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NASTT's
Trenchless Today
Educate - Train - Research - Publish

A large-scale construction site for a trenchless tunnel. The image shows a deep, circular shaft lined with corrugated metal sheet piling. A large, precast concrete segment is being lowered into the shaft by a crane. The shaft is supported by a complex network of steel beams and cables. In the background, there are trees and power lines under a clear sky.

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Compiled by NTT staff

NASTT works hard each year to make sure it is providing the essential resources for professionals working in the trenchless technology field, and the Society takes on this mission with pride and passion. With NASTT's annual membership directory, trench-

less professionals can connect with contractors, manufacturers, professional service providers and municipal representatives who are NASTT members. When planning your next trenchless project, you may need it!

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Mike Willmets
NASTT EXECUTIVE
DIRECTOR



Are You Part of NASTT's Trenchless Community?

OUR SOCIETY THRIVES ON NETWORKING AND FRIENDSHIPS

Can you believe we're more than halfway through 2017? Today is an exciting time to be involved in the trenchless industry and the NASTT community! We hope that you are taking full advantage of your NASTT member benefits, and if you aren't already a member, we hope you'll join our dynamic Society of trenchless innovators.

Trenchless education is both the foundation and the mission of NASTT. It is the leadership and dedication of our members and volunteers that makes our educational programs so successful. NASTT's 2018 No-Dig Show Program Committee recently met in Palm Springs, Calif., to plan the technical program for the annual show. The committee is led by 2018 Program Chair Don Del Nero of Stantec, and Vice Chair Cindy Preuss of HydroScience Engineers. With this guidance, the committee of more than 130 volunteers and industry experts peer reviews each abstract that is submitted and uses their expertise and real-world experience to build a technical program that simply cannot be topped. If you are in the trenchless industry, I guarantee you will take away so much more than you came with after attending NASTT's No-Dig Show.

Another committee that dedicates many hours of service is NASTT's Educational Fund Auction Committee. Our educational program owes so much to these volunteers, along with our generous donors and bidders. The 2018 Auction Committee Chair is Gregg Leslie of Xylem and the Vice Chair is Dennis Walsh of PSE&G. Gregg, Dennis and the rest of the committee will work throughout the year to plan the annual auction event held at NASTT's No-Dig Show, which raises funds for our educational initiatives. To date, we've raised more than \$1 MILLION thanks to our trenchless community! If you'd like to join this committee and help raise funds dedicated to education while having fun and building your professional network, please contact NASTT's Marketing Manager, Jenna Hale, at jhale@nastt.org. We'd love to have you join us!

A huge part of our community and family here at NASTT are our member volunteers who donate their time to serve on our Student Education Committee, Awards Committees, Networking Committees and Technical Committees. There is something for everyone at NASTT and we'd love to put your unique skills and talents to work for our mutual benefit. If you would like to join one of our committees and really make your mark in our trenchless community, please contact NASTT's Membership Coordinator, Molly Margosian, at mmargosian@nastt.org.

If education is the foundation of our Society, our dedicated expert instructors are the building blocks! These fine individuals use their own time to travel all over North America to teach NASTT's Good Practices Courses to hundreds of trenchless professionals every year. NASTT offers eight Good Practices Courses along with various discussion panels and webinars every year. If you'd like to learn more about our expert instructors, please visit our website at nastt.org/training/instructors. If you'd like to learn more about becoming an instructor, please contact NASTT's Program Director, Michelle Hill, at mhill@nastt.org.

We're in the depths of planning for our conference in 2018 in Palm Springs, Calif., March 25-29. We hope that you will join us for top-notch education, valuable networking and, of course, a really good time!

Michael J. Willmets

Michael J. Willmets
NASTT Executive Director



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Frank Firsching
NASTT CHAIR

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NASTT Members, We Thank You!

NASTT members, the trenchless industry is strong because of your dedication.

Every year in the trenchless industry seems to be better and better. Our members and volunteers are true innovators who are continually thinking outside the box for ways to improve technology and protect our precious natural resources. Our fall issue of *NASTT's Trenchless Today* is dedicated to our members and the support system that this industry community has built.

Our annual No-Dig Show is like a family reunion we look forward to each year. More than 2,000 of our closest friends and colleagues gather together to learn, teach each other, and simply have fun during a week packed with valuable events. We are currently in the thick of planning for our 2018 Show in Palm Springs, Calif. We're excited to take NASTT's No-Dig Show back to the West Coast and we know you will want to join us there, as well. I'd like to thank our 2018 Program Chair, Don Del Nero of Stantec, and our Vice Chair, Cindy Preuss of HydroScience Engineers, along with our growing Program Committee for putting together another stellar technical program for next year. I guarantee you will be impressed with the papers slated for 2018.

With education as our goal and striving to provide valuable, accessible learning tools to our community, one of the things we are most proud of here at NASTT is our free webinar series. This year marks the sixth year we've been able to offer complimentary technical webinars to the trenchless industry. Join us for another installment on Nov. 7: NASTT's Sealing a Collection System Webinar, featuring Larry Kiest of LMK Technologies and Jeff Maier of C&L Water Solutions, Inc. Visit nastt.org/training/events for details and registration. We have two additional webinars that were broadcast earlier in the year available for instant download in our archives, along with all the webinars from the past six years. NASTT is dedicated to bringing you the latest information on our industry, and our webinars are a great way to stay current on technology, as well as to learn about case studies and real-world solutions right from your desk, and for free!

Trenchless technology is an industry built on innovation, and as your community organization, we strive for innovation, too. This year, we are extremely excited about launching the NASTT Centers of Excellence. This new initiative focuses on developing trenchless method-based Centers of Excellence within the organization. The first Center of Excellence will be dedicated to the trenchless pipe bursting method and its full breadth of capabilities for potable water, gas, electrical and sewer applications. Establishing a group focused on driving excellence within the discipline of pipe bursting will create energy and engagement with the trenchless industry and beyond, while continuing to fulfill NASTT's mission to advance trenchless technology and promote its benefits.

The Pipe Bursting Center of Excellence will provide leadership in education, standards, training and elevating the profile of the method throughout the construction industry. In addition, the group will work on the refinement of best practices and act as a resource and forum for utilities, contractors and manufacturers to share information and continue to move the pipe bursting method forward.

NASTT endeavors to be the premier resource for trenchless education and networking for all of our members. For more information on member benefits, visit our website at nastt.org and please feel free to contact us at info@nastt.org.

Frank Firsching

Frank Firsching
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Strength in Numbers



Molly Margosian

NASTT
MEMBERSHIP
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NASTT Young Professional Committee member Amana Arayan (middle) conducting guided tours through NASTT's 2017 No-Dig Show Exhibit Hall.

NASTT has grown its Student Chapter network to 19 chapters in North America! The rapidly developing field of trenchless underground methodology represents the leading edge of construction technology today. Students enrolled full-time in construction management, engineering and other related professional programs are seeking opportunities to keep abreast of these developments. One of the most effective ways of accomplishing this is by combining these individual efforts in the form of a NASTT Student Chapter.

While on campus, Student Chapters are involved in a number of activities throughout the academic year including field trips, seminars and fundraisers. Members of NASTT Student Chapters also attend and participate in NASTT's No-Dig Show where they present research posters that describe their trenchless research, participate in competitions and provide staff support such as monitoring the technical paper sessions. NASTT Student Chapter members are eligible for scholarships, networking opportunities, education, career advancement and much more.

The Youth Evolution



What happens after graduation? Opportunities for future industry leaders are out there. NASTT's Young Professionals Committee focuses on fostering participation from NASTT's Student Chapters, as well as increasing networking opportunities for other young professionals. Providing guidance, support, mentorship and real networking avenues, NASTT's Young Professionals Committee truly bridges the gap between the generations.

NASTT's mission begins with educate: Educate, Train, Research, Publish.

