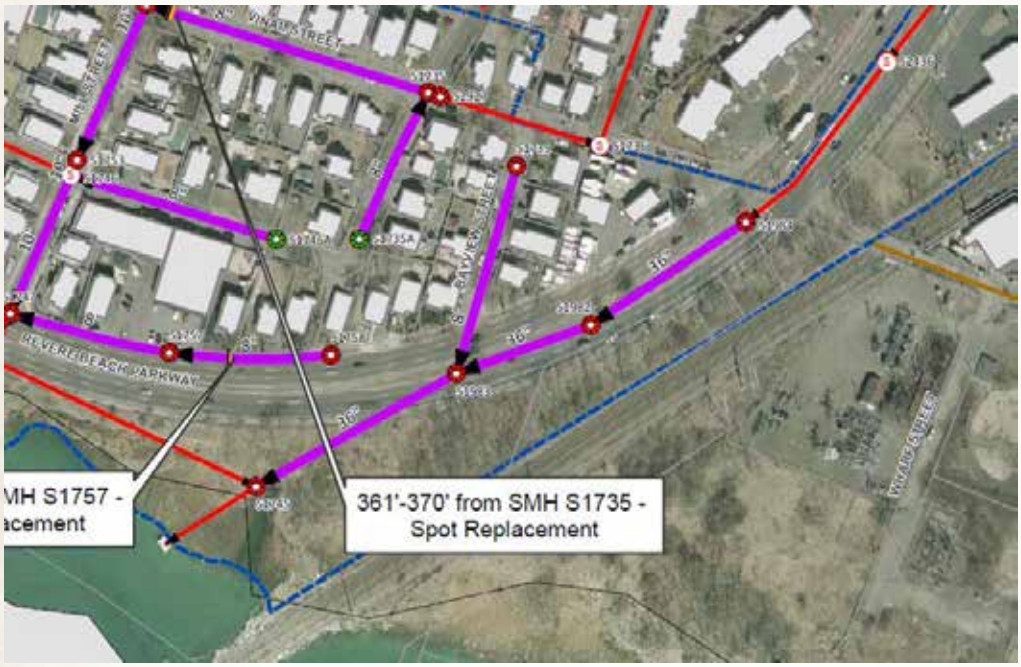

Figure 2. 36" x 40" Interceptor Evaluated for Rehabilitation

The access manholes associated with these sections of trunk sewer were constructed with brick and built to be integrated into the interceptor. They are, on average, 25-feet deep. While these manholes were in generally good condition, there were signs of infiltration observed, especially in the lower, deeper portions of the manholes that are continually submerged beneath the groundwater table. The first three manholes are located in the median of Revere Beach Parkway, before the pipe cuts across the eastbound lanes and travels cross-country through swampy, brackish, tidally influenced marshland, to manhole S1745. This most downstream manhole (S1745) is owned by the Massachusetts Water Resource Authority (MWRA), rather than the City of Revere, and is located in a tidally influenced wetland. The subsequent downstream section of pipe carries all of the City's wastewater flow, then discharges into a structure referred to by the MWRA as the "hen house", which is partially submerged underwater during high tide, prior to crossing beneath the Chelsea Creek and entering the City of Chelsea. All of this infrastructure is owned by the MWRA (but was not evaluated as part of this project), and carries the City's wastewater flow to the Deer Island Wastewater Treatment Plant, also owned and operated by the MWRA.

During a review of the Record Drawings for the Revere Trunk Sewer from December 1904, it was determined that the brick sewer increases in size from a 36″ x 38″ egg-shape to a 36″ x 40″ egg-shape before reaching the manhole structure at S1982, as can be seen in Figure 3 below. This change in pipe size prior to entering the downstream manhole presented design challenges that are described later in this paper.

The condition of the brick interceptor was evaluated based on closed-circuit television (CCTV) inspection videos, in which a traditional CCTV camera was floated through the pipe on a raft during overnight hours and in dry weather; a period of consistently low flows. While defects including active infiltration, mineral deposits and staining were observed, the overall structural integrity of the pipe appeared to be solid. However, due to the critical nature of the interceptor, and its location 25-feet below a busy commuter roadway, the City elected to rehabilitate the brick sewer with a trenchless, structural solution and eliminate the potential for a catastrophic collapse that could result in a very costly emergency repair in the future. Photographs showing the general condition of the interceptor, as well as active infiltration and mineral deposits in multiple locations can be found in Figure 4 and Figure 5, respectively.

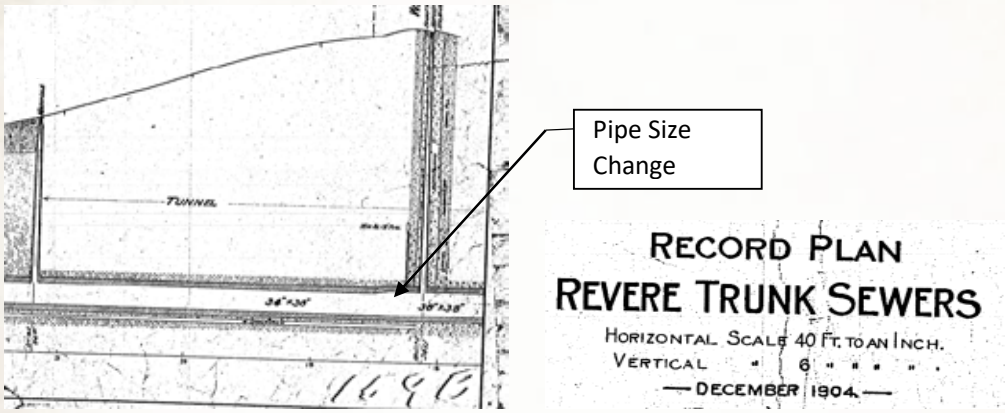

Figure 3. Pipe Size Change Without Manhole Access

Figure 4. City of Revere Brick Trunk Sewer

Figure 5. Active Infiltration and Mineral Deposits

4. DESIGN CONSIDERATIONS

Bypass Pumping

Because the access manholes on the trunk sewer are in the middle of a very busy roadway, and the most downstream manhole is located in a tidally influenced waterbody, the first design challenge faced was the feasibility of bypass pumping. To successfully bypass pump sewer flow around the three sections of pipe to be rehabilitated, permits for accessing state highway, and more importantly, trenching across the northbound lanes for temporary bypass piping, needed to be obtained through MassDCR. Due to the busy nature of Revere Beach Parkway at all hours of the day, but especially during the morning and evening commutes, restrictions on working hours and special considerations for trench paving in state highway needed to be included. In addition to permit requirements and coordination with MassDCR, permission from the MWRA to access their "hen house" structure as a discharge location for the bypass piping had to be obtained, and coordinated during construction. Because the "hen house" structure is partially submerged during high tide, and access to the structure is limited by restrictions associated with accessing tidal land and wetlands, timing of the installation of bypass piping around tide cycles needed to be considered. Furthermore, all of the work associated with laying the bypass piping in the tidal area/wetlands and installing the necessary hardware for discharge at the "hen house" would need to be performed by hand since access by anything heavier than a pick-up truck was virtually impossible.

Trenchless Sewer Rehabilitation Options

Three distinct trenchless rehabilitation technologies were evaluated for this project including spiral-wound lining, centrifugally cast concrete pipe (CCCP) lining, and cured-in-place pipe (CIPP) lining. Since spiral-wound liners can be installed with active flow in the sewer, essentially eliminating the need for bypass pumping, this lining technology was initially considered. While this technology is applicable for large diameter, odd-shaped sewer and drain rehabilitation, for a variety of reasons, with cost being the most critical, it was decided that spiral-wound lining was not the preferred rehabilitation method for this particular project. Additional trenchless rehabilitation options such as centrifugally cast concrete pipe (CCCP) lining were also evaluated during design, in addition to traditional

CIPP lining. While CCCP lining is more commonly used in the rehabilitation of large diameter drain pipes, this technology was included in the design documents as an alternate rehabilitation lining technology to allow for a comparison of unit costs for CCCP lining versus CIPP lining. Depending on the bid prices received, the City would then have the option of selecting the most cost-effective lining technology to complete the work. Additionally, the narrow diameter (24-inch) of the intermediate manholes where CIPP lining would be inverted from needed to be considered when evaluating the options for trenchless rehabilitation since equipment for most lining methods would need to be able to fit into the manholes along with necessary technical personnel.

Manhole Rehabilitation Options

Two manhole rehabilitation options were evaluated including cementitious lining and epoxy lining of manhole walls. Due to the depth of the manholes at an average of 25 feet, and portions of them existing permanently below the groundwater table, it was quickly determined that epoxy lining was the preferred option for manhole rehabilitation.

Pipe Size Change Between Manholes

Because a pipe size change was found between two access manholes during the review of record drawings, consideration needed to be given for a special order CIPP liner with a manufactured transition from 36" x 38" to 36" x 40", if CIPP lining was the preferred method of rehabilitation. Special order CIPP liners with transitions have additional costs associated with manufacturing, as well as lead times for ordering and delivery, that need to be factored into the pricing by the contractor during bidding. Thus, additional details about this transition, including the fact that it existed and the location of the pipe size change were emphasized and clearly presented in the design documents to ensure that all costs would be accounted for appropriately.

5. CONSTRUCTION

Bids were received in early March 2016, and included prices for an alternate bid item for CCCP lining so that the City could compare unit prices for rehabilitation. The low bidder's unit price bid for CIPP lining was $259.60 per linear foot, while the unit price for CCCP lining was $652.50. Since both rehabilitation technologies would require bypass pumping, the City elected to award the contract based on CIPP lining of the 36" x 40" brick interceptor.

Special Order Liner Confirmation

The contract was awarded to the lowest bidder in late March 2016, with construction commencing at the end of April. The first step in rehabilitation of the brick interceptor was to perform cleaning and CCTV inspection of the sewer to confirm lengths of each segment as well as the exact location of the transition of the egg-shaped interceptor from 36" x 38" to 36" x 40" between manholes S1984 and S1982. Once this information was confirmed, a special-order liner with a transition manufactured into the felt tube was ordered by the contractor. It was important that this liner length and transition be determined as early as possible in the project as the lead time to manufacture and deliver this unique liner was at least one month.

Bypass Pumping Setup

The next step in the construction process was to coordinate with MassDOT to access state highway for the purpose of trenching temporary bypass piping from manhole S1984, across the northbound lanes of Revere Beach Parkway, and along the shoulder. This manhole was selected as the suction manhole for the bypass so that manhole S1982 could be used as the inversion manhole to line both upstream and downstream. Due to the volume of traffic on the Parkway, the MassDOT permit required all trenching work to be performed between the nighttime hours of 8:00 pm until 5:00 am. Since Revere Beach Parkway is a state-owned roadway, special paving requirements were written into the access permit to ensure that the finished thickness of the restored pavement met MassDOT paving specifications. The permit required a finished thickness of 8 ¼-inches (4-inch base; 2-inch binder; 1 ¾-inch "State Top"; and ½-inch top course) with additional requirements for controlled-density fill (CDF) and other sub-base materials and compaction limits.

