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# TRENCHLESS NORTH AMERICA



The Official Magazine of the North American Society for Trenchless Technology

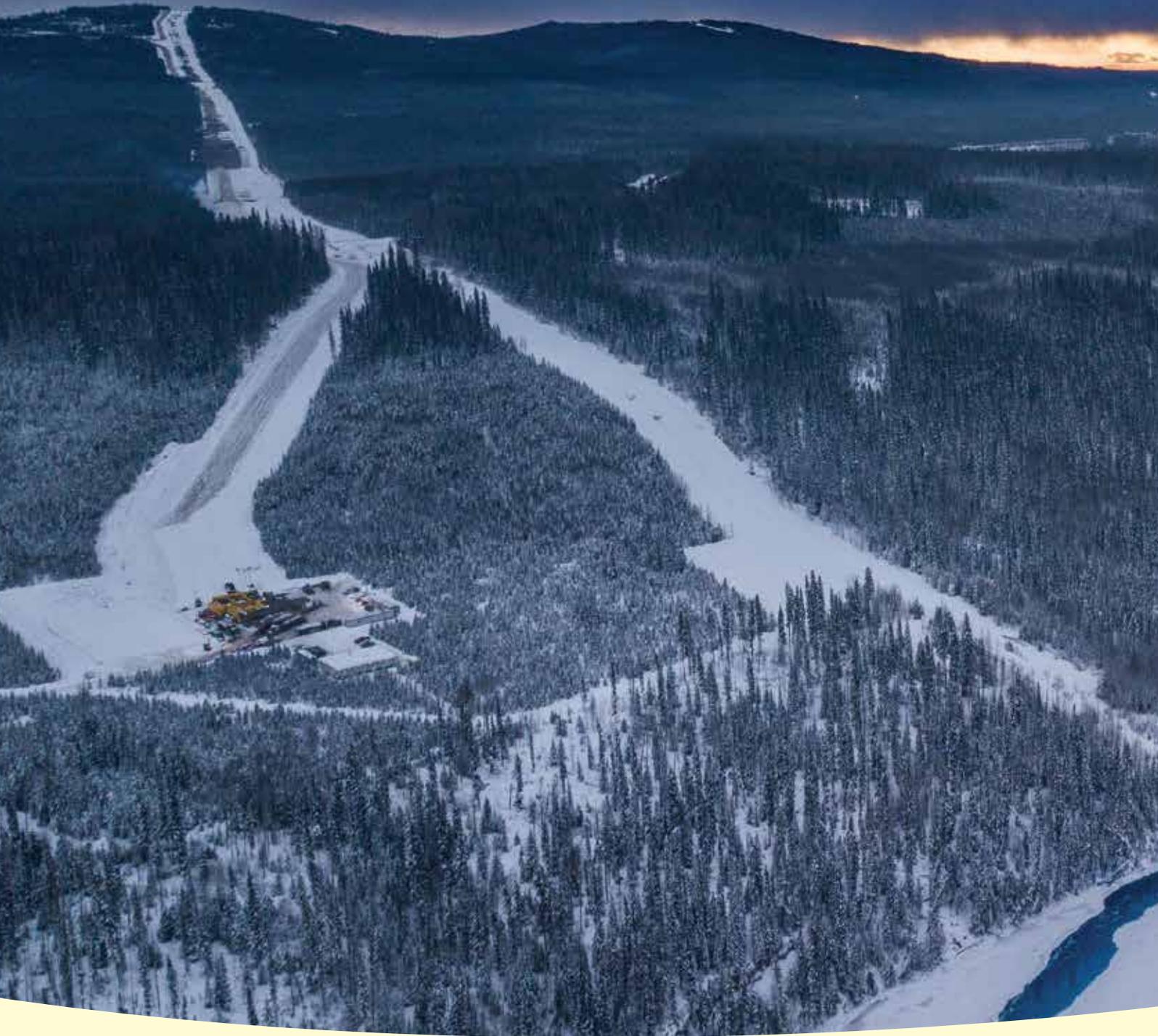
**Interactive  
Digital Edition**



**MEMBERSHIP ISSUE**  
**NASTT Welcomes MEXTT Chapter**  
**Corporate Member Listings Inside**

**FALL 2021**  
Volume 11 • Issue 3

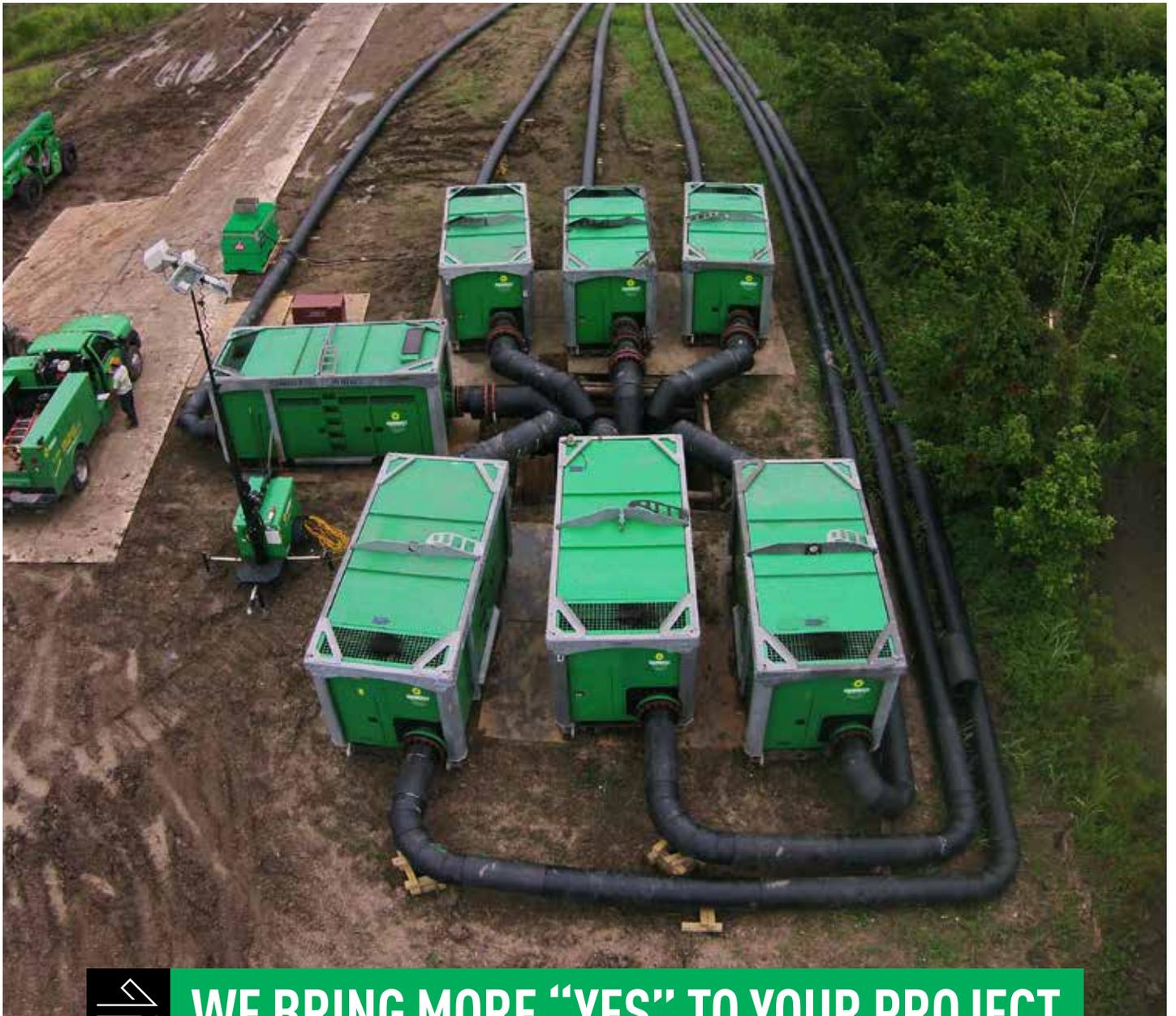
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# TRENCHLESS NORTH AMERICA



The Official Magazine of the North American Society for Trenchless Technology

FALL 2021 – VOLUME 11, ISSUE No. 3

## NASTT WELCOMES NEW MEXTT MEXICO REGIONAL CHAPTER!

On August 3, 2021 a new Chapter began in the history of NASTT, with the formation of the MEXTT Regional Chapter. As the 12th and latest Regional Chapter covering trenchless technology in all 32 states of Mexico, the addition of MEXTT offers NASTT complete coverage of the North American continent. Welcome to NASTT Mexico!

10



## FEATURES

### 16 Q&A: Marty Paris, P.E., Kimley Horn

Marty Paris P.E. serves on the NASTT No-Dig Program Committee for 2022 and is a Technical Track Session Leader. In this interview, Marty describes his first encounter with trenchless technology, and shares his thoughts on the bright future ahead for the trenchless industry as the best response to current challenges.