Molly Margosian

Molly Margosian
NASTT Membership Coordinator

1996

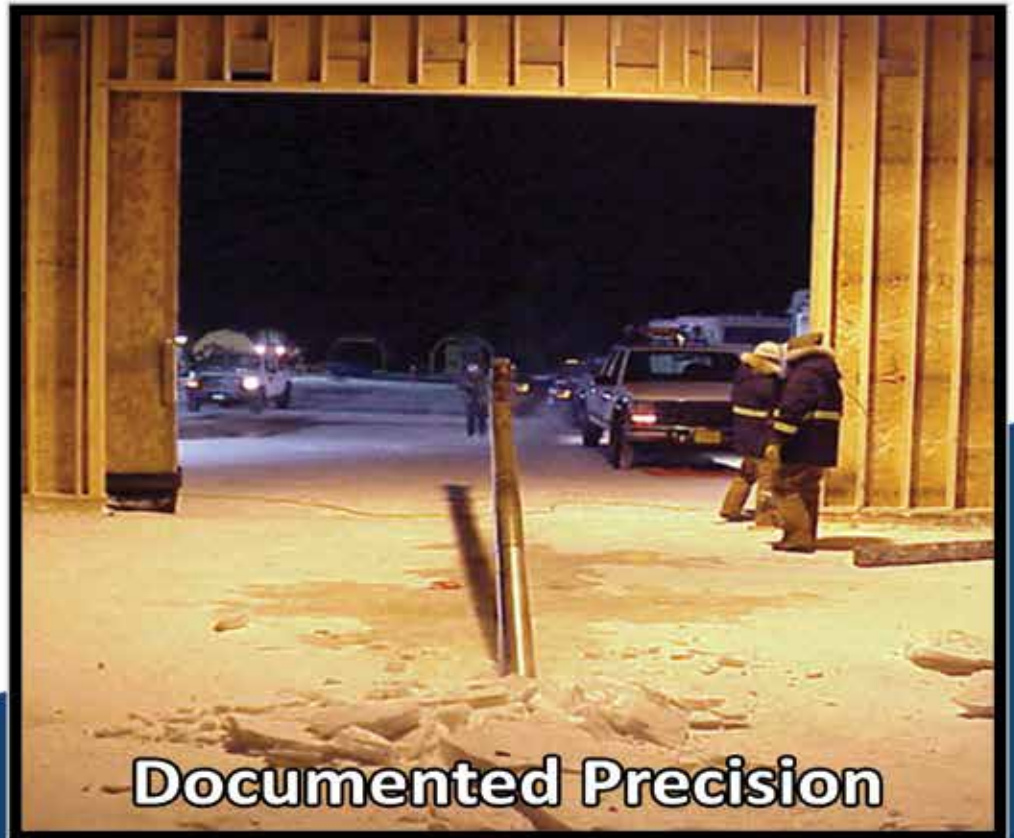
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Q & A

NTT Talks Trenchless with Rick Melvin

We sat down with Rick Melvin, National Product Specialist with TT Technologies, to chat about today's industry challenges and the notable results that have come from education.



“The best part of working in the trenchless technology field is, without question, the people. Everyone has such a can-do positive attitude. That attitude is like a wildfire that doesn’t need any additional fuel to spread.”

What first piqued your interest in the construction business?

I was looking for a job as a junior in high school and eventually went to work for a general contractor, Specialized Services, in Phoenix. It was a great opportunity for a young kid to learn and gain real-world experience. The owner, Arvid Viedmark, took the time to teach and encourage me to learn all aspects of the business. After graduating high school, I went into the Navy. When I got out of the Navy five years later, I returned to Specialized Services.

Tell us about your first introduction to the trenchless industry.

Arvid took me back and soon I became superintendent. He decided to take the company into the trenchless industry through tunneling and boring. I loved everything about the boring business. Every bore is different, and those challenges made you constantly think and learn. Not every job goes perfectly, but those are the ones that provide the best educational and learning opportunities.

Things go wrong, but you remember what worked and what didn't and that makes the next problem easier to deal with.

What are your thoughts on the current state of the industry?

It is a great time to be in the trenchless industry. The push for education over the past years, specifically in terms of engineers and municipalities, is really paying dividends. With an organization like NASTT promoting the quality and effectiveness of trenchless methods, providing a forum for informative white papers and discussions about trenchless techniques and equipment, the industry is advancing quickly.

What are the trends on the manufacturing side

Forecasting equipment needs now is the most challenging part. Having ample equipment on hand to handle the demands of industry growth is challenging.

What areas do you see evolving?

All aspects of HDD from assist to conductor barrel installation have grown rapidly over the past years. We pride ourselves on having the equipment and expertise to help whenever the calls come in. And they are usually calls on the weekends and holidays!

What is the biggest challenge facing the trenchless industry today?

Education is still the biggest hurdle we face, you still run into people every day that have not heard about the many trenchless options available. While much progress has been made in the area of education, it continues to be the area of greatest need in many cases.

How did you first get involved with NASTT?

I got involved in NASTT through TT Technologies. Our company attends NASTT's No-Dig Show each year and is a platinum sponsor. Over the years I have become more involved in roundtable discussions, as well as white paper presentations.

Do you see any particular needs in the way of education/training? Is the industry doing a good job of promoting the benefits of trenchless methods?

I think contractor involvement has been key. Design engineering company participation in recent years has also grown and that is a plus. When contractors and engineers come together, the information transfer process is enhanced exponentially!

How has the acceptance of trenchless methods evolved?

The acceptance of trenchless technology has grown in large part because of the many advancements that have been made in the industry. As a need for a product, method or solution occurs, the industry has stepped up, without hesitation, and through R&D developed viable options to help overcome challenges and make doable many of the things that we didn't know where possible in the trenchless arena.

What do you enjoy most about working in the trenchless technology field?

The best part of working in the trenchless technology field is, without question, the people. Everyone has such a can-do positive attitude. That attitude is like a wildfire that doesn't need any additional fuel to spread. It grows because if a product or method is "just okay," or something is just an acceptable solution, the trenchless community strives to make it great. That's my favorite aspect of working in the trenchless technology field.

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In the Trenches

BY ANDREW FARR



Matt Boeh

On his second day working in the trenchless industry, Matt Boeh visited an HDD jobsite in Southern California. The project was in beautiful suburban neighborhood with new homes. As he approached the jobsite, he saw a 12-in. diameter blue Fusible PVC pipe in the middle of the neighborhood street resting on furniture dollies from Home Depot. "Ingenuity at its best," he says he recalls thinking. A quarter-mile later, he reached the main area of the site that consisted of a small trench in a cul-de-sac. Other than the drill rig, Boeh was surprised by the overall lack of equipment and machinery for a seemingly big project. There was less to it than he envisioned.

But then as he approached the pit, he was promptly notified to get back right before he and the rest of the crew got sprayed with drilling mud. "We went to rig side where the crew began to panic,"

he explains. "The pipe was hydrolocked and their 80,000-lb. rig was laboring to break it loose. Two hours later the pipe broke free and they completed a successful install. I made a remark to the HDD rig operator about it being a drama filled day and that I bet he was glad it was over. He said to me, 'son this is every day in the drilling world.' I thought to myself, I am in the right job!"

Boeh says his interest about the potential of the trenchless industry is what first led him to get involved. "The rapid growth of the trenchless industry has made it a very attractive part of the municipal market," he says. "Coming from the water and wastewater treatment industry where projects and technology tend to move at glacial speed it was very intriguing. Presented with the opportunity to be part of one of the fastest growing companies in the industry, it was a no brainer for me."

Boeh first joined Underground Solu-



Matt Boeh
AEGION

tions in 2010 as a regional sales manager covering the Mid-Atlantic territory. In 2011, he also took over the Northeast Region, holding that position until earlier this year when he took the position of Area Manager of Business Development with Fibrwrap Construction (Underground Solutions sister company at Aegion).

For Boeh, the decision to join the trenchless industry was the right one, as he believes the industry is even better positioned now to grow and capitalize on the much-needed infrastructure work that exists. He says aging infrastructure, economic shortfalls and increased community awareness has kept the trenchless market at the leading edge of making a difference across the globe.

"I see the rehabilitation of potable water distribution systems as having the most need and continues to be a key focus of innovation," he says. "Where once municipalities focused on rehabilitating small and medium diameter pressure lines through cleaning and lining or dig and replace, municipali-

ties and investor-owned utilities are taking advantage of trenchless technologies like pipe bursting and pressure CIPP technologies. The CIPP market is not just for gravity pipelines anymore. A lot of exciting technical advances have been made over the last 12 months. I am very interested in what will come next."

Shortly after entering in the industry, Boeh attended his first No-Dig Show in Washington, D.C. He has also served on the formation committee for the Northeast Chapter of NASTT, which he says gave him a firsthand perspective of just how supportive and committed NASTT is to the trenchless industry. But even with that support, he says more education and training is the one area in which the industry cannot afford to slow down.

"Even though the industry is growing at rapid speed, it still lacks the availability of reliable technical training, specifically at the end-user level," he says. "Education of the customers' engineering, operations and inspection staff should be a priority of our industry. NASTT's municipal scholarship

is one of the few programs promoting education of trenchless technologies for end-users. Protecting their investment and demanding that every contractor perform at a high level is key. Too many times I have heard about end-user dislike for trenchless technologies because of past installation issues. Proper education of the technical capabilities and project expectations should be a priority of our industry."