Once the trenching was complete, and the temporary piping was laid along the shoulder of Revere Beach Parkway, the contractor then needed to coordinate with the MWRA to access manhole S1745 as the discharge location of the bypass piping. As stated earlier, this manhole is located in a wetland and restrictions were in place for vehicle access though wetland and tidal lands. In fact, any construction vehicle other than a small pickup truck would sink and get stuck in the swampy, brackish, tidally influenced wetland. Therefore, to protect these tidal lands, the wetlands permit did not allow vehicle access to the structure. As such, the last 300 feet of bypass piping had to be carried in on foot and installed by hand. Since this area is also subject to increased water levels due to the tide, such that it was not possible to even walk out to the manhole during high tide because a person would sink into the ground, the tide cycles also had to be considered when planning the installation of the last few sections of the temporary bypass piping.

This discharge location into manhole S1745 was appropriate for the lining of the first two sections of the interceptor, however the discharge had to be moved to complete the lining from manhole S1983 to S1745. The new discharge location was the MWRA "hen house" structure located in a tidally influenced waterbody that is partially submerged and inaccessible at certain times during the tide cycle. Figure 6 shows the "hen house" at low tide and at high tide. Thus, further coordination was performed to ensure that access to the structure could be gained during low tide, while at the same time ensuring that MWRA personnel could also be onsite. Again, restrictions were in place for vehicle access to this location since it required entry into a tidally influenced wetland. Therefore, all work had to be carried out on foot.

Figure 6. MWRA "Hen House" Structure at Low Tide and High Tide

Insertion Manhole Modifications

Once the bypass pumping setup was complete, the contractor then needed to make modifications to manhole S1982 to allow for the insertion of the 36" x 40" CIPP liner. The manhole was only 24-inches in diameter at the top, but expanded out to 5-feet in diameter approximately 6-feet below ground. Therefore, the contractor removed the top 6-feet of bricks to gain access to the wider portion of the manhole and allow for the liner to be inserted and inverted both upstream and downstream from one location. Because of the working hours imposed by the MassDOT permit, all of this work had to take place during the nighttime hours between 8:00 pm and 5:00 am.

Cured-in-Place Pipe (CIPP) Lining Installation

The installation of cured-in-place pipe (CIPP) lining commenced with utilizing the modified manhole S1982 as an insertion point for the resin impregnated liner. The first shot was inverted in the upstream direction, toward the bypass pumping suction manhole S1984 and the second shot proceeded downstream to manhole S1983. All of this work was completed at night, per the MassDOT access permit as described above. Once this work was complete the contractor relocated the discharge location of the bypass pumping from manhole S1745 to the MWRA "hen house" as described above. Meanwhile manhole S1982 was rebuilt to its original condition, while manhole S1983 was modified in the same manner to allow for the insertion of the 36" x 40" CIPP liner. The third and final shot was then installed from manhole S1983, downstream to manhole S1745.

Manhole Rehabilitation

Following completion of the CIPP lining the three access manholes owned by the City of Revere were rehabilitated using a monolithic epoxy manhole lining system. In addition, manhole top sections were raised to grade utilizing recycled HDPE grade rings. All of the manhole epoxy lining work took place while the bypass pumping was still in operation to ensure that the bottom portion of the manhole was dry. Upon completion of the manhole lining, the contractor disassembled the temporary bypass piping, again coordinating with the MWRA and tide cycles, and conducted final paving of the trench across Revere Beach Parkway per paving guidelines outlined in the MassDOT access permit as described above.

6. CONCLUSION

The rehabilitation of this historic egg-shaped brick interceptor lasted approximately two months, including pre-construction CCTV inspection, bypass pumping setup, CIPP lining installation, post-construction CCTV inspection, and bypass pumping removal. The total cost to perform all of the work associated with this work was approximately $340,000 and required the collaboration of contractors, design engineers, resident engineers in the field, City of Revere DPW Department personnel, MWRA staff, and the City of Revere Engineer all working together to produce a successful end product. Many challenges were faced and ultimately overcome, and now a critical piece of sewer infrastructure has been rehabilitated and will continue to convey the majority of the City's wastewater through the City for years to come.

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WESTPORT'S PUMP STATION NO. 2 FORCE MAIN REPLACEMENT PROJECT USING HDD: A CASE STUDY

By: Bryan Thompson, Town of Westport, CT
Abhinav Huli, Haley & Aldrich, Inc.
Lori Carriero, Tighe & Bond

Figure 1: Project Location in Westport, CT

Figure 2: Work area west of Saugatuck River, Westport CT

INTRODUCTION

The Town of Westport had experienced several sanitary sewer force main breaks on pipes of similar age and material and decided to proactively replace the Pump Station 2 force main to avoid the catastrophic environmental impacts that would result from a force main break under the river.

Pump Station No. 2 is a sanitary sewer pump station located in the Town of Westport, CT that provides service to 25 per cent of the sewer customers on the western side of the Town. The station is located on the western shore of the Saugatuck River. The river crossing is near the confluence of the river with Long Island Sound and hence the river is influenced by tidal activity. The existing force main is a 10-inch cast iron pipe that crosses the river to connect the station to the Westport Water Pollution Control Facility (WWPCF) located to the east of the river. The force main was originally constructed in 1959 by floating it across the river and sinking the pipe to the river bottom. Traditional methods of pipeline replacement such as open cut excavation or sinking a replacement pipe were not feasible given the need for a tidal river crossing and expected difficulties in obtaining permits for this type of installation. Horizontal directional drilling was therefore selected as the preferred installation method to install the new 14-inch HDPE force main. Figure 1 shows the project location.

HORIZONTAL DIRECTIONAL DRILL DESIGN

Logistical Challenges:

As is the case for most trenchless projects in busy areas, it is critical to address the stakeholder challenges and logistics before tackling the technical

Figure 3: View of the HDD rig, overhead lines, I-95 bridge, site access and the conductor sleeve

Figure 4: Work area east of Saugatuck River, Westport CT

Figure 5: Marsh grass along with bedrock outcrops indicating steep joint sets west of Saugatuck River, Westport CT

Figure 6: Sample rock core showing Precambrian Gneissic bedrock

challenges. In that regard, the project location posed a few logistical challenges.

West Side:

The existing main is located to the south of the I-95 Bridge over the Saugatuck River and is within the right-of-way for Interstate 95. The bridge was constructed in 1957 and rehabilitated in 1992 with additional width expansion of 14 feet on both sides. This required the HDD alignment to be of sufficient depth so as to not affect the bridge foundation. The Metro-North commuter rail line's Westport train station is located to the south of the project site. This resulted in heavy traffic movement along Riverside Avenue through the course of the day and especially during the peak hours. Therefore, the traffic movement along this road could not be disturbed during construction. The commuter parking lot located north of Pump Station 2 between Riverside Avenue and the Saugatuck River and beneath the I95 Bridge had to be closed during construction. Based on review of CDOT drawings, a portion of the existing parking lot north of the pump station beneath I95 was a former gas station with underground storage tanks. The project site was also adjacent to numerous restaurants, one of which was on the water and was pile supported.

East side:

The east side contained the WPCF, the Town Animal Shelter and a boat ramp. The HDD exit location and pipe assembly area were also partially within the right-of-way for Interstate 95. It was crucial to maintain access to these facilities at all times during construction.

Technical Challenges

The technical challenges included underground and overhead utilities, potential settlement of nearby buildings and I-95 bridge foundation, subsurface conditions, potential inadvertent returns and the HDD alignment design.

Underground utilities and Instrumentation plan

Underground and overhead utilities were of concern, especially on the west side of the river. The west side HDD entry area was in close proximity to a 36-inch diameter storm pipe and a storm manhole. The 36-inch diameter storm sewer pipe terminated in an outfall into the river. In addition, the new force main was proposed to cross underneath the existing force main from Pump Station No. 2. This force main had to remain in operation throughout the drilling operation.

An extensive instrumentation plan was designed due to the presence of a restaurant on piles, Pump Station No. 2, and the bridge foundations near the HDD alignment on the west side. On the east side, the animal control facility and existing infrastructure conveying sewage to the WPCF were of concern. A combination of utility monitoring points, inclinometers, two types of deformation monitoring points were installed at strategic locations and monitored on a regular basis. The bridge piers were surveyed daily to ensure that no movement was observed.

Subsurface conditions

Haley & Aldrich, Inc. had previously performed geotechnical engineering for the I-95 bridge expansion in 1992. The bridge was originally constructed in 1957 and consisted of two abutments and nine piers. The foundation consisted of steel H piles, cast-in-place concrete piles (mandrel driven concrete drilled steel shells), cast on bedrock or dense granular deposits.

Haley & Aldrich, Inc had also performed temporary excavation support and subsurface evaluation for the improvements to the Westport WPCF in 2003. Based on the available information, a desktop study was performed to establish

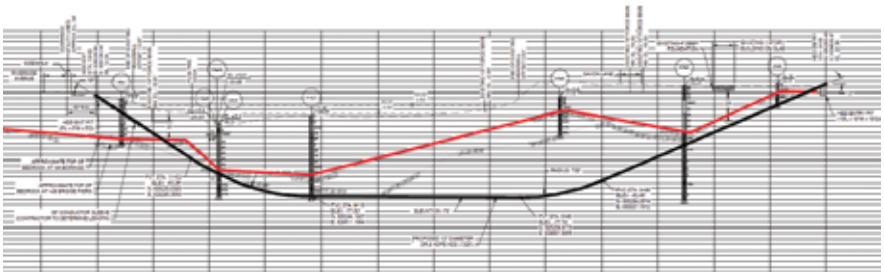


Figure 7: HDD alignment profile. Red line indicates the approximate top of bedrock.

Figure 8: Installation of the conductor sleeve

Figure 9: The Magnetic Beacon system

Figure 10: 22-inch diameter reamer on the HDD rig before starting the ream

the subsurface exploration program for the HDD alignment.

A total of 6 borings were performed as a part of the subsurface exploration program. Based on a review of the existing I-95 bridge borings and the six test borings, the subsurface profile at the project HDD crossing includes Fill soils, Organic Deposits and granular Glaciofluvial Deposits overlying gneissic bedrock. Bedrock outcrops were observed near the WPCF along the eastern river bank.

Bedrock was cored in the borings and was generally described as a hard to very hard, fine to very coarsegrained foliated Gneiss with high to extreme abrasivity, unit weight of 150 to 175 pcf, and a compressive strength of up to 34,000 psi.

Figure 11: 22-inch diameter reamer exiting on the east side

Multiple joint sets (discontinuities) were noted with joint spacing judged to be very close to moderately spaced. The top of bedrock elevations varied widely along the project alignment. A Fault line was located along the eastern side of the Saugatuck River. Subsequent glacial scouring removed broken rock from faulted bedrock zones, likely contributed to the highly variable and weathered top of bedrock elevations which ranged from 9 to 56 feet below ground surface.