### 22 NASTT Membership Benefits & Volunteer Opportunities

Gain exposure, build competencies, gain leadership experience, and give back to the profession by volunteering with NASTT! Make your mark within the NASTT community! Includes details on the NASTT No-Dig Celebrate Trenchless Awards and Volunteer Committee Organizational Structure.

### 28 NASTT 2021-2022 Corporate Membership Listings

The NASTT Membership listings are a condensed version of the NASTT Online Membership Directory, a searchable directory with full contact info. The NASTT Corporate, Government & Education Members are highlighted here, along with key contacts, websites and corporate logos – the NASTT community!

### 48 Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

Awarded Paper of the Year - Rehabilitation, at the 2021 NASTT No-Dig Show in Orlando, this paper outlines the geopolymer lining of a granite and brick arch sewer tunnel in Columbia SC, originally built in the 1820s. This successful project involved lining 600LF of arched pipe up to 8 feet in size.

## DEPARTMENTS

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*“All roads  
lead to  
NASTT”*

## WELCOME TO THE MEMBERSHIP ISSUE!

“All roads lead to St Louis!” NASTT recently attended the American Public Works PWX Show in St Louis, home of the inspiring Gateway Arch, where East meets West. Our booth promoted the Municipal Scholarship program to the infrastructure Owners, Program Directors and Engineers in attendance to attract organizations to visit the NASTT No-Dig Show and to learn more about trenchless technology.

Successful applicants are provided a hotel room and entrance to the conference, where they can meet manufacturers, suppliers, designers, and contractors who may be able to assist them on projects, as well as earn CEUs by listening to the renowned technical session presentations and networking at one of the reception events.

Each year the Municipal Scholarship program enables hundreds of local municipal and public utility owners to become familiar and utilize trenchless technology by attending the No-Dig Show and meeting exhibitors and sponsors. Many millions of dollars have been saved, disruption and environmental impact reduced as pipes and cables have been installed, re-laid, or repaired because of the business opportunities created at the conference, as our industry and membership has developed.

The NASTT is itself a gateway to all sectors of the market in promoting trenchless technology, not only by connecting organizations but also in providing education to both current and future people through our Training Courses and Student Program. We engage those without knowledge of trenchless technology to develop their understanding and promote the activities of our members to contribute toward growing your market. Additional initiatives have included a wider circulation of our publications and reaching out to other similar associations for mutual benefit.

Membership is the focus of this issue of *Trenchless North America*, highlighting many of the achievements of our members and the activities NASTT has undertaken on your behalf. We would especially like to welcome the newly formed Mexico Regional Chapter to our ‘family’ and are excited by the program they have planned. Other Regional Chapters are busy with their conferences, and we look forward to No-Dig North in Vancouver.

As members we encourage you to become involved with NASTT. Have a direct voice and involvement in NASTT activities through one of our sub-committees, or Regional Chapters, maybe become a trainer or reviewer for one of our training courses, write and send in an article for our marketing, sponsor or decide to attend an event - we welcome your participation and appreciate your support.

We hope that by continuing to bring everyone together, no matter what your interest or level in trenchless technology “All roads lead to NASTT”.

Thank you for taking the time to read *Trenchless North America*, we hope you enjoy it.

*Matthew Izzard*

**Matthew Izzard, Executive Director**

North American Society for Trenchless Technology (NASTT)  
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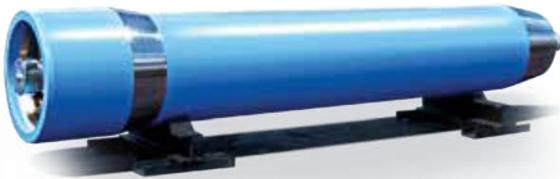


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## Our Society Members and Volunteers ARE PRICELESS

### **We are a resilient industry!**

The trenchless Industry grows stronger every year. Even in the pandemic our membership and regional chapters are moving forward to educate the public. It’s amazing when you look back at what we have done in 2021. We had an in-person and virtual No Dig Conference in Orlando, 4th Quarter regional chapter conferences and networking events, and November 8th - 10th No Dig North in Vancouver, BC. If you are unaware of your local regional chapter conferences, national conferences, or events; then go to our website and get more information to register. The value of networking with NASTT members is truly priceless. Our members and volunteers are innovative and creative thinkers, always looking for ways to improve technology and infrastructure and protect our environment.

The Fall issue of *Trenchless North America* is dedicated to our members and volunteers. This organization is able to grow and thrive because of you, and for that reason, it is important to us to recognize