Boeh's admiration of working in the trenchless industry has led him to one conclusion about its continued success and positive outlook.

"People. Trenchless construction is truly a team sport," he says. "The key is having a professional and capable crew of construction professionals working on your team. At the end of the day its construction, things will go wrong. It's how your team reacts and supports the customers through the issues that differentiates your organization - it's the people. My favorite part of working at Aegion is that our entire team, from the top to the bottom is committed to doing what's right."

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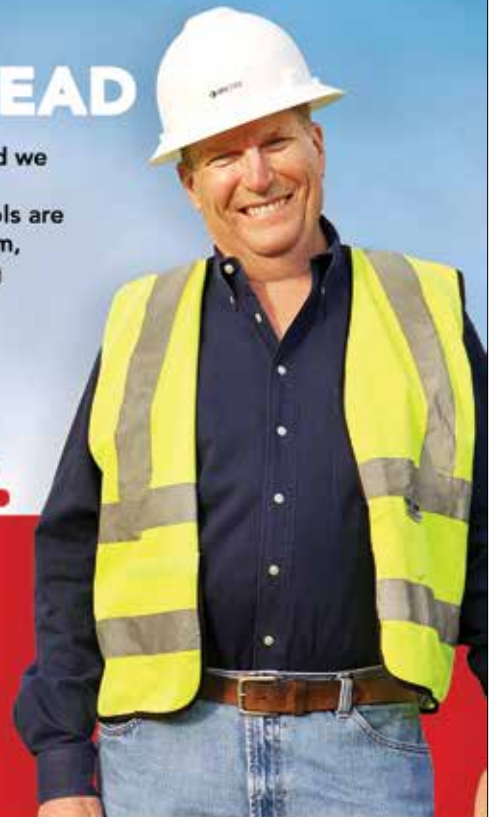
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Michelle Moore
NIAGARA REGION

Michelle Moore

Michelle Moore got her start in the underground construction business after becoming fascinated with the equipment and technologies for pipe cleaning and everything that goes along with managing those projects on the jobsite.

Her first role in water and wastewater involved the sewer flushing and cleaning program and she says she became interested in the spray jets, the root cutters and the various ways you can investigate sewer deficiencies. "It seems a bit crazy now, but being on site and interacting with the contractors was the best part of my day," she says.

Moore was introduced to trenchless technology literally from the ground up. Her first position in Niagara Region's Water Wastewater Department was as an environmental analysis technician for which she monitored the Niagara Region's sewer system via CCTV and using WRC defect coding.

"It allowed me to see the good, the bad and the ugly," she jokes. "I remember being fascinated by the whole other world inside the sewer. I used to tell my friends that I watched dirty movies for a living!"

Since her early roles with the utility, Moore has also worked in flow monitoring, (installing and calibrating meters and sensors and keeping track of flow data), and has conducted condition assessments and evaluation to aid in planning for

the utility's rehabilitation program. She is now a project manager for Niagara Region. "Serving the public is the best part of what I do," she says. "Knowing that the job I do matters."

In addition, Moore has also worked on several rehabilitation projects for the utility over the years, having been directly involved with sewer system rehab projects ranging from small diameter (250mm municipal pipes) to trunk sewers (1200mm). "My most recent project has a little bit of everything, lateral, manhole and sewer relining, manhole replacement and the construction of a trail," she says. "It is also a large diameter sewer located at the end of a force main that carries a third of the flows in the City of Niagara Falls to a wastewater treatment plant."

Moore agrees with most trenchless professionals that the industry is growing and holds an important place in the future of utility construction, while noting the challenges of getting buy-in to use trenchless means versus open cut construction.

"Lack of funding dollars coupled with a shortage of good contractors can create big issues," she says. "The experienced contractors are always busy. Inexperienced contractors will 'low bid' jobs and are not necessarily prepared for some of the challenges that may present themselves on projects."

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Another challenge, she notes, is retaining qualified contractors with sufficient experience in trenchless installations in an industry where current practice is to procure contractors based on lowest compliant bid.

"It would be groundbreaking in my opinion [if] NASTT would come up with a way to certify contractors (i.e. training, experience and a requirement to bid.) that would assist with contractor qualification," she says.

Moore also says the advancement of the trenchless market will also be dependent on the number of younger, qualified engineers coming into the industry.

"I think that training in trenchless methods needs to be highlighted and taught at the college and trade school levels," she adds. "Focus needs to be placed on best practices and sound Quality Assurance and Quality Control as well as sound inspection practices to monitor various trenchless methods. Our infrastructure continues to age and the need for rehabilitation versus replacement is real and a more cost-effective option for communities."

Chris Sivesind

As a second-generation horizontal boring industry professional, trenchless technology is in Chris Sivesind's blood. When he was just seven years old, his dad – who worked in the auger boring business since he was in high school –

started his own boring and tunneling company in the Seattle area (Tunnel Systems Inc.). Sivesind grew up spending summers and Saturday's looking at new prospective projects all over the Pacific Northwest with his dad and began estimating projects at a very young age. His dad's uncle also had a plumbing business in Seattle that eventually launched a horizontal boring division when natural gas was being brought into Seattle.

"I spent a lot of Saturdays helping load trucks so they were ready for the next project on Monday," he says about working with his dad. "I truly love the business, the people and the challenge these projects represent. Also, the fact that no two crossings are ever the same makes it exciting."

Sivesind later earned a degree in business administration-finance from Washington State University, after which he worked for a couple banks before returning to the construction world. He decided to join his dad's company on a full-time basis, where he was responsible for project management, estimating and business development for its eastern Washington branch office.

In 2006, he moved back to Seattle and joined The Robbins Company as its Western U.S. sales engineer for SBU Products. After five years at Robbins, he was presented with an opportunity to join Akkerman.

"The move to Akkerman has been great and I love working for a company that has such an



Chris Sivesind
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IN THE TRENCHES

impact on the trenchless industry," he says. "I believe we are in a real time of growth and the demand for trenchless work is increasing. Cities like Seattle, Portland, Denver, San Francisco, Vancouver, Salt Lake City and Los Angeles are growing so fast and creating such a demand for larger, more reliable infrastructure."

Sivesind says one of the biggest challenges the industry faces is the aging and diminishing workforce. He says concern over the lack of awareness of the different installation and rehabilitation methods available can be both good and bad. "It's good because it shows how much bigger our industry can be, but also shows how we have so much more work to do as a group to educate the next level of professionals," he says. In this aspect, Sivesind says the industry has only scratched the surface of its potential.

"NASTT hosting the No-Dig Show annually does a wonderful job at increasing education and knowledge within the industry, but it still amazes me how few people know about trenchless technology and that it can actually save them money and heartache on many projects," he says. "I think we will also notice a big difference in the coming years as the regional chapters of NASTT continue to gain momentum hosting local conferences and site visits."

As a life-long trenchless professional, it's only natural Sivesind would be one to volunteer his time to support NASTT and do his part to help expand its educational reach. His interest and involvement deepened when he became the secretary and later chapter chair for the Pacific Northwest Chapter.

"It was an awesome experience that I learned a lot from," he

says. "Attending four or five regional chapter conferences a year gave me a great opportunity to see what works and what makes the regional conferences a success.

"I think we need to continue to get more people to the No-Dig Show, and at the regional level, we need to make the cost so low for engineers and municipalities that they cannot afford not to go and take advantage of a wonderful educational opportunity. The cost of attending No-Dig for most engineers and municipalities is a barrier – not to mention all the time out of the office. This is where the regional chapters can offer a great opportunity to educate people for a fraction of the cost."

Sivesind says his favorite part about working in the trenchless technology field is being around the collaborative environment created by all the people in the industry. "It has always been important for me to develop relationships with sales team members from 'competitor' companies because we can work together or I can simply hand off a project to one of them who may have a better tool for a particular project," he says.

"We have such a tight knit group of people in the 'trenchless technology family' who work together for the same goal. We all want to complete our projects safely and to the highest quality. I get to work with a wonderful team of people at Akkerman and the customers – many whom I have known for years – who I am so fortunate to work with on a day-to-day basis across the Western U.S., Canada and abroad. It really makes me proud to have grown up in this industry."

ANDREW FARR IS THE ASSOCIATE EDITOR OF NASTT'S TRENCHLESS TODAY.

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Selected applicants will be awarded complimentary **full conference registration** to NASTT's 2018 No-Dig Show in Palm Springs, California, March 25-29. One day conference registrations will also be available. Registration includes full access to all exhibits and technical paper sessions... all you have to do is get yourself to the conference! Selected applicants will also be eligible to receive overnight accommodations. Selection based on responses to the application as well as need.