HDD Alignment Design

Various HDD alignment alternatives were examined to minimize the disturbance to the various stakeholders. Considering the changes in subsurface conditions, the HDD alignment was designed almost entirely within bedrock to minimize the potential for inadvertent return of drill fluids in the river and to avoid drilling in potentially unstable borehole conditions. In general, rock was expected to be very hard and very abrasive to cutting tooling.

The hydraulic design of the new force main in combination with the expected HDD installation stresses and pull loads resulted in a 14-inch diameter DIPS DR9 HDPE pipe. The DR9 thickness was selected to provide a wall thickness that could not only sustain higher installation loads but also potential gouges since the drill was almost entirely in rock.

The final HDD alignment was designed with HDD entry/exit angles of 18 degrees and 12 degrees on west and east sides with a total length of 1,300 feet and approximately 90 feet in depth from the HDD entry location. The pipe laydown for pullback was designed east of the river along the treatment plant access road. A combination of a steep entry angle and use of a steel conductor sleeve was recommended to be used on the HDD entry (west) side to mitigate the potential for inadvertent returns while drilling from the ground surface to the top of bedrock. This was also intended to mitigate the potential for over-excavation and settlement of the nearby utilities and

Figure 12: HDPE product pipe fused laid for pullback along Elaine road. WWPCF and I-95 are to the left and right side of the photograph respectively

Figure 13: View of the east side work area at the at the beginning of pipe pullback

pile supported buildings. As required by regulatory agencies, the specifications also required the contractor to submit a detailed inadvertent return contingency plan delineating the steps that would be implemented in case of inadvertent returns.

Permitting Efforts

The proposed drilling work required extensive permitting efforts as part of the design phase, including:

– CTDEEP Office of Long Island Sound Approval was required due to work within a tidal wetland area. This permit required the following:

- Review and approval from the Army Corps of Engineers, Westport Shellfish Commission,
- Natural Diversity Data Base (NDDB) State species review
- Review and approval from the CT Department of Agriculture/Bureau of Aquaculture
- Notification of all property owners within 500 feet of either side of river

– CTDOT Approvals for work in right of way of Interstate 95, State Route alongside the project site, and boat ramp access on the east side of the river

The NDDB review resulted in peregrine falcons having known nesting locations within the project area. Because of this, construction was prohibited from taking place between March and July.

Resident/Agency Coordination Efforts

The Town of Westport directly handled all coordination and communication with local businesses, train commuters and the CT DOT. This included all resident notifications required by permitting agencies. The construction of the new force main required the closure of the commuter parking lot throughout the drilling work. The commuter lot, although State of CT property, is maintained and operated by the Westport Office of Railroad Parking, a division of the Westport Police Department. In November 2017, (one-month prior to expected start date), the Police Department notified all commuters with parking passes that the lot would be closed from January 1, 2018 to March 5, 2018. Notification was in form of an email as well as on a tow behind variable message board positioned in the parking lot stating the dates of the closure.

Extensive coordination was also required with the CT DOT during the permitting phase and throughout the construction phase. The Town worked directly with the State to obtain the necessary approvals. The Town's longstanding working relationship with the DOT ultimately resulted in a much shorter approval process and reduced the overall project cost as consulting fees were reduced accordingly.

Bid Phase Issues

The contract was initially advertised for bid in April 2017, with a scope of work including both the directional drilling and piping connections on either side of the river, and a construction cost estimate of $2.5M. The contract specifications indicated that all drilling work should be completed in August and September both to adhere to DEEP permit requirements and coincide with lowest use of the commuter parking lot due to summer vacations.

Only one bid was received which was well above the cost estimate. Conversations with potential drilling contractors revealed that the proposed time frame was too restrictive given their existing project workloads. In addition, combining the drilling and piping connection work was adding subcontractor markups to already high drilling prices. The decision was made to separate the drilling work from the piping connection work and allow proposed drilling contractors to specify the drilling timeframe (which had to be in accordance with DEEP permit limitations).

The project was re-bid in June 2017. A total of three bids were received, and the contract was awarded to Carson Corporation of Lafayette, NJ who was the low bidder with a bid price of $1.4M. A meeting with Carson prior to contract award confirmed their intent to perform construction in January and February of 2018.

Construction Specifics/Photos

In view of logistical and technical constraints, Carson Corporation chose

Figure 14: Product pipe pullback complete

Figure 15: View of the I-95 Bridge and the product pipe

Figure 16: Flooding during one of the nor'easters

to drill from west to east so that drilling and pullback could be performed from the same side. Carson used an American Auger D210 with a smaller footprint to fit in the available work area.

A 36-inch diameter steel conductor sleeve was installed on the HDD entry side. TT Technologies pneumatic hammer "Goliath" was used to install approximately 85 feet of casing at an angle of 18 degrees until the refusal criteria of 1ft/10 min was met.

Upon completing the installation of the conductor sleeve, the HDD rig and associated support equipment were mobilized into the commuter parking lot underneath the I-95 Bridge. Limited site access and tight work space resulted in the drill rig partially hanging over the sidewalk which required installation of scaffold over the sidewalk to protect pedestrians from potential falling objects. Because of the hard bedrock Carson also had spare mud motors and drill bits onsite. Simultaneously on the west side, three 500-foot sections of new force main pipe were fused, and low-pressure tests were performed in preparation for the pipe pullback.

The contractor used a magnetic beacon system with a range of approximately 300 feet. Due to this limited range, the beacon was moved to strategic locations along the alignment as the drill progressed.

Carson began drilling the pilot hole using a 9.625-inch diameter pilot head. Inadvertent returns were observed when the drill head exited the conductor sleeve at approximately 90 feet at what appeared to be the interface of the conductor sleeve and possible weathered rock. Drill rig chatter was also observed when the drill head passed through this location. Carson immediately stopped the drilling operations and implemented the inadvertent return contingency plan which included containing the inadvertent returns using silt curtains and sand bags as applicable, using appropriate loss prevention material such as magma fiber and cedar chips, having a mud engineer reassess the drill mud parameters to ensure appropriate properties to mitigate inadvertent returns and finally, increasing the depth of the alignment so as to increase the capacity of the overburden to sustain drill mud pressures. Tidal fluctuations of approximately 7 feet resulted in Carson having to work during low tide. Drilling was resumed after establishing drill mud circulation and plugging the inadvertent returns. As the drill progressed toward the east, the rock was observed to be harder based on the production rates, HDD rig behavior, and the soil cuttings.

The bedrock was observed to be shallow (<10 feet) on the eastern side and inadvertent returns were observed at the interface of top of rock and soil when the pilot drill proceeded past the animal shelter location. Carson implemented contingency plans and installed haybales and sand bags around the affected area and vacuumed the inadvertent returns. The pilot drill was completed approximately 23 feet short of the designed location.

Upon completion of the pilot drill, given the prior observations, a 20-inch diameter reamer was used to push-ream up to 210 feet from the entry location to assess drilling conditions at the end of conductor sleeve and check for inadvertent returns at the previously observed location, if any. No inadvertent returns were observed. The 20-inch diameter reamer was replaced with a 22-inch diameter reamer and push-reamed to the east side. The combination of push-reaming and an elevation difference of 11 feet between entry and exit location assisted the drill mud flowing back to the HDD entry side for processing. During the reaming process, a 22-inch diameter reamer had to be swapped with a new reamer due to wear on the cutting head.

A pit was excavated at the exit location for multiple purposes:

- To expose the shallow bedrock and prevent any broken rock from falling into the borehole
- Temporarily contain the drill mud until completion of the pipe pullback.
- Use trucks to transport the contained mud from the exit side to the entry side for processing.

A final swab was completed using a 22-inch diameter reamer. The 14-inch diameter HDPE product pipe was then pulled in place over a two- day period. Considering that the drill was completed almost entirely in rock, Carson pulled approx. 500 feet of pipe on day one and left the pipe in the borehole overnight. The remainder of the pipe was pulled on day two without any issues. A hydrostatic pressure test was successfully performed upon completion of the pipe pullback.

The tidal fluctuations of approximately 7 feet combined with the risk of flooding due to the three nor'easters resulted in Carson having to take precautions to avoid damage to equipment and personnel and avoid flooding the entry pit. The snow plows driving on I-95 Bridge resulted in the snow falling over the bridge and onto the equipment layout. Carson took

precautions to avoid overhead risks and called off operations when the conditions were deemed unsafe.

Once the drilling work had been completed, the Town worked with Tighe & Bond to bid a separate contract to make the connections between the newly drilled force main to the influent WPCF piping and Pump Station No. 2. This work was successfully completed in the spring of 2018.

CONCLUSION

The construction of this force main replacement contract was ultimately a successful project. Lessons learned/takeaways from this project include:

- Separating the drilling work from the pipe connections avoided excessive markup on subcontractors and allowed drillers to bid the work directly, resulting in lower costs for the client
- Allowing flexibility in the construction time period allowed drilling contractors to plan the work around existing projects, resulted in more bids being submitted, and ultimately lower bid prices
- Having the Owner directly involved in permitting efforts, agency coordination during construction, and resident communication helped to speed up the overall permitting timeline during the design phase and also allowed swift emergency approvals when needed during construction

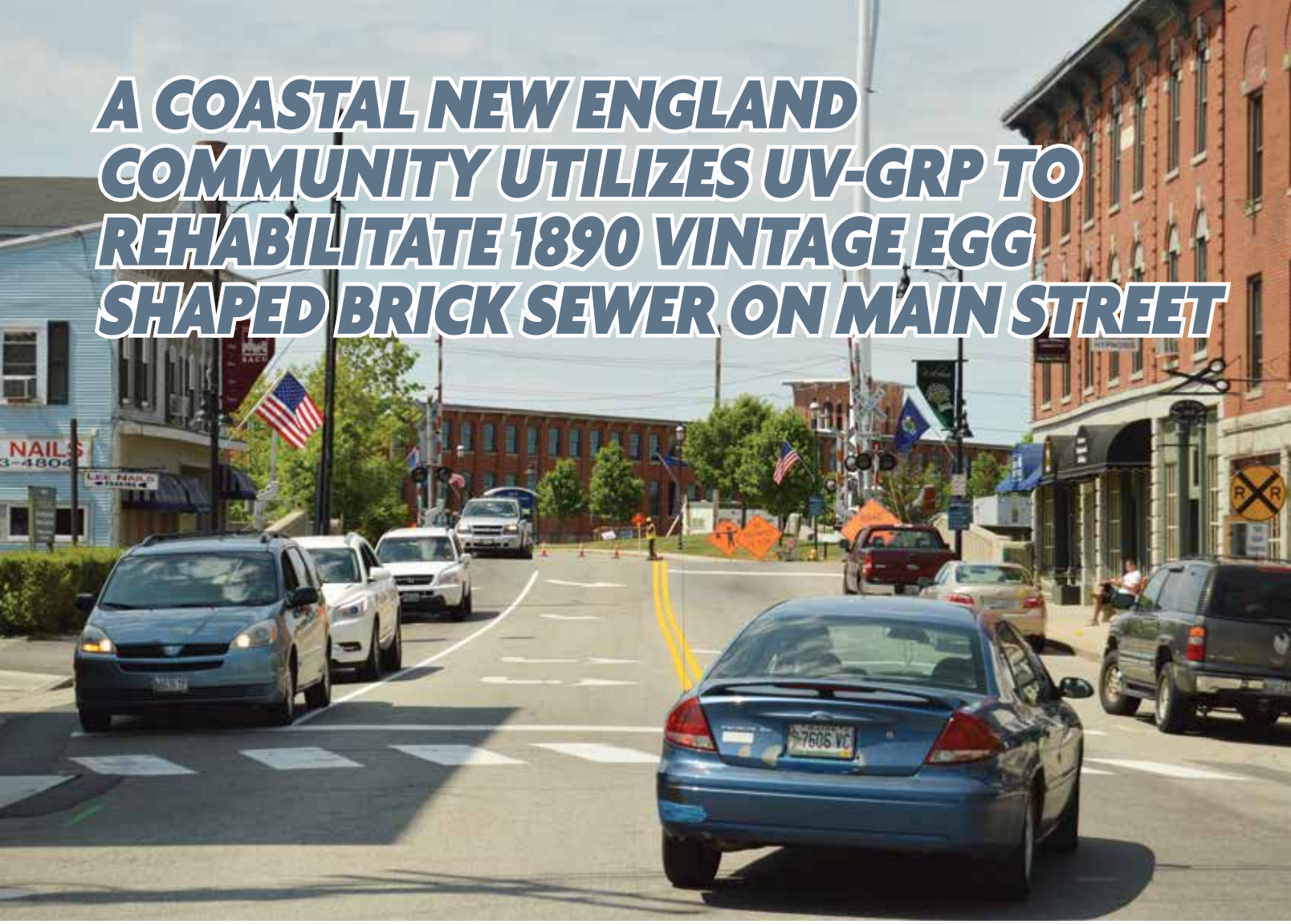
ABOUT THE AUTHORS:

Bryan H. Thompson *has been serving the Town Of Westport, Connecticut for over 29 years. As the WPCA Collection System Supervisor he is responsible for all facets of the Town's sanitary sewer collection system, including oversight of collection system operation and maintenance as well as the design and construction of facility improvements and sewer extension projects. Through his role with the Town, he has developed an expertise in coordinating with residents and contractors, as well as local, State and Federal regulatory agencies.*

Lori Carriero *is a Project Manager with Tighe & Bond who has significant experience in the evaluation and rehabilitation of sanitary sewer systems. She has overseen the evaluation and installation of numerous trenchless technology products, and has presented papers on trenchless technology at various seminars and conventions. Lori is a member of the NASTT-NE Chapter.*

Abhinav Huli *is a senior trenchless engineer with Haley & Aldrich, Inc. He has 8 years of experience in preparation of contract documents, design calculations, and with onsite construction monitoring of various new trenchless installations including Horizontal Directional Drilling, Microtunneling and Horizontal Auger Boring.*

A COASTAL NEW ENGLAND COMMUNITY UTILIZES UV-GRP TO REHABILITATE 1890 VINTAGE EGG SHAPED BRICK SEWER ON MAIN STREET



By: Peter Goodwin, Ted Berry Company

The City of Saco, Maine encompasses 53 square miles of prime real estate along Maine's Southern coastline and is located approximately 14 miles south of the City of Portland, Maine. Saco is a destination for residents and visitors alike due to its 2.5 miles of accessible coastline, and proximity to Portland, Maine, Portsmouth, New Hampshire, and Boston, Massachusetts along with major transportation links including the Maine Turnpike, US Route 1, and the Amtrak Downeaster rail station.

Saco has approximately 18,500 residents based on the 2010 US Census. Like many historic New England manufacturing communities, the initial sewer system was a combined sewer system conveying rainwater runoff, domestic wastewater, and industrial wastewater in the same pipe with direct discharges to the Saco River. In 1971, the City constructed its first wastewater treatment facility on Front Street along the Saco River to treat the combined sewage and upgraded it in 1988 to its current design capacity of 4.2 MGD. Since 1995, the City has been completing an aggressive sewer separation program to reduce the nine CSO discharges. The treatment facility is now known as the Saco Water Resource Recovery Facility (WRRF). The WRRF currently treats an average daily flow of approximately 2.5 MGD from 4,700 customer accounts. City staff have indicated that seasonal wet weather flows can increase to over 12 MGD at the facility.

Main Street in Saco is the backbone of a vibrant and bustling community stretching from the renovated Mills of Biddeford and Saco to the Town of Old Orchard Beach. In 1996, a large part of downtown Saco was nominated as a National Register Historic District, which acknowledges the rich architectural and social heritage that makes Main Street distinctive and important to the broader understanding of the history and culture of Maine. Historic buildings including Saco City Hall, constructed in 1855, line Main Street, which now includes local shops, businesses, and restaurants with high vehicular and pedestrian traffic. Saco is also a proud member of Main Street America Program with cultural activities occurring year round.

In the late 1800s with significant growth and industrial development, the City began constructing a combined sewer system with the trunk line consisting of a 39-inch egg shaped brick sewer below Main Street. In the late 1990s and

> **"BY COMPLETING THIS PROJECT WITHOUT DIGGING IN THE ROADWAY, WE WERE ABLE TO REDUCE THE COSTS FOR PUBLIC INFRASTRUCTURE IMPROVEMENTS WHILE ALSO MINIMIZING THE IMPACT TO OUR RESIDENTS AND COMMUTERS TRAVELING ON OUR MAIN STREET,"**
>
> **- Kevin Sutherland, Saco City Manager**

early 2000s, the City completed sewer separation in the downtown area, but continued to utilize the brick sewer for wastewater flows. Just under 2,000 linear feet along Main Street, this sewer ranges in depth from ten to over fifteen feet and was determined through CCTV inspection to be well past the end of its useful life. Remarkably, certain sections were in pristine condition; however, signs of deterioration of the brick, including missing bricks, were identified throughout the length of sewer. A localized failure and repair of a collapse in this line in 2014 began the process of determining and funding a long-term solution to this aging infrastructure in the heart of downtown.

In 2017, Unitil Gas secured approval to install 17.5 miles of new natural gas mains to over 2,100 homes and businesses in downtown Saco and along Main Street. This project proceeded with significant daily traffic, pedestrian, and business impacts. The gas main project was completed and then the City learned that Maine Department of Transportation was planning a paving project in the near future.

Based on traffic, timing, location of existing utilities (water, drainage, gas, communications, etc.), depth, and the economic/social impacts this work would cause to the downtown district, the City

A detailed installation plan maximized efficiency and reduced impacts to daily life for Main Street businesses and residents

Each segment could be installed without bypass pumping if the work was done at night

determined that open cut construction was not an option for the sewer rehabilitation.

Based on previous success with trenchless technologies including pipe bursting and UV-GRP trenchless in the Bear Brook sewer-shed, the City decided to evaluate trenchless options as an alternative to open cut excavation. In addition to a CCTV inspection, a comprehensive field assessment determined that there were actually three different size egg-shaped segments along the Main Street length. It was also found that an emergency repair had been completed and a short section of 30-inch PVC pipe had been grouted into the line along 600 feet of manhole-to-manhole run. City staff recommended removal of this section and installation of a new manhole to allow for consistent installation of a UV-GRP liner from manhole to manhole.

The City prepared bid documents and publically bid the project in August 2017 using a UV-GRP specification. The Ted Berry Company, Inc. was the low bid at $ 297,500 with a second alternate bid for conventional thermal cure CIPP liner coming in slightly higher.

During the bidding process, Ted Berry Company Inc. developed a detailed installation plan to maximize installation efficiency and reduce impacts to daily life for the Main Street businesses and residents. Based on flow data, it was

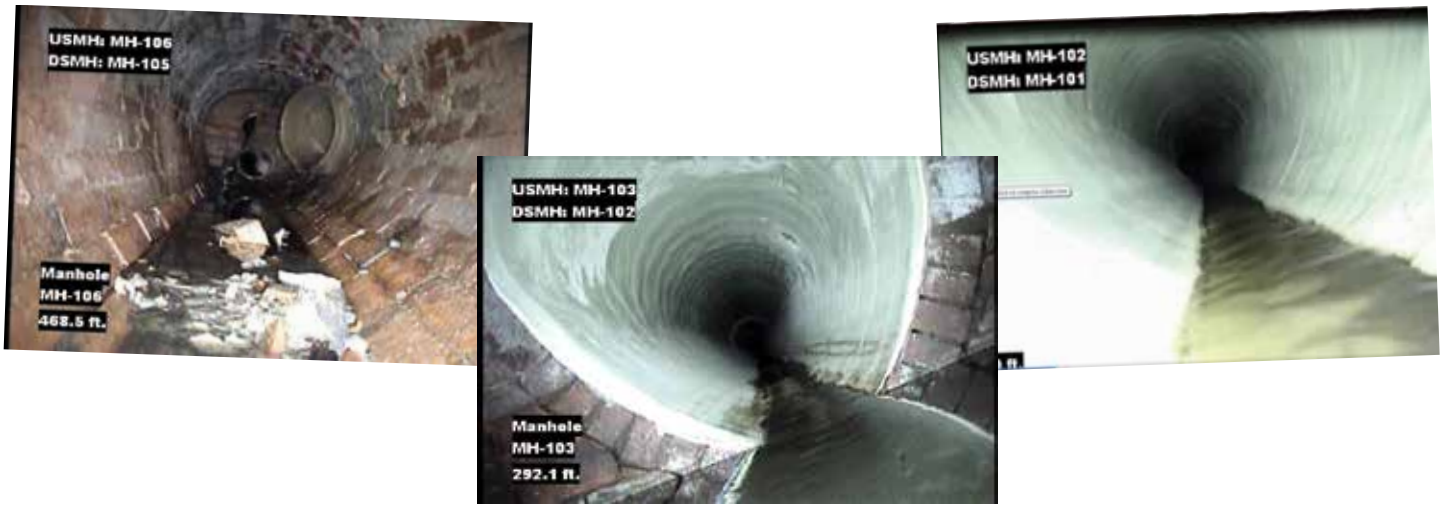
A motorized conveyor load system was used for liner placement into the existing manholes

> **"KNOWING WE SAVED THE COMMUNITY HUNDREDS OF THOUSANDS OF DOLLARS BY UTILIZING TRENCHLESS TECHNOLOGY AND PROVIDING A LONG TERM SOLUTION IS UNBELIEVABLY SATISFYING FOR OUR TEAM,"**
>
> – Matt Timberlake, President, Ted Berry Company Inc.

determined that each manhole-to-manhole segment could be installed without bypass pumping if the work was completed at night. This saved considerable cost associated with above ground bypass scenarios. This also was beneficial to the known traffic and pedestrian concerns. Based on the size, weight, and length of the liner sections, Ted Berry Company Inc. also utilized a motorized conveyor load system for liner placement into the existing manholes.

The Ted Berry Company, Inc. is a licensed installer for Reline America from Saltville, Virginia. Reline America's ALPHALINER™ GFRP is a seamless liner spirally manufactured to provide superior structural qualities. The liner system utilizes a thin HDPE slip-sheet to protect the uncured liner system during installation. Once installed, a high volume-low pressure blower truck inflates the uncured liner. When the liner is inflated, the UV light train is installed and a CCTV pre-inspection is performed to ensure the liner is ready for curing. UV bulbs are activated and the cure truck is activated to pull the light train at a specific design speed to cure the liner. After curing, the inner protective film is removed and the new GRFP liner is ready for service.

Ted Berry Company Inc President Matt Timberlake commented, "This project took a total team effort and the Ted Berry UV Team did an amazing job working in the tight confines of Main Street at night to minimize the impacts to the residents of Saco and neighboring communities that travel this corridor daily. Knowing we saved the community hundreds of thousands of dollars by utilizing trenchless



The egg-shaped sewer UVGRP liner was installed in seven sections completed in under two weeks

technology and providing a long term solution is unbelievably satisfying for our team."

The egg-shaped sewer UV-GRP liner was installed in seven sections and the project was completed in just under two weeks in the Fall of 2017. The structural GRP liner will serve the City for many years into the future.

ABOUT THE AUTHOR:

Peter Goodwin *has over 30 years of municipal consulting experience specializing in water and wastewater infrastructure planning, design, construction, and operations. He is the Client Services Manager for the Ted Berry Company, Inc. of Livermore, Maine serving all of New England with Industrial and Municipal Infrastructure Assessment and Trenchless Rehabilitation Technologies.*

NTA & NASTT-NE PAST PRESIDENTS

NASTT-NE & former Northeast Trenchless Association Past Presidents met for dinner Thursday October 18 in Portsmouth NH. (Front to rear, left to right) Bruce Hubbard, Jim Hargraves, Warren Hagenbuch, Jeff Martin, Brian Dorwart, Linda Hargraves, Eric Schuler, Babs Marquis, Danielle Martin, Marshall Gaston, Matt Timberlake, Dennis Doherty, Amanda Ready, Sandy Hubbard , Ian Mead, Scott Kelly, Ralph Edwards, Shawn Ready, Liz Edwards

CURED-IN-PLACE-LINING PRESERVES A HISTORIC PHILADELPHIA BLOCK

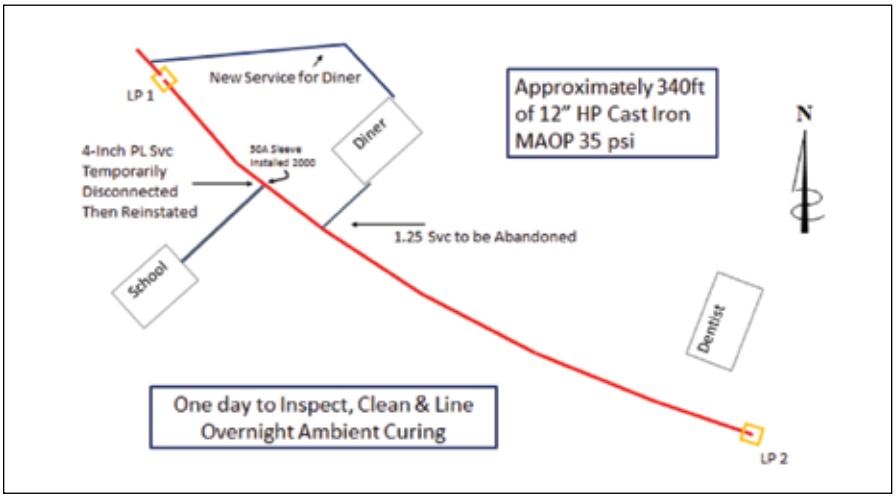
By: Cindy Kerr, Ckarma Marketing

Trolley Stop Diner on Germantown Ave.

This project was designed to eliminate a final segment of cast iron pipe still in service on a trunk line in a north western section of Philadelphia. The Germantown neighborhood is a National Historic Landmark District dating back three centuries to the American Revolution. Germantown Avenue runs through the upscale Chestnut Hill and Mt. Airy neighborhoods. The area is brimming with charm along the tree-lined streets, historic houses, unique restaurants and boutiques.

Underneath the street, a 12-inch cast iron main dating back to 1930 has been replaced section by section with wrapped steel and/or plastic pipe per PHMSA & state regulations. Only one section of 340 feet remained to be replaced. Along that block of Germantown Ave. sits the iconic 24-hour Trolley Car Diner & Deli. It dates back to 1952 and includes a refurbished trolley car serving ice cream and drinks. The historic cobblestone street is also home to mom-and-pop businesses, a school and homeowners.

Traditional pipe replacement was ruled out. Trenching would destroy the cobblestone street. Inserting a plastic pipe into the cast iron would not meet the volume demand needed for customer service. And, there were two somewhat complicated services to consider on this section of main that made the long list of



Site Map

Preparing the Launch Pits

Removing the End Cap on the 12-inch Cast Iron Pipe

reasons why this segment of cast iron had not yet been replaced.

The decision was made by the utility to rehabilitate the 12-inch cast iron section with Starline Cured-in-Place-Lining (CIPL) by the team at Progressive Pipeline Management (PPM). PPM is a full service contractor and team of highly skilled infrastructure renewal specialists serving the industry for 16 years. CIPL uses the patented Starline technology that inserts a liner into the pipe which renews the pipe and extends its life by 100+ years. The project was led by Phillip Hoffer, Regional Manager of PPM. He joined the 1st Starline CIPL team in 2000 and leads projects and client relationships with his experience.

The process would require about 5 days of work in inspecting, cleaning, lining and curing. First, alternate services had to be secured for the days the main would be out of service. A 1 ¼-inch service line that supplied the 24-hour Trolley Car Diner would need to be abandoned. The utility crews dug a trench down the side and the back of the diner parking lot for a new 1-¼-inch service that was then connected to the recently replaced main just outside the scope of the renewal.

A second service to be considered was a large 4-inch plastic pipe feeding the school property across from the diner. The line would need to be taken out of service during the 5 days of construction. Since it was late May, heating the building was not a big concern and school administrators agreed that it would not disrupt their operation for gas to be out of service for a few days.

The line was excavated and the tee uncovered for the 4-inch service. The service tap would be reinstated once the liner was cured by cutting a hole through the cured liner. It was a relief to find that the service tee was located in a grassy area and the main was relatively shallow. It could be reinstated by digging over the tee, removing the cap and guts and then reinstating the tap externally with a drill rather than doing an internal robotic reinstatement to save time.

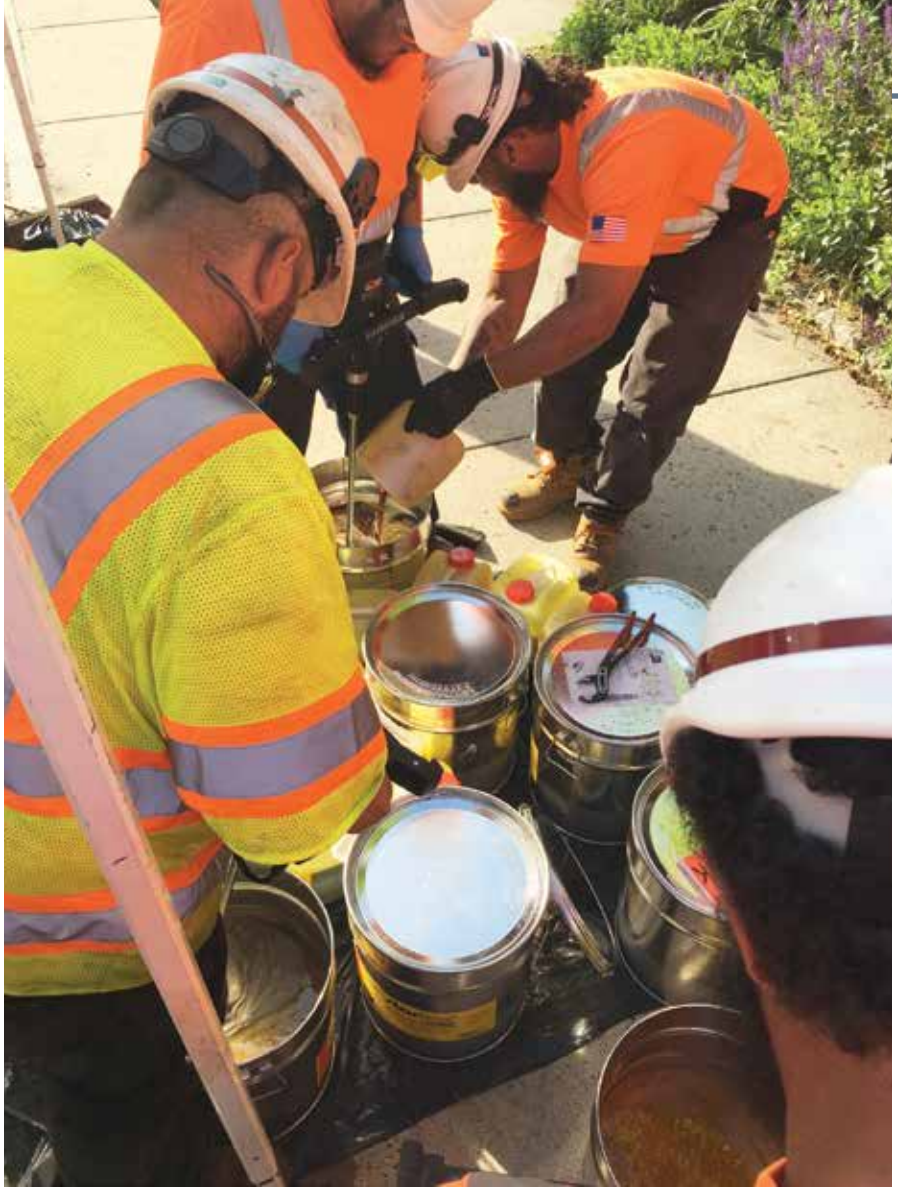
As the scheduled day for the beginning of the project was nearing, alternate services were in place and the team was ready to go. Back at the utility, a major challenge was brewing that could jeopardize the project.

THE CHALLENGE

At a final meeting of management to review the schedule, senior operations and engineers expressed serious concerns about the risks involved with the proposed outage of 5-6 days that the main being lined would be out of service. This pipeline on Germantown Ave is one of just two main feeds supplying the outer regions west and northwest of the city of Philadelphia. The other main trunk line on Ridge Ave., parallel to Germantown Ave, would be supplying gas for all the customers in the area during the days the lining was taking place.

If there was an unforeseen failure of one kind or another on the Ridge Ave. main, it could be disastrous. If for example, a construction backhoe hit the Ridge Ave. pipeline and it was shut down, it would quickly become a major catastrophe involving tens of thousands of customers and businesses affected, or possibly put out of service. Philadelphia neighborhoods like Chestnut Hill, Roxborough, Manayunk and Andorra could be impacted. In those neighborhoods are schools, shopping centers, businesses and industrial firms. The residents include influential politicians and business leaders.