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NASTT's 2017 Membership Directory

The vision of the North American Society for Trenchless Technology is to be the go-to resource for education and information for professionals working in the underground construction field. At NASTT, working toward this vision is our passion.

Trenchless industry professionals know that there's one thing the industry always needs – more education. Making these needed educational opportunities available requires effective outreach and communication among various industry segments. This annual directory will provide you with a resource for connecting with engineers, contractors, manufacturers, professional service providers and municipal representatives who are NASTT members. Make sure to keep it close by, as it may prove to be helpful when planning your next trenchless project. For more, visit nastt.org to access real-time directory information day or night.

This directory is current as of Aug. 15, 2017, so if your information has changed, please contact NASTT's Membership Coordinator Molly Margosian at mmargosian@nastt.org. You can also log on to nastt.org/directory to update your information.

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2018 EDUCATIONAL FUND AUCTION & RECEPTION



In conjunction with
NASTT's No-Dig Show



NASTT'S 17TH ANNUAL EDUCATIONAL FUND AUCTION & RECEPTION

The Annual Educational Fund Auction helps raise money for very worthy causes. Since 2002, NASTT has raised over **ONE MILLION DOLLARS** and used those funds in support of our many educational initiatives. Due to your generosity, NASTT is able to provide targeted trenchless training courses to the industry, publish trenchless resources manuals and sponsor university students' attendance at NASTT's No-Dig Shows, as well as award scholarships.

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Aegion Corp.

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EYE ON THE INDUSTRY

HammerHead Trenchless introduces new air hammer for small utility drills

HammerHead Trenchless, a Charles Machine Works company, has introduced the new HammerHead Roughneck R200, the first 2-in. rock hammer engineered specifically for horizontal directional drilling applications. The R200, the smallest pneumatic rock hammer of HammerHead's Roughneck line, is designed to expand the capabilities of small utility drills allowing 7000- to 10,000-ton class directional drills to effectively drill through solid rock as well as other difficult soil conditions.

The R200 rock hammer was made to be the most efficient system available to HDD contractors in communications, gas, electrical and water service installations. The R200 model drills a 3.125-in. pilot hole.

"The R200 allows you to use a small drill on jobs you couldn't before. If you needed to drill through solid rock, you'd have to bring a large drill to supply enough power which requires more labor, more support equipment, and more time to complete the job. With the R200, contractors can save money by maximizing the capabilities of a small drill," explained Josh Hood, HammerHead HDD product manager. "When you're working in small spaces or drilling short distances such as under a road bed, it makes sense to use a small drill and now you can, regardless of soil conditions."

A key feature unique to the R200 rock hammer is the electronically-controlled air flow. With the touch of a button, the



operator can adjust the air flow from open to closed and anywhere in between which allows them to manage the power of the hammer on the fly. This feature is critical in situations where soil conditions change abruptly. The ability to reduce or increase power quickly prevents costly interruptions during the bore.

The R200 rock hammer system is available from HammerHead Trenchless or from authorized dealers, worldwide. Authorized dealers can be found on the web at hammerheadtrenchless.com or by calling 800.331.6653. (International: + [1] 920.648.4848).

LMK to upgrade Neofit potable water product range

LMK Technologies has announced it is continuing its five-year partnership with Flow-Liner as a national distributor of the Neofit system. The updated Neofit system is a durable, green and cost-effective method of trenchless rehabilitation of potable water lines, providing almost instantaneous results with increased flow rate and minimal diameter loss while creating a barrier from lead, preventing contamination and making water safe for consumers.

"LMK is very excited to continue partnership with Flow-Liner," said Larry Kiest, Jr., president, CTO and founder of LMK Technologies. "We look forward to

promoting this technology with our highly skilled network of licensed contractors and distributors so water utilities across the country can benefit from improved water quality and meet the demand for renewed water service lines, complimenting the rise in rehabilitation of water mains."

Neofit+ Plus system is a non-invasive pipe lining system especially designed for small diameter potable water service piping. The Neofit+ Plus Liner seals small leaks and pinholes in 1/2-in. thru 2-in. ID service piping. It also acts as a barrier between existing lead piping and potable drinking water. The Neofit+ Plus Liner is

NSF-61 approved and has been tested to a minimum 50-plus year life expectancy. LMK is promoting the advanced Neofit processing equipment, now providing lining lengths up to 300 ft. The technique necessitates minimal disturbance of surrounding ground, removing the risk of damaging other utility services. The absence of chemicals required makes it environmentally friendly and allows consumers to receive immediate return to service post processing.

To learn more about the Neofit+ Plus System, please contact LMK at 815-640-9302.

Mexico City's record-breaking crossover TBM makes final breakthrough



In June, a select group of project officials, including Mexican President Enrique Peña Nieto, celebrated the final breakthrough of an epic tunneling project. The 8.7 m (28.5 ft) diameter Robbins Crossover TBM is the first such hybrid machine to operate in North America, and it completed the Túnel Emisor Poniente (TEP) II on a high note. The TBM, known as XRE—a Crossover (X) between Rock

(R) and EPB (E) TBMs—navigated fault zones, variable ground, low cover, and more to achieve a national record of 57 m (187 ft) in one day as well as maximum rates of 231 m (758 ft) in one week and 702 m (2,303 ft) in one month.

The unique machine setup—able to convert between a non-pressurized Single Shield mode and pressurized EPB mode—was the first such Crossover TBM to be used in North America. The crew encountered obstacles including a fault zone with water inflows and a large, 90 cubic meter (3,200 ft) cavern, all of which were successfully dealt with. The Crossover machine was converted to EPB mode in October 2016 and successfully finished the tunnel in a section of low cover with just 4 m (13 ft) between the tunnel crown and building foundations overhead.

Now that tunneling is complete, the tunnel will receive a secondary concrete lining of 35 cm (14 in.) thickness before going into service. The wastewater tunnel will overhaul the current system in western areas outside of Mexico City and serve to prevent recurrent flooding in Valle Dorado. In particular, the tunnel will benefit the cities of Cuautitlan Izcalli, Tlalnepantla, and Atizapan de Zaragoza, which altogether are home to 2.1 million inhabitants.



Straightline HDD expands hole opener lineup

StraightLine HDD recently expanded its hole opener offering with the introduction of the XL-I Series. Designed from the ground up for horizontal directional drilling, the XL-I Series is positioned as a cost-effective alternative to "split-bit" hole openers.

At the core of the design are proprietary cones—available in six sizes, in either Tungsten Carbide or Mill Tooth configurations. Mounted to a purpose-built platform, the design facilitates load transfer to the shaft and bearing, with minimal radial load. The result is a dramatic improvement in production, service life and consistency, bore after bore.

Next, designers set out to address wear and performance characteristics by re-examining the interplay between cone diameter, height and carbide placement. Cones are sized and attached to the baseplate at an angle that protects vulnerable surfaces. Shortened cone height further improves wear resistance. Carbides placed to cut independent paths yield higher efficiency and longer service life.

Internally, the cone's proprietary sealing and bearing system mitigates fluid intrusion, yielding a myriad of user benefits, from reduced torque and fuel consumption to extended tool life.

As a platform, the XL-I Series incorporates design characteristics that ensure the tool's original geometry is maintained—even after rebuild. This approach yields consistent and repeatable performance. The XL-I Series includes six sizes, from 12.75- to 24-in. with IF Box x Box shafts.

Vermeer Great Plains dealership offers employee stock incentives

Vermeer Great Plains, a full-service construction equipment dealer with locations in Kansas, Okla. and Western Missouri, is now 100 percent employee-owned through an employee stock ownership plan (ESOP).

As part of the new ESOP structure, Scott Ryals, former general manager of Vermeer Great Plains, has taken on responsibilities as chief executive officer. He leads the dealership with a vision focused on maximizing and improving the customer experience, though this goal is nothing new for the dealer's employees.

"Since Vermeer Great Plains was founded, we have placed a high emphasis on serving our customers," Ryals said. "The new ESOP plan will only reinforce this culture as the dealership's success will directly benefit our employees who work every day to take care of our customers. We're all working toward the same goal."

Research shows that an employee ownership structure creates a positive work environment as employees all work towards a common goal. In the upcoming months, the employees of Vermeer Great Plains will be further educated about the new ESOP structure.

"The transition to the ESOP means the employees will receive an added future benefit based on how well we all grow the company," Ryals said.

Customers have always been the most important aspect of the Vermeer Great Plains vision. They can expect even better service as the company learns and grows through this transition. According to the ESOP Association, 84 percent of companies who participate agree the ESOP improved motivation and productivity. The combination of determined employees, excellent leadership and a fresh employee-owned plan is sure to be a recipe for success and outstanding customer satisfaction at Vermeer Great Plains.



Plymale to succeed Hollenbeck as RJN president

RJN Group, Inc. (RJN) announced that its Board of Directors has unanimously chosen Jeff Plymale as the organization's next president. Plymale, who currently serves as RJN's executive vice president and chief operating officer, will succeed Al Hollenbeck, the company's current president and CEO. Hollenbeck will remain CEO and chairman of the board.

Plymale has a track record of strong leadership and innovation both inside and outside of RJN as he becomes the third president in the 42-year history of the firm. "I'm honored for the opportunity to lead this exceptional organization of creative, dedicated, and talented professionals," said Plymale. "RJN provides innovative, cost-effective engineering solutions, every day, and our solutions offer a cleaner and safer community around the United States. This is a terrific opportunity that any leader would welcome."

Plymale holds a Bachelor of Science in Civil Engineering from the University of Illinois and

joined RJN Group, Inc. in 2000. Since then, he has undertaken various management positions within the organization, including business development, strategic planning, geographic expansion, product development, and management of multiple large-scale condition assessment programs around the country with municipalities under federal consent decrees. Prior to joining RJN, Plymale worked both in the U.S. and internationally on large scale engineering programs with some of the largest utilities in the world including Australia, Singapore and Europe.

Al Hollenbeck, P.E., BCEE, expressed confidence in the board's choice. "Jeff is an outstanding leader and has been instrumental in our growth, innovation, and success over the years," he said. "I'm very pleased with the board's decision, and I'm confident Jeff will ensure that RJN continues to be an industry leader in solving challenging infrastructure issues." SYSTEM SPECIA



New president Jeff Plymale (left) with RJN Group CEO Al Hollenbeck (right).



NASTT Chapter News



BRITISH COLUMBIA

The British Columbia Chapter is continuing to promote the *Trenchless Technology Roadshow*, coming Sept. 25-27. With a sold out exhibit hall and three sessions of presentations running at a time, this roadshow is perfect for the trenchless novice and specialist alike. The event is expected to draw more than 250 attendees.

The British Columbia Chapter is also continuing its efforts to introduce trenchless technologies into educational institutes. The chapter has had very promising meetings with the University of Victoria and the British Columbia Institute of Technology.

Lastly, using the carbon calculator and carbon credit protocol developed in British Columbia, the City of New Westminster, a local municipality, has submitted an application for carbon credits amounting to 358 tonnes of carbon dioxide, realised through the use of trenchless technologies!



GREAT LAKES, ST. LAWRENCE & ATLANTIC

The GLSLA Chapter held its second CIPP good practices course this year in Halifax in May, in partnership with NASTT and ACWWA. The course was well attended with more than 20 participants. We would like to thank ACWWA for their partnership in presenting this course and look forward to continuing to promote the trenchless industry in Atlantic Canada with ACWWA. Stay up to date on training opportunities and other events on the chapter website at glsla.ca.



MID ATLANTIC

MASTT is planning the "Trenchless Technology, SSES and Buried Asset Management" seminar for Philadelphia, Pa. (Mt. Laurel N.J.) on Nov. 1-2, 2017. MASTT also published its third annual *Mid Atlantic Journal of Trenchless Technology* in April.



MIDWEST

The Midwest Chapter conducted the first of two 2017 seminars on July 27 in downtown Milwaukee, Wis. The seminar changed from a two-day format into a longer one-day program with 14 presentations and speakers, which increased overall

participation. The seminar drew 48 attendees and 14 exhibitors. There were six representatives from the City of Milwaukee in attendance, as well as a presentation by Kevin Lyons, P.E., engineering design manager of the Milwaukee Metropolitan Sewerage District, who gave an overview of MMSD's tunnel program. The next 2017 seminar will be held in Cincinnati in December followed by a 2018 program in Des Moines, Iowa. The Midwest Journal Magazine will also publish in September 2017.



The Midwest Chapter conducted the first of two 2017 seminars in July in Milwaukee. The one-day seminar format included 14 presentations and speakers, drawing nearly 50 total attendees.



NORTHEAST

The Northeast Regional Chapter will be ending its second full year on Dec. 31. The chapter has accomplished much in a short period of time thanks to its many strong, supportive volunteers. The chapter will soon publish its fall edition of the *Northeast Journal of Trenchless Practices*, will host what is turning out to be a very popular fall conference in Cooperstown, N.Y. and hold elections for its Board of Directors and officers. We look forward to growing to be known as the go-to professional society for trenchless technologies in the Northeast United States.



NORTHWEST

Registration for the 2017 Northwest Trenchless Conference is now open. The conference will be presented in Calgary, Alberta, Canada on Nov. 8, 2017. This will be the 21st annual presentation of this event. The one-day conference offers excellent learning and networking opportunities for trenchless professionals and includes several technical presentations covering a variety of topics and a tradeshow. Arrive early on Nov. 8 to complete your registration and have breakfast while checking out the tradeshow. Prize drawings will be held throughout the day.

While the chapter will host the conference and tradeshow on Nov. 8, there will also be a post-conference presentation of

an updated version of the Horizontal Directional Drilling Short Course on Nov. 9. All events will be held at the Coast Plaza Hotel in Calgary. For complete information and details about registration, please visit nastt-nw.com.



PACIFIC NORTHWEST

The Pacific Northwest Chapter continues the charge forward to get the trenchless word out there. The chapter magazine, *Pacific Northwest Trenchless Review*, is scheduled for publication at the end of the year. If you are interested in receiving a copy, please contact our chapter chair to be added to the distribution list. We are currently planning to host a NASTT Good Practices Course in January/February of 2018 in Anchorage, Alaska (date and location to be confirmed soon). We will also be assembling a planning committee toward the end of the year to begin planning for our biennial chapter symposium which will be held in Portland, Ore., in early 2019.



ROCKY MOUNTAIN

At the Rocky Mountain Chapter, planning is under way for educational jobsite visits, young professionals and outreach committee events, sporting clays tournaments and our annual conference this fall in Colorado. Look for these events and more in the near future. As always, the chapter is looking for new volunteers and members and would love to see YOU get involved!



SOUTH CENTRAL

The South Central Chapter's second annual Trenchless Technology & Pipe (TPP) conference in conjunction with the University of Texas Arlington's Center for Underground Infrastructure Research and Education (CUIRE) in June was a huge success, doubling last year's attendance and offering some truly great exhibitors and technical presentations throughout the event. The South Central Chapter was also pleased to be able to award \$4,500 in scholarships to talented young students at the event. If you are a Texas or Oklahoma resident interested in getting involved in this quickly growing chapter, please contact Molly Margosian at mmargosian@nastt.org.



SOUTHEAST

The Southeast Chapter (SESTT) was planning a "Trenchless Technology, SSES and Buried Asset Management" seminar for New Orleans on Sept. 13-14. Please plan to support and at-

tend the seminars to enjoy the networking and learning. SESTT plans to publish the *Southeast Journal of Trenchless Technology 2017* in mid-November.






WESTERN



The Western Chapter (WESTT) is excited for its upcoming 13th annual Western Regional No-Dig Conference & Exhibition to be held Oct. 16-17 in Walnut Creek, Calif. In addition to a well-balanced technical program kicked off by Alexander Coate, general manager of the East Bay Municipal Utility District (EBMUD), the two NASTT Good Practices Course offerings on the topics of HDD and Introduction to Trenchless (New Installations and Rehabilitation) tout some of the best instructors in the industry. WESTT's annual publication, WESTT Trenchless Review, will hit the streets in mid-September and includes excellent papers from some of our regional members. Lastly, WESTT is now better connected. In addition to the website, westt.org, the chapter now has an email address, WESTTChapter.org@gmail.com and LinkedIn account to boot (WESTT NASTT). We'd love to hear from you!

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NASTT has a network of 11 regional chapters throughout the United States and Canada. With a single NASTT membership, you're automatically enrolled in the national organization, the international organization (ISTT) and also in your regional chapter. Regional chapters offer valuable educational and networking opportunities in your local area. Share your ideas, network with colleagues and find solutions to your everyday challenges.



BRITISH COLUMBIA

The British Columbia (NASTT-BC) Chapter was established in 2005 by members in the province of British Columbia, Canada.