These appropriate and legitimate and concerns could easily have killed the project and future lining jobs. A call came from the lead engineer to Phil Hoffer.



Mixing the Adhesive - The Clock Starts

They had decided that five days was too long to be out of service and wanted to know if PPM could speed up the job. Phil had to think fast.

He explained the stages of the five day scenario. Day one, CCTV camera inspection, cleaning, and sandblasting the pipe. Day two, the liner is prepped, adhesive mixed and the pipe is lined. Days three and four for the adhesive to cure, leaving room for temperature variances. Day five pressure is released and liner cut out on both ends flush with the end of the pipe. Another CCTV inspection to ensure all looks good. Then the 4-inch tap opening would be reinstated and the pipe turned back over to the utility.

From past field experience, Phil knew the only place he could shorten the process was if they used a different adhesive with a shorter curing time. It would be possible to complete the process of lining the pipe in 36 to 48 hours. He had completed past jobs with the quick-curing adhesive, however the shorter pot life meant the crew had to act fast and avoid any errors or miscalculations. Once the A and B components of the material were mixed together, there was less time to complete the process before the adhesive started to harden. Each step had to be precise, the crew had to quicken the pace and work efficiently. As the liner went through the pressure drum, it had to be placed perfectly. If the adhesive cooked early, it wouldn't adhere to the pipe properly.

Phil reasoned if the utility could give them the pipe early Monday morning and they could clean and line the pipe by the end of the day with the quick-curing adhesive, there was a good possibility that the liner might be cured by the end of the following day, Tuesday. The exact time of curing would depend on the ambient temperatures outside. A worst-case scenario was if delays in the cleaning process caused the completion of the lining to a later time of 10:00 PM. Temperatures in the fifties would mean a 24-hour cure time. Even under these conditions, the crews could work through the night and have the main back in service Wednesday morning. This would save two entire days enabling the utility to get the main back in service sooner.

The other major concern was if the pre-cleaning CCTV inspection when the main was out of service found an unexpected pipe anomaly. If they found anomalies such as a big rock, it would have been impossible to clean and blast it in half a day. A build-up of debris and deposits would require extensive internal sandblasting to prepare the pipe wall surface for good liner adhesion.

Because of the possibility of surprises like these, a precaution was implemented to add a live camera insertion cam by the utility while the main was still in service. This enabled both crews to check the condition of the main and ensure it was in acceptable shape to stick to the schedule. The utility executives and engineers were satisfied with the new plan.

The utility has two camera trailers designed and manufactured by ULC Robotics, equipped to do live CCTV inspections with a push-pull camera. It is intrinsically safe and is inserted through a vertical shaft mounted on the pipe over a three-inch tap. Phil observed the live inspection and assured the pipe was in acceptable condition for lining.

Once the main was "dead," the standard PPM CCTV inspection was done using the ARIES LETS camera, which is used in all phases: pre-clean, post-clean and post-lining.

In late May, the warm weather made the prospects of the plan look good. There was still reason for concern because in a city in the northeast the possibility of adverse weather and colder temperatures at that time of year are not unusual. There had been rainy days while the excavations were being made that gave the team some apprehension, but when the time drew near to take the main out of service, forecast of sun and warmer weather was an encouraging sign.

LINING DAY - MONDAY MAY 21

The conditions were sunny. The CCTV pre-clean Inspection was completed by 8:30 am. Equipment was moved and set into position for internal sandblasting. Sandblasting was completed, but the post-clean camera inspection revealed sharp protrusion discovered at the abandoned 1-¼" service tap for the diner. Thin, sharp shavings of metal from the original tap revealed that otherwise the pipe was clean.

Now they had to deal with the protrusion. A call was made to have a specialized cutter truck sent to the site. Pigging attempts were made to try and break away the protrusions, but not completely successful. Concurrently, the crew continued to set up the equipment for the wet-out process for lining.

The cutter was modified for the different pipe diameter on site. The cutter was placed into the pipe but there were problems with the compressor including the air supply for the cutter and ultimately the pressure drum for lining. Moisture was found to be the cause, then remedied. By 5:30 pm the cutter went back in and protrusion was removed.

Then the quick dry adhesive was mixed. The wet out process and liner loaded into drum, and the drum was pushed to Inversion. By 9 pm the liner had been Inverted into pipe and received in the catch with adhesive temperature 70.8 and ground temp 66.2. The day finished just before 10 pm.

Tuesday May 22 was a rainy day. At 2:00 pm the air pressure was released, liner ends cut out and CCTV post-lining Inspection complete. The utility team set-up restrained end caps for air pressure test.

From 6 to 10 pm, a 4 hour pressure test was done at 52.5 psig. The project was considered a success. A decision was made to wait the following morning to put the main back in service because of the rain. The main was handed back to the utility within 36 hours.

The following morning, May 23, the Germantown Ave. main was back in service within 48 hours as promised. If there had been an emergency on the other main, the main could have been gassed and back in

Preparing to Tape the End of Adhesive Filled Liner for Wet-Out

PAST JOBS HAD BEEN COMPLETED WITH THE QUICK-CURING EPOXY, HOWEVER THE SHORTER POT LIFE MEANT THE CREW HAD TO ACT FAST AND AVOID ANY ERRORS OR MISCALCULATIONS...THE MAIN WAS HANDED BACK TO THE UTILITY WITHIN 36 HOURS.

service within 36 hours. That morning the 4-inch service tap was reinstated for the school externally with a drill.

CONCLUSION

The success of this project was due to communication, teamwork and solution based thinking on both sides. The utility communicated the critical concerns and together the leaders engineered a reasonable, realistic solution that did not add additional costs. In this case, the conditions were right to turn the project around in a shorter period of time. The right conditions included the warmer temperatures, the relatively short length of pipe and minimal service connections to deal with.

While this is not a schedule PPM recommends or uses as standard practice, if the conditions are right and there is a critical time factor at hand, a faster cure solution can be an option. The most important factor was that both teams worked professionally and rapidly with a can-do attitude.

ABOUT THE AUTHOR:

***Cindy Kerr** is a seasoned marketing communications and website designer with 25 years experience across several continents. She has worked in the pipeline and infrastructure industries for many years and is able to translate complex technologies into clear and powerful visual branding for web, trade show and print. To learn more: www.ckarmamarketing.com or cindy@ckarmamarketing.com*

UNDERSTANDING GEOLOGICAL HISTORY WHEN SELECTING TRENCHLESS INSTALLATION METHODS

PART 2: EFFECTS OF GLACIAL AND PRE-GLACIAL COASTAL DRAINAGES ON HDD CROSSINGS

By: Bradford A Miller, P.G., Haley & Aldrich
Dennis J Doherty, P.E., F. ASCE, Haley & Aldrich

INTRODUCTION

On many large, engineered trenchless installations, it is imperative for the engineer to understand the geological history of the subsurface, and determine the possible consequences and controlling effects the geology has on the proposed crossing. Deciphering the underlying geologic history (and its local anomalies) drives selection of the most appropriate trenchless method.

Part 2 of this three-part series looks closely at the complications associated with an HDD crossing in an over-deepened, coastal New England pre-glacial bedrock valley, and how it was affected both by glacial advance and catastrophic meltwater releases from an upstream glacial lake that filled the valley with large cobbles and boulders, at thicknesses approaching 100 feet. A more favorable 15-foot thick layer of sands and gravel below the cobble/boulder layer was targeted for part of the HDD crossing to install the 12-inch natural gas pipeline. This paper will review the regional bedrock and local glacial geology, and its effect on the engineering complications encountered during HDD drilling and pipe installation.

SELECTION OF TRENCHLESS METHODS

When undertaking new trenchless installation work, it is crucial that engineers and contractors understand how the ground may behave in response to a given trenchless method. Much of the expected behavior is based on real-world experience and also a fundamental understanding of ground response when a specific soil matrix is removed from the ground, whether the ground has sufficient strength to support equipment and also to provide a stable borehole to prevent inadvertent drill fluid returns (aka, "frac-out"). Ground behavior from the Tunnel-Man's Ground Classification Guide like "raveling" (slow and fast), "squeezing," and "running" (or similar terms) are used to describe the anticipated unstable ground and emphasize areas of concern.

The major concerns for trenchless projects are: weak

overburden soils, weight-of-hammer (WOH) material, nested cobbles, gravel with little fines, running ground, and squeezing or swelling ground all that suggest unfavorable ground conditions. Where bedrock is shallow, the contrast in drilling behavior between overburden (soil) and bedrock drilling is a further complicating factor to consider.

For expensive and large-dollar trenchless projects, extensive ground characterization is typically performed, but for small-dollar trenchless projects, adequate ground characterization is often overlooked, either due to lack of budget, a perception of low value for the upfront project cost, or in the case of limited engineering/designer experience with trenchless installations, a misjudgment of the possible risks.

For many owners, a new installation project is just a line on a piece of paper - but there is much more to it than that. It is understanding construction risk and how to manage that risk and how the ground will behave based on a specific trenchless method. Thus, understanding the sequence of geologic events of a specific area provides clues that can inform the designer of the anticipated ground behavior.

TAUNTON RIVER CROSSING

This crossing in southeastern Massachusetts is an excellent example of how geological history can affect both the planning, execution and success of a trenchless project. A deep, pre-glacial bedrock valley exhibiting different bedrock types on either side of the river, combined with thick cobble and boulder gravels from a rapid draining of an upstream glacial lake, required modifications to the HDD crossing by the contractor due to the difficult ground conditions.

Figure 1 – Plan of 12-inch gas pipeline installed in 2016/2017 by HDD below the Taunton River. Base image from Google Earth Pro, dated 26 Feb 2018.

IT'S THE BEDROCK

Geologic maps [Reference 1] and subsurface data from highway bridge studies [2] indicated the Taunton River is aligned with a major northeast-trending bedrock fault zone separating Pennsylvanian-age Rhode Island Formation rocks to the west from the older Fall River Granites to the east. Yet, even though bedrock is exposed on both sides of the Taunton River upstream, bridge borings indicate the bedrock surface drops to at least 200-foot depths below the river in the vicinity of the HDD crossing, and further deepens to over 450 feet in depth below the Sakonnet River downstream, between Portsmouth and Tiverton, RI.

Both the bedrock surface and fault between these two rock types remain poorly understood. The Taunton River valley was scoured by glacial ice advance, but recent research suggests [3] that wholescale removal of all pre-glacial material down to rock by ice was not as complete as often portrayed, a concept attributed to the "thin ice" model near the terminal limit.

IT'S THE GLACIERS

Late Wisconsinan glacial ice reached its limit along the Rhode Island and Massachusetts southern coasts around 28,000 to 23,700 years before present (YBP)[4] creating an intermittent string of morainal islands along the ice terminus: Long Island, Block Island, the Elizabeth Islands, and portions of Martha's Vineyard and Nantucket (5) (see Figure 2).