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ELECTED OFFICERS

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Treasurer - Preston Creelman



GREAT LAKES, ST. LAWRENCE & ATLANTIC

The Great Lakes, St. Lawrence & Atlantic (GLSLA) Chapter was established in 1995 and represents the Eastern Canadian perspective of the trenchless technology marketplace. GLSLA members are from Ontario, Quebec and the four Atlantic provinces.

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Secretary - Gerald Bauer
Treasurer - Derek Potvin



MID ATLANTIC

The Mid Atlantic (MASTT) Chapter was established in 2004 by members from the states of Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia and the District of Columbia.

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Vice Chair - Michael Delzingaro
Secretary - Dennis Walsh
Treasurer - Tom Wyatt



MIDWEST

The Midwest (MSTT) Chapter was established in 1998 to promote trenchless technology education and development for public benefit in Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin.

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ELECTED OFFICERS

President - Jeff Boschert
Vice President - Chris Schuler
Secretary - John Milligan
Treasurer - Ryan Poertner



NORTHEAST

The Northeast Chapter was established in 2015 by members in the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont.

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ELECTED OFFICERS

Chair - Dennis Doherty
Vice Chair - Ian Mead
Secretary - Marshall Gaston
Treasurer - Babs Marquis

NASTT CHAPTERS



NORTHWEST

The Northwest Chapter was established in 1995 by members in the provinces of Alberta and British Columbia, Canada, and in Washington state. In 2005, the members in BC established the NASTT-BC Chapter. In 2009, members in Washington state established the Pacific Northwest Chapter and the Northwest Chapter adjusted the geographic area to include members in the provinces of Manitoba and Saskatchewan.

CHAPTER CONTACT

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ELECTED OFFICERS

Chair - Craig Vandaele
Vice Chair - Greg Tippett
Treasurer - Keith Moggach



PACIFIC NORTHWEST

The Pacific Northwest Chapter was established in 2009 by members in the states of Alaska, Idaho, Oregon and Washington.

CHAPTER CONTACT

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ELECTED OFFICERS

Chair - Brendan O'Sullivan
Immediate Past Chair - Chris Sivesind
Secretary - Carl Pitzer
Treasurer - Dylan Davidson



ROCKY MOUNTAIN

The Rocky Mountain Chapter was established in 2009 by members in the states of Colorado, Utah, Montana and Wyoming.

CHAPTER CONTACT

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ELECTED OFFICERS

Chair - Joe Lane
Vice Chair - Chris Larson
Secretary - Benny Siljeborg
Treasurer - Stephanie Nix-Wille
Past Chair - Bo Botteicher



SOUTH CENTRAL

The South Central Chapter was established in 2015 to serve the members of NASTT from Texas and the south central area of the United States.

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ELECTED OFFICERS

Chair - Larry Johnson
Vice Chair - Alan Goodman
Secretary - Luis Cuellar
Treasurer - Josh Kercho, P.E.



SOUTHEAST

The Southeast (SESTT) Chapter was established in 2001 to serve the members of NASTT from Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Puerto Rico.

CHAPTER CONTACT

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ELECTED OFFICERS

Chair - Jerry Trevino
Vice Chair - Ed Paradis
Secretary - J. Chris Ford
Treasurer - Kelly Derr



WESTERN

The Western (WESTT) Chapter was established in 2003 by members from the states of Arizona, California, New Mexico, Nevada and Hawaii.

CHAPTER CONTACT

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ELECTED OFFICERS

Chair - Cindy Preuss
Vice Chair - Brian Avon
Secretary - Jennifer Glynn
Treasurer - Norman Joyal

NASTT STUDENT CHAPTERS

NASTT Student chapters are involved in a number of activities throughout the academic year including field trips, seminars and fundraisers. Members of student chapters also attend and participate in NASTT's No-Dig Show where they present trenchless research posters, participate in competitions and provide event support monitoring the technical paper sessions. There are many benefits for students who belong to a NASTT student chapter – scholarships, networking opportunities, education and career opportunities to name a few. To learn more about NASTT's 19 student chapters, visit nastt.org/about/student-chapters.



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Trenchless Training Enables Record Setting Directional Drilling in Paradise



The Beaufort Jasper Water and Sewer Authority (BJWSA) is the regional provider of water and sewer services in a two-county area along the beautiful southeastern coast of South Carolina. Beaufort County is famous for its historical significance and our many waterways and marshlands. Of its more than 920-sq-mile area, 40 percent is comprised of waterbodies and marshlands.

Along with being a thriving retirement community and home to several important Marine Installations, Beaufort County has become a popular tourist destination and has been experiencing rapid growth since the mid-1990s. Any local significant extension of water and sewer service involves crossing our pristine estuaries and our community demands that we protect these valuable assets during construction. Prior to 1980, the traditional cut and cover method was used for these crossings, and once the project was completed, it took several seasons for the impacted area to recover. BJWSA was introduced to horizontal directional drilling (HDD) in the 1990s and our first use of HDD occurred when we installed a 24-in. waterline across two major rivers to provide potable water to Hilton Head Island in 1999 (two segments, ~7,500 ft total HDD). BJWSA and our customers quickly discovered the benefits of using HDD and we now widely use HDD for many types of pipeline projects.

BJWSA has expanded our knowl-

edge of HDD by tapping NASTT's vast expertise in the trenchless technology field. Both our Engineering and Operations Divisions have relied on NASTT's Horizontal Directional Drilling Good Practices Guidelines publication to develop internal skills needed to properly oversee all aspects of HDD projects. BJWSA has taken advantage of NASTT's No-Dig Show Municipal & Public Utility Scholarship program to send individuals to the annual No-Dig show where they are able to network with their municipal peers to share HDD experiences and to learn the latest advances in the trenchless industry. We have also sent our construction inspectors to specialty training focused on pipe fusion, a critical component of the HDD project process.

As our workforce gained confidence in our ability to successfully manage HDD projects, we looked for opportunities to make our HDD projects more efficient, shorten project timelines and when possible, reduce project costs. A good example of this is our innovative approach to sharing risk on major HDD projects by agreeing to supply the pipe and fusion services to the drilling contractor and developing a drilling contract based on a specific project timeline. The contract allowed for a HDD daily rate in accordance with the mutually agreed upon HDD project timeline and if the drilling exceeded the timeline, a significantly reduced daily rate was established until the HDD was completed.

This innovative contracting approach was first used in June 2007 to install 5,100 ft of 10-in. fusible PVC reclaimed waterline under the Beaufort River to irrigate a famous golf course. We had a limited budget and were able to reduce costs by procuring the fusible PVC pipe and fusion services for the HDD contrac-

tor. This was BJWSA's first experience with fusible PVC pipe and we worked closely with the pipe supplier and HDD contractor to determine the maximum pulling force and establish a pullback force monitoring protocol. The project was completed under budget and on schedule and at the time, was a world record length for 10-in. fusible PVC.

BJWSA faced another difficult HDD project in December 2009. We had acquired the water and sewer infrastructure on the Parris Island Marine Corps Recruit Depot and decided to decommission the wastewater treatment plant on the base and divert flows to a regional water resources facility located miles away. The project included installing a 16-in. force main under Archers Creek. Based on our success on the Beaufort River HDD in 2007, we decided to use a similar HDD contracting approach and prequalified HDD contractors based upon their experience using fusible PVC pipe and doing HDDs greater than 3,000 lf. The Archer's Creek crossing would require a 6,400-lf HDD, and based on their qualifications and cost proposal, the same HDD contractor that completed the Beaufort River HDD was awarded the Archer's Creek HDD contract. BJWSA again supplied the fusible PVC pipe and fusion services and a similar risk sharing contract was executed with the HDD contractor. Again, the project was a great success and we set another HDD world record for 16-in. fusible PVC pipe.

In summary, none of these HDD successes (or world records) would have happened without the valuable trenchless training and resources we received from NASTT.

This article was contributed by the Beaufort Jasper Water and Sewer Authority.

Assessing the Performance of 38 Years of CIPP Installations in Winnipeg, Manitoba, Canada

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rehabilitation with a dedicated program to upgrade the physical condition of sewers annually. Rehabilitation with cured-in-place pipe (CIPP) technology was first undertaken in 1978 and then in a number of trial applications over the next 18 years. Including the 1978 installations, seventeen trial installations were undertaken from 1978 to 1996. In 1997 and 1998, the modern Condition Upgrading Program commenced with the creation of primarily six (6) dedicated work streams for sewer upgrading as follows:

- Work Type 1 – Stabilization methods
- Work Type 2 – Full manhole to manhole trenchless relining
- Work Type 2a – Relining in conjunction with external point repairs
- Work Type 3 – Trenchless point repairs
- Work Type 4 – Competitive relining/replacement stream
- Work Type 5 – Full manhole to manhole replacement with minimum excavation technology, and
- Work Type 6 – External point repairs

The cost effectiveness of lining work made Work Types 2, 2a, and 3 immediately transitioned CIPP from a trial technology to over 75 percent of the annual capital work assignments. These work streams have continuously maintained this percentage of work or greater to the present day and eliminated the need for Work Type 4; originally envisaged to be a competitive relining/replacement work stream. While there has been a limited amount of segmental GRP and sliplining work carried out in the Condition Upgrading Program, the vast majority of relining work has been undertaken by CIPP methods. And while the early years of the modern program included both point repair and full manhole to manhole relining work, very few point repairs have been undertaken since 2003, due to the ever-improving economics of full manhole to manhole relining.