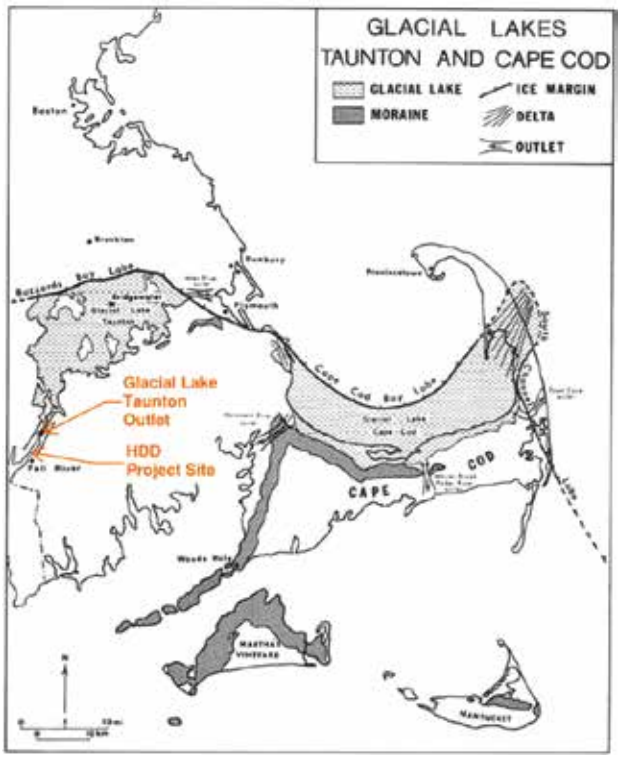


Figure 2 - Glacial Lake Taunton impounded against ice front or moraine formed by Buzzards Bay ice lobe. Outlet channel and HDD project shown (Modified from Larson, 1982, Fig. 3).

The melting and retreat of the ice sheet across southeastern New England discharged streams with significant volumes of sand and gravel into the proto-Narragansett Bay, to a paleo-shoreline was about 360 ft below present sea level, forming a shoreline at the southern end[6]. The Narragansett Bay "valleys" (such as the Taunton and Sakonnet Rivers) were exposed and filled with sediments [7, 6].

Deglaciation was rapid during warming trends, and intermittent cold events caused ice retreat to halt and locally re-advance, building moraine ridges during the cold periods [4, 8]. This retreat pattern is seen in several irregular topographic "belts" of sandy moraine till, formed at the ice lobe margins, that cross parts of southeastern Massachusetts [8], including the Sandwich Moraine near Wareham. An impoundment termed "Glacial Lake Taunton" was formed in a lowland against the ice margin on the north and blocked by a debris dam across the Taunton River to the southwest [9, 8]. The shallow water body spread over much of southeastern Massachusetts, exacerbated by crustal depression due to weight of overlying ice [3].

At its maximum extent, Glacial Lake Taunton was estimated to cover an area of approximately 54 square miles [5], extending roughly from Norton, MA (to the west) to Kingston, MA (to the east), and beyond Bridgewater to the north [10], and estimated to be over 130 feet deep in places [11] with an overall lifespan slightly longer than 300 years [12]. The lake plane surface was about 55 to 65 ft above mean sea level [5].

Eventually, the contribution of glacial meltwater and sediments caused the lake to overflow its basin and catastrophically breach, erode, and drain down the outlet channel near Fall River, flowing into the upper reaches of Narragansett Bay [11]. Engineering investigations in the Fall River area provide us with direct subsurface evidence of the Glacial Lake Taunton catastrophic event.

EFFECTS OF MELTWATER RUNOFF FROM RETREATING GLACIERS

The draining of Glacial Lake Taunton rapidly discharged several square miles of meltwater, entrained with sediment, down the Taunton River rock valley leading into Narragansett Bay. The high-velocity glacial meltwater carried very coarse debris of gravel, cobbles and boulders in torrents, filling in the upper portions of the rock valleys and deposited them on finer-grained sands beneath. As depicted in Figure 3, the very coarse deposits are primarily found on the Fall River side of the Taunton River and approach 100 feet in thickness.

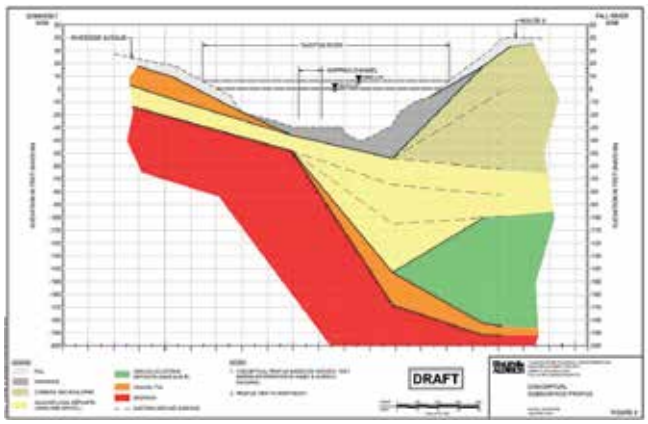


Figure 3 – Conceptual subsurface profile from test borings taken near the Taunton River HDD crossing. Profile is oriented west to east, with view towards north. Explanation of color representations are provided in text.

Geotechnical data assembled from the nearby Grand Army of the Republic (GAR) Highway-Veterans Memorial Bridge (Route 6) bridge, from borings for the old Brightman Street Bridge, and other proprietary sources indicated varying thicknesses of cobbles and boulders, granular outwash sands, and deeper glaciolacustrine deposits filled the Taunton River valley. The variation in thicknesses can be attributed to variable warming periods during the retreat of the glaciers in combination with rising land and rising sea level when glacial run off was slower or flow impeded by the rising ocean.

The presence of these coarse boulder-cobble-gravel deposits were confirmed during the construction of the GAR Highway-Route 6 bridge by the Massachusetts Department of Transportation between 2007 and 2011 (see Figure 1). The bridge was designed to be founded on deep caisson (shaft) foundations. Difficult drilling conditions in the cobble and boulder-containing glacial soils hindered the drilled shaft advance. A photograph of the well-rounded material air-lifted from the drilled shafts is shown on Figure 4, with a hardhat placed in the photograph for scale.

Figure 4: Gravel, cobbles and boulders from deep glacial meltwater deposits below the Taunton River. Note hard hat for scale

NEW TRENCHLESS CROSSING

Just south of the new Route 6 Bridge, Liberty Utilities recently replaced two old distribution gas mains with a new 12-inch diameter steel grade X-52, FBE & Powercrete-coated, natural gas pipeline using horizontal directional drilling.

The route of the HDD crossing is shown on Figure 1, which was about 1,950 feet in length. The cross-section profile of the Taunton River in the area of the HDD crossing is provided as Figure 3.

On the profile, bedrock is indicated by the red coloration; glacial till deposits are colored in orange; granular glaciofluvial sand and gravels are colored in yellow; coarse glacial meltwater deposits of boulders/cobbles and gravel are in yellow with an open symbol overprint; green reflects glaciolacustrine sands and silts; and organic river bottom muds are depicted in dark gray.

The subsurface profile also depicts shallow bedrock that extends below the west side of the Taunton River in the vicinity of the HDD alignment. However, the top of bedrock drops off to over 200 feet below the Fall River shoreline.

KEY CONSIDERATIONS FOR HDD DESIGN

The glacial deposits on the Fall River side are granular and contain numerous hard cobbles and boulders, which would be

THE MAJOR CONCERNS FOR TRENCHLESS PROJECTS ARE: WEAK OVERBURDEN SOILS, WEIGHT-OF-HAMMER (WOH) MATERIAL, NESTED COBBLES, GRAVEL WITH LITTLE FINES, RUNNING GROUND, AND SQUEEZING OR SWELLING GROUND ALL OF WHICH SUGGEST UNFAVORABLE GROUND CONDITIONS.

a critical factor to consider in the HDD drill-path design. In contrast, the Somerset, MA (western side) of the alignment is underlain by glacial till deposits overlying shallow bedrock, which is classified as gray/black, fine-grained weathered shale of variable strengths and fracture density. Glacial till typically contains cobbles and boulders; nevertheless, the western side poses a slight advantage for HDD because glacial till and "soft" bedrock tends to remain open during pilot boring advance.

In contrast, highly granular deposits without silts or clays as binding agents are subject to HDD drill fluid loss and unstable behaviors (collapsing/raveling/enlarging of the borehole), as drill fluids used in stabilizing the HDD drill hole may penetrate and disperse into the permeable deposits if the fluid pressures are not carefully controlled. High fluid pressures exiting the bore and hydraulically fracturing the overlying soils may lead to inadvertent drill fluid returns. As such, during the HDD drilling, drill fluids were subject to seep out through the deposits into the Taunton River itself on the Fall River side of the crossing.

With this faulted and highly variable bedrock geometry, a challenging "mixed-face" condition for the HDD drill in this situation could also be anticipated, where the drill advances from bedrock-into-soil, or from soil-into-bedrock. Drills of this nature have been successfully built, but the variation in ground conditions must be carefully defined, clearly communicated, and understood by the HDD contractor.

Figure 5: Historical photograph of the old Brightman Street Bridge looking west across the Taunton River towards Somerset, MA. The bridge has since been closed for demolition. Note the quantity of man-made debris on the Fall River shoreline. The new natural gas line was installed below the river to the right of the image. (Photograph courtesy of Liberty Utilities.)

An additional point of consideration in trenchless design is the history of man-made impacts, and how they can also have a significant effect on a trenchless alignment, as shown on Figure 5 (above). Industrial cities and modified commercial coastlines can jeopardize a trenchless crossing, as a deep debris field, in combination with the steep river bank sides, can present obstructions and the potential for some very significant impediments to HDD drilling and pipe installation. Challenging geology only adds to the complications.

PROJECT SUCCESS

Based on the as-drilled HDD records, Liberty Utilities reported that the contractor drilled the HDD crossing from the west side to the east side, and also used an intercept method (drilling down from the HDD exit end to meet up with the initial pilot drill from the HDD entry side).

The contractor reported difficulty with the HDD pilot drill and borehole collapse once it reached the east (Fall River) side of the alignment and needed to open up the borehole to 36-inch diameter for around 100 feet. (In comparison, typical bore hole sizes for a 12-inch diameter steel pipe would be 18 inches). The additional enlargement was required to stabilize the borehole and prevent cobbles and boulders from rotating or dropping out of the borehole wall. Liberty also reported that the contractor had two inadvertent fluid returns on the Fall River side of the alignment, which is likely attributed to the highly permeable coarse cobble and boulders shown on the Figure 3 profile. Nonetheless, the contractor was successful in building the HDD crossing and installing the new pipeline.

CONCLUSIONS

Clearly, the complex geological history in the Taunton River area was a major factor that had to be accommodated in constructing a successful trenchless crossing. In this case, the geologic models of the region drive the constructability of the HDD crossing.

New trenchless installation work is not without risk. Small, low-dollar/low risk on new installation projects may not necessarily warrant a detailed understanding of ground conditions, especially in areas of homogenous ground conditions not impacted by irregular bedrock or glacial/coastal deposits. However, for high-dollar value projects, long alignments, or in complex geologic settings, more than just a few geotechnical borings are required to sufficiently characterize the ground conditions.

FOR HIGH-DOLLAR VALUE PROJECTS, LONG ALIGNMENTS, OR IN COMPLEX GEOLOGIC SETTINGS, MORE THAN JUST A FEW GEOTECHNICAL BORINGS ARE REQUIRED TO SUFFICIENTLY CHARACTERIZE THE GROUND CONDITIONS.

Having a sound understanding of the local geologic history provides a valuable understanding of how the ground may behave when pipe jacking, microtunneling, or selecting between a small-bore HDD versus large bore HDD. It is not just a line on a piece of paper - understanding ground behavior when selecting a trenchless method typically leads to lower risk with an associated decrease in cost of that risk.

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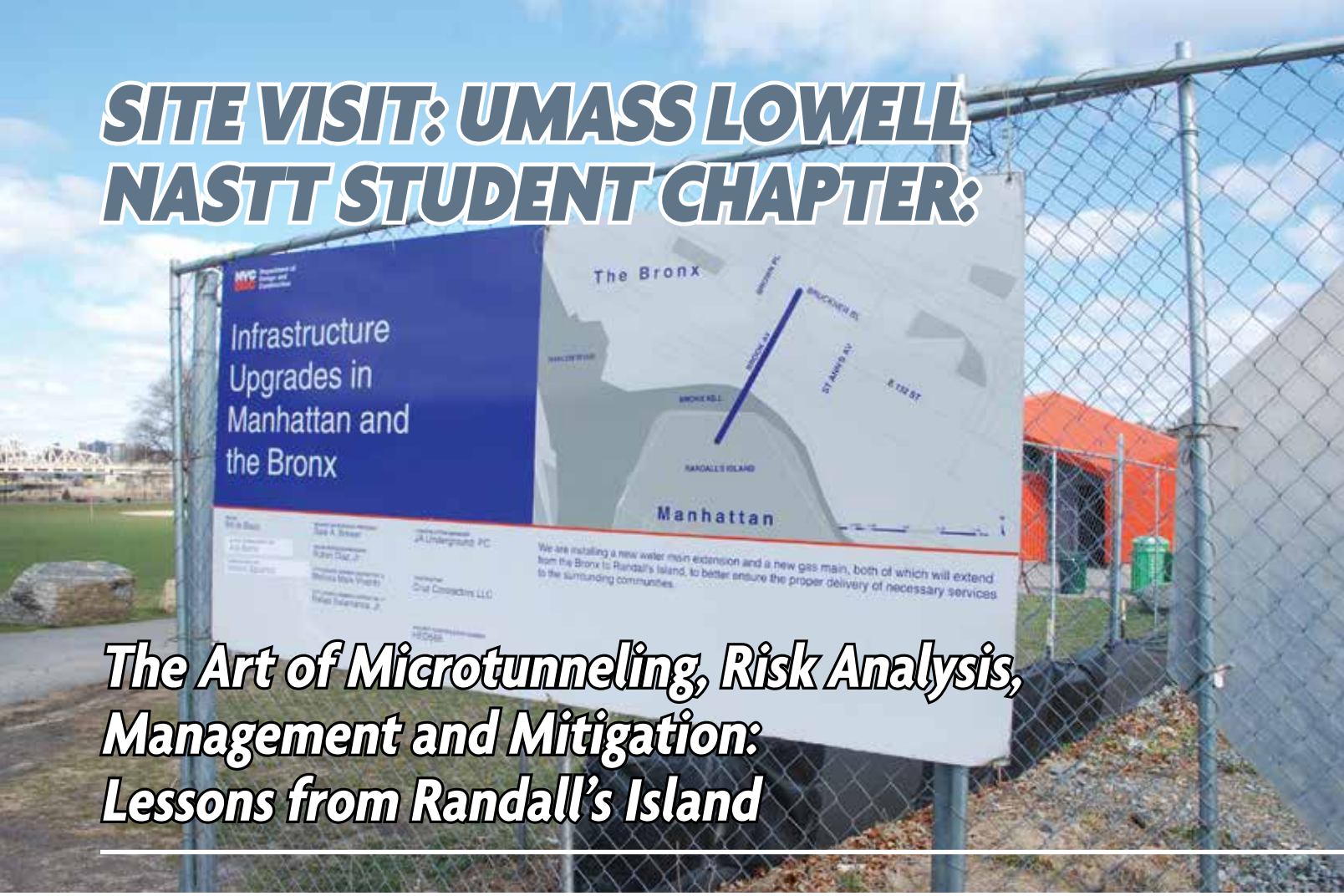
ABOUT THE AUTHORS:

Bradford A Miller *is Senior Geologist at Haley & Aldrich, whose expertise is the geologic interpretation of complex soil, rock and groundwater conditions as they influence a broad variety of geotechnical projects, including trenchless utility construction, pipelines, linear energy corridors, highway rock slopes and foundation construction. He has served as President of the New England Chapter of the Association of Engineering and Environmental Geologists (AEG).*

Dennis J Doherty *is a Senior Consultant and the National Practice Leader for Trenchless Technologies at Haley & Aldrich, applying a total trenchless approach on microtunneling, HDD and other trenchless method projects for private sector energy clients. An ardent proponent of the benefits and value of trenchless methods, Dennis has a unique understanding of risk management as it relates to trenchless design, having worked on a number of innovative projects across the US. He serves on the NASTT No-Dig Show Program Committee and is an instructor for NASTT's HDD Good Practices Course. Dennis is proud to be Past-Chair of the NASTT-NE Chapter.*

SITE VISIT: UMASS LOWELL NASTT STUDENT CHAPTER:



The Art of Microtunneling, Risk Analysis, Management and Mitigation: Lessons from Randall's Island

By: Steven Fallon, Pedro Lopez, Gumisayi Vengesayi and Dr. Raj Kumar Gondle (Faculty Advisor)

On Saturday March 10, 2018, members of the UMass Lowell North American Society of Trenchless Technology (NASTT) student chapter visited a microtunneling field site at Randall's Island, New York with support from McMillen Jacobs. The microtunneling project in particular aims to install subaqueous water main extension and high-pressure gas main from Bronx to Randall's island, with virtually no disruption to the land or people above the project site. The efforts coincided with its ongoing resiliency program in response to Hurricane Sandy, which highlighted the weaknesses of the city's infrastructure and pointed engineers toward critical projects.

Two 900-foot-long, 5-foot-diameter tunnels were bored, each utilizing a microtunnel boring machine (MTBM), stretching between two, 20-foot-diameter, 58-foot-deep launch shafts at Randall's Island, and two 64-foot-deep receiving shafts in the Bronx region. The interesting aspect of the project was the design of receiving shafts – one being a circular shaft and the other one being an elliptical shaft designed specific to the project site. Variations in subsurface conditions, a matrix of utility lines, several easement and permitting issues, along with other risks and uncertainties were challenges associated with the project. Students visited the project site to grasp the real-life complications and challenges faced by engineers in the industry; something that cannot be learned in the classroom. The field site visit helped civil engineering students witness the real-life application of concepts learnt in courses like geotechnical engineering, deep foundations, structural engineering, and other relevant engineering courses. The project witnessed many setbacks, and the engineers on site heavily emphasized the importance of risk analysis, decision-making, risk management, and risk mitigation to prevent such

> **"EXPERIENCE AND MOTIVATION TO WORK WILL GET YOU PLACES AND TEACH YOU MORE THAN WHAT IS TAUGHT IN CLASS."**
>
> **– Babs Marquis, McMillen Jacobs Associates**

UMass Lowell students and faculty with Engineers at the site

delays. One of the notable setbacks involved obtaining easements to operate TBM underneath a busy commercial property in the Bronx, delaying the first drive considerably. In addition, several utility lines, ranging from high-voltage electricity lines to local water service lines, crucial to the day-to-day operations of the Bronx, Manhattan, and Randall's Island, had been discovered to be placed in a tangled maze underneath the road, interfering with the location, design, and construction of the shafts. During the design phase, engineers had originally planned to construct two circular shafts. However, due to the newly discovered utility interferences, the receiving shafts were changed from circular to elliptical. Project engineers were concerned about the loads on the asymmetric shape and had to compensate by building horizontal brace supports spanning along the perimeter of the shaft, placed 15 feet apart from each other, down the entire length of the shaft. Additionally, the change in shape resulted in elevated risks that required monitoring of the MTBM.

Large boulders at the project site were not anticipated. Upon

Circular shaft

Elliptical shaft

excavating the shaft for the second drive, a 15-foot-thick, glacial erratic boulder occupying approximately 60 per cent of the shaft's cross-sectional area was discovered. The presence of this large boulder resulted in a delay and additional costs to clear the boulder from the site. Understanding the regional geology and comprehensive geotechnical site characterization is therefore critical for such large projects. It is plausible that, on a project of this scale, an engineer will run into a situation that he or she cannot solve alone on the spot, a major reason why planning for the unexpected situations is of the essence. Continuous and effective communication with all parties involved has been proven to help resolve these unwanted or unforeseen situations in a timelier manner.

The field site visit enriched the students with tremendous knowledge about the various aspects of trenchless technology. Students were able to witness, first hand, the engineering behind a microtunneling project from start to end. This project sparked many of the students' curiosity. Any questions they had, no matter how complex or theoretical, were diligently answered by the experienced engineers who have worked on countless

After the trip

projects throughout their career, each different from its preceding. The one crucial piece of learning that Babs Marquis, a project associate from McMillen Jacobs, wanted all students to gain from this site visit was: *"experience and motivation to work will get you places and teach you more than what is taught in class."* He also stated that every trenchless project is different; engineers are expected to learn and adapt at a faster pace, and in order to successfully complete the project in a time effective manner, it is imperative to have a solution for possible obstacles that the project might encounter. Experiential learning is therefore critical to our engineering and such skills cannot be gained within the classroom. After visiting the site, students ended the trip by going to Times Square and ate at The Halal Guys, considered to be the best street food in New York City.

ABOUT THE AUTHORS:

Steven Fallon *is a junior in Department of Civil and Environmental Engineering at UMass Lowell. He takes part in several organizations at Lowell, notably serving as secretary for the school's NASTT student chapter. Steven is also an undergraduate research student on the UMass Lowell Structural Engineering Research Group.*

Pedro Lopez *is a junior in Department of Civil and Environmental Engineering at UMass Lowell. He is an active member of the NASTT Student Chapter. He has participated in the 2017 NASTT-NE conference in Cooperstown, NY and the 2018 No-Dig Show in Palm Springs, California.*

Gumisayi Vengesay*i is a sophomore majoring in Civil and Environmental Engineering at the University of Massachusetts Lowell. While Gumisayi is involved in several organizations at UMASS Lowell, he is also an active member of the NASTT Student Chapter.*

Dr. Raj K. Gondle *is an Assistant Teaching Professor in the Department of Civil and Environmental Engineering at the University of Massachusetts Lowell (UMass Lowell). He serves as a faculty advisor for North American Society for Trenchless Technology (NASTT) Student Chapter.*

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