A very robust matrix was originally developed in the Sewer Condition Assessment Program to convert observed defect patterns into each Work stream. The extraordinary cost effectiveness of CIPP relining, however, turned that matrix into a far simpler one, as depicted in Figure 1 below. Simply stated, if it was technically feasible to reline and major hydraulic upgrading was not required, it should be relined.

INTRODUCTION

The City of Winnipeg, Manitoba, Canada has a sewer system that services a population of approximately 700,000. The sewer system includes 3454 km (2146 miles) of sewer which is comprised of 1057 km (656 miles) of combined sewer (CS), 1286 km (799 miles) of separate wastewater sewers (WWS), 925 km (574 miles) of land drainage sewer (LDS) and 185 km (114 miles) of storm relief sewers (SRS). Since 1998 the Sewer Condition Assessment Program has inspected 100 percent of the combined sewers, 95 percent of separate wastewater sewers and a small percentage of land drainage and relief sewers.

As much of the system is near or in excess of 100 years old (Winnipeg reached a population of 250,000 before 1920), there has been a long history of sewer

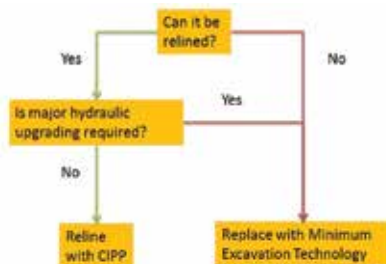


Figure 1 – CIPP Decision Tree

Since 1998, approximately 176 km (109 miles) of CIPP has been installed in diameters ranging from 150 mm (6 in.) through 1800 mm (72 in.), including both circular and many non-circular pipes; host pipes that have included vitrified and segmental clay tile, reinforced and non-reinforced concrete, and brick pipes with original installation dates back to 1876 (~140 years old). Average depths are in the 4–6 m (13 – 20 ft) range with the deepest installation about 10 m (33 ft) below grade.

The Sewer Condition Upgrading Program is driven by an annual Sewer Condition Assessment Program, which, in addition to identifying upgrading candidates, has afforded a unique opportunity for visual confirmation of CIPP performance of the 17 liners installed during the 1978 to 1996 period as well as many of the liners since the onset of the modern program in 1998. As CIPP technology has evolved considerably over this time, the review of the long-term program provides considerable insight into not only the anticipated longevity of CIPP but the impact into changes in design, product, and installation technique.

OVERVIEW OF CIPP INVENTORY IN WINNIPEG

The entire CIPP lined inventory includes over 177 km (109 miles) of relining installed in 2159 sections of sewer. The diameter range distribution by unique installation and length are depicted in Figure 2.

Since the original installations, more than 2,000 inversions have been successfully installed including:

- Approximately 90 non-circular cross sections (predominately standard egg-shaped sewers).
- 74 brick sewers, largely non-circular and dating back to 1876.
- A number of segmental clay sewer sections.
- A number of corrugated steel pipes.

EVOLUTION OF CIPP DESIGN AND INSTALLATION IN WINNIPEG

The CIPP product, its design, and installation techniques have evolved considerably since the first installation trial in 1978. As reported in the writer's 2013 No-Dig Paper, that installation had numerous challenges with an Insituform Licensee from Fresno, Ca-

lif., trying to install CIPP in Winnipeg's -40 oC (-40 oF) winter weather. They attempted to install 316 m (1037 ft) of liner, had 206 m (676 ft) go well, had 115 m (377 ft) go very badly, and simply walked away from the last 200 m (656 ft) of their contract. That was not the only hiccup in the early history of CIPP use in Winnipeg. However, while a number of the early installations had their challenges in getting liners installed correctly; the ones that made it in have all fared well in terms of their longevity and current visual condition.

All of these installations were installed by Insituform Licensees using the inversion process, utilized standard unreinforced polyester tubes, and were cured with hot water. All of the polyester resins were "neat" unfilled resins.

Three of the first four contracts had notable installation challenges (1978, 1987, and 1989); two of these (1987 and 1989) had installation issues which necessitated coming back the following construction season to install a 3-mm (1/8-in.) thick supplemental liner to meet project structural enhancement objectives.

The 1987 project had severe disbondment problems with the internal polyurethane coating in two installations which compromised the finished mechanical properties, while the third inversion was installed 4.6 m (15 ft) short as the liner length was measured incorrectly. The 1989 installation manufactured a multi-layered tube incorrectly, with the inside layer at inversion (i.e. the outside layer after installation) being made to the same circumference as the outside layer. The increased stress levels resulting from this caused a circumferential fracture to occur at every service connection that was reinstated. Despite these initial issues, all of these liners are in good physical condition to this day, with no evidence of wear or material degradation whatsoever.

"As installed" means that the visual condition of the liner shows no evidence of material breakdown, wear or disbondment. Wrinkles from original installs were still wrinkles and visually the pipe-soil system was still stabilized.

While the local market (and Insituform Licensees serving it) varied resin types over the initial installations in the 1980s, the CIPP tube and installation method evolved subtly not radically over this period. The science of getting installation heads correct for the installation was perfected; boiler capacity was better matched to curing requirements, prevailing weather conditions and varying heat sinks; and the tube construction improved to preclude disbondment during cure in cold weather installations. Polyurethane coatings evolved in PVC coatings and tube construction moved from the United Kingdom to the United States.

Compared to the initial 20 years or so of experience with CIPP, the last seven years (2008 to date) have seen change at the speed of light! Some of the most significant changes over the years have included:

- Prior to the release of the Insituform 1983 Engineering Design Guide (see Figure 3), no design

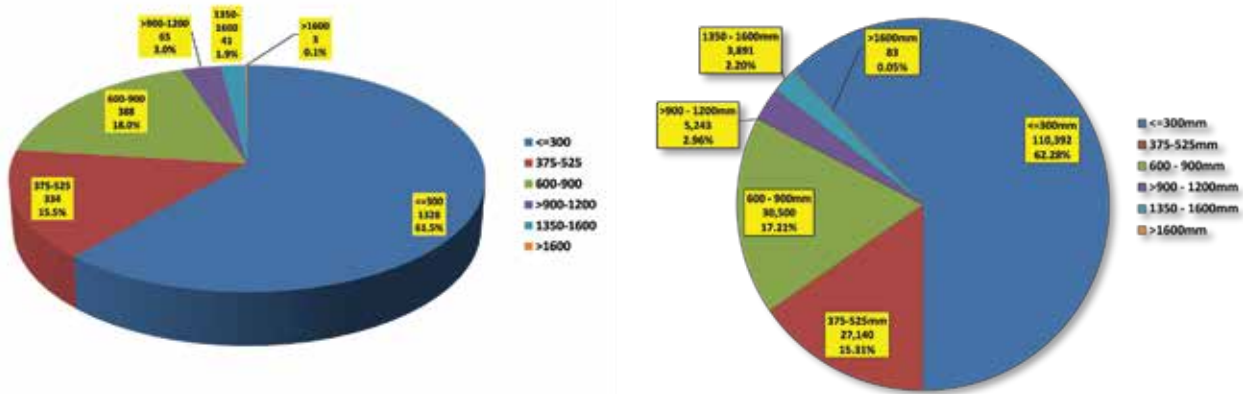


Figure 2 – Breakdown of CIPP inventory.

was carried out and all tubes were sized as 6 mm (1/4-in.) liners irrespective of the applied loads or installation specifics.

- The 1983 Insituform Engineering Design Guide introduced the market to the same partially deteriorated design concept that is still in use today in ASTM F1216, a modified Timoshenko buckling model based on the research of Aggarwal and Cooper. Fully deteriorated design was based on a Spangler deflection model.
- The 1988 Insituform Engineering Design Guide (see Figure 3) was the first introduction to the market of the concept of fully deteriorated design using the modified AWWA buckling model; however, it retained Spangler deflection checks.
- In 1989, the first version of ASTM F1216 was released which largely followed the 1988 Insituform Engineering Design Guide with the exception of the Spangler deflection checks. 1990 trial installations used the 1993 ASTM version for design, installation and recommended quality assurance testing.
- In 2007, ASTM further modified the AWWA buckling model for fully deteriorated design and the -07b version was adopted for use into the local market.
- In 2008, the local market started utilizing steam as well as hot water cures. Steam cures reduced construction timeframe and was rapidly adopted into the market place, originally in diameters up to about 600 mm (24 inch) and now in installations 1350 mm (54 inch) and larger.
- In the past 2 years, more challenging installations have incorporated the use of both glass and carbon fibre reinforced tubes for increased mechanical properties.

OBSERVATIONS OF CURENT LINER CONDITION BASED ON CCTV INSPECTION REVIEW

Literally thousands of CIPP installations have been reviewed in Winnipeg in one-year warranty inspections. From 1989 through 2012, 100 percent of installations had a one-year warranty CCTV inspection in addition to a Completion of Construction inspection for acceptance purposes. The fact that all of the 17 installations installed from 1978 through 1996 era show no evidence of material degradation, wear, or overall stability of the CIPP/host pipe/soil system suggests that this practice (warranty inspections), even on a portion of the installations,

is good insurance to confirm long term performance.

In addition to the 17 installations installed from 1978 through 1996 era the Sewer Condition Assessment Program has also facilitated reviews of the current condition of many more that were installed from 1998 to date. Based on the writers 2012 and 2013 investigations (reviewing the current mechanical properties of the 1978 and 1984 installations), there is good evidence to support the assumption that visual classification methods are a good indicator of CIPP retaining its mechanical properties over time. The balance of warranty and condition assessment CCTV inspections has contributed greatly in the Winnipeg market to confirm that CIPP installations will consistently achieve a long useful life.

In this investigation, the writers had originally envisaged the use of standard WRc and PACP coding techniques to quantify existing condition of CIPP liners. However, given the unique nature of CIPP; it is a reflective liner installed in host pipes that have many defects; that proved to be problematic. The use of WRc Version 3, coding in particular, has only observational codes for CIPP lining, not codes directed to fully understand the performance/condition of the liner and the overall pipe-soil structure that a CIPP lined system has become. Detailed review of raw condition coding and inspection video from 45 inspections highlighted that standard coding protocol captures “apparent defects” that are reflective of natural features of the original installation and have no real bearing on whether the CIPP lining was performing adequately or not. Some observations upon review include:

- Wrinkles inherent and accepted by reasonable protocols in many original installations need to be assessed for wear over time as opposed to being viewed as defects. While a certain degree of wrinkling is inherent in many CIPP installations, the review indicated that even what would be considered excessive wrinkling and pleats by many standards, showed no evidence of breaking down, wear, or loss of overall of structural integrity of the CIPP lined system.
- The ovality of the host pipe needs to be assessed in the context of overall evidence of stability in the pipe-soil system (is the CIPP liner doing its job to stabilize the pipe-soil system) as opposed to being scored as a defect that is inherent in the lining of original host pipes with significant loss of cross section. A review of installations with considerable levels of ovality showed no evidence of any further

loss of stability.

- Defective sewer connections which were consciously accepted by the original contract need to be assessed for deterioration of CIPP/connection/host interface as opposed to being classified as a CIPP lining defect. The majority of Winnipeg's sewers are installed in highly plastic, lacustrine clays soils with very little active infiltration. Therefore, the use of special termination seals at manholes and service connections has been rare and grouted in service connections are not uncommon when services were added over time to concrete and clay tile sewers.



Figure 3 – Defective connection after 10 years of service with no CIPP degradation.

An example of a defective connection after 10 years of service is shown in Figure 3. While the connection of the service lateral would clearly be classified as defective in standard inspection vernacular, the CIPP interface is intact, shows no evidence of disbondment or wear and is performing well.

The liners assessed to date show no real evidence of any breakdown of CIPP material or overall CIPP liner/host pipe/soil systems after CIPP was installed to stop deterioration mechanisms like soil migration. The review did highlight the need to more closely evaluate the means of sealing CIPP installations at manhole terminations and possibly modifying service connection reinstatement details in some areas, likely in areas where active infiltration is present.

Aside from the overall exemplary performance of CIPP in the Winnipeg market, the other notable observation is that there is no marked different in performance over the wide range of changes noted in Table 1 in design, installation technique, CIPP product or curing technique (hot water or steam). While one would certainly not promote the complete absence of design from the 1978 installations, the following overall observations can be made based on the current review:

1. The performance and technical reviews of the 1978 installations suggest that the post-design era models are all conservative models (no installed liners are failing due to buckling).

2. Liners designed and installed prior to introduction of ASTM F1216 in 1989 have performed as well as liners installed post ASTM F1216. This includes liners designed based on modified Timoshenko buckling for partially deteriorated conditions and fully deteriorated conditions with either a Spangler deflection model or the modified AWWA buckling formula.
3. While all applications are subjected to relatively normal wastewater streams, there is no difference in liner performance based on the use of epoxy, vinyl ester and both unfilled and filled polyester resins.
4. Although the period of record is much shorter (about seven years), there is no observed change in liner performance based on the use of steam versus hot water cures. Previous investigations in the Winnipeg market have shown that both curing methods deliver the same average mechanical properties. Steam cures have produced more consistent physical properties.
5. Although the period of is also short (about eight years), there is no difference in observed liner performance in fully deteriorated liners designed with Appendix X1 of ASTM F1216-07a or all later versions of F1216 (07b and later).

CLOSURE

The City of Winnipeg has a 37-year history with sewer rehabilitation by CIPP methods. The use of CIPP in the local market has saved the City literally hundreds of millions of dollars in direct capital cost in the last decade alone. While the first decade had its share of challenges in perfecting the use of CIPP, all the liners that were installed during the first decade of installation have performed as well as liners installed during the past 25 years.

While the review highlighted the need to more closely consider the way liners are terminated in design (both at manholes and at defective service lateral connections), the overall performance of the inventory is very likely better than newly installed infrastructure installed over the same time frame. This is likely attributable to a robust quality assurance program associated with CIPP use in the market and prequalification of installers which has produced a very high quality of installation of liners versus new infrastructure which has limited acceptance testing and no qualification based selection criteria.

While the sampling and review was a relatively small portion of the 177 km (109 miles) of CIPP installation, it does suggest that previous assertions of CIPP having an effective design life of 50 years is very conservative and that the actual service life for the rehabilitated inventory will last for a much longer period of time.

THIS PAPER WAS EDITED FOR STYLE AND SPACE FOR PUBLICATION IN NASTT'S TRENCHLESS TODAY. TO VIEW THE FULL VERSION OF PAPER MM2-T3-01, PLEASE VISIT NASTT.ORG/TECHNICALPAPERS.

CALENDAR

SEPTEMBER

13-14
2017 League of California Cities Annual Conference & Expo
Sacramento, California

13-14
Trenchless Technology Seminar
Hosted by NASTT's Southeast Chapter
New Orleans, Louisiana

OCTOBER

16
13th Annual Western Regional No-Dig Show
Hosted by NASTT's WESTT Chapter
Walnut Creek, California

17
NASTT's HDD Good Practices
NASTT's Introduction to New Installations
NASTT's Introduction to Rehabilitation
Hosted by NASTT's WESTT Chapter
Walnut Creek, California

NOVEMBER

1-2
Trenchless Technology Seminar
Hosted by NASTT's Mid Atlantic Chapter
Mount Laurel, Pennsylvania

7
Sealing a Collection System Webinar

8
2017 Northwest Trenchless Conference
Hosted by NASTT's Northwest Chapter
Calgary, Alberta
Trenchless Elevated 2017
Hosted by NASTT's Rocky Mountain Chapter
Denver, Colorado

9
NASTT's HDD Good Practices Course
Hosted by NASTT's Northwest Chapter
Calgary, Alberta

15-16
2017 Northeast Chapter Municipal Outreach Forum
Hosted by NASTT's Northeast Chapter
Cooperstown, New York

For more info, visit nastt.org/training/events.

FUTURE NASTT'S NO-DIG SHOW LOCATIONS



NASTT's 2018 No-Dig Show
March 25-29
Palm Springs Convention Center
Palm Springs, California

NASTT's 2019 No-Dig Show
March 17-21
Donald E. Stephens Convention Center
Chicago, Illinois

NASTT's 2020 No-Dig Show
April 5-9
Colorado Convention Center
Denver, Colorado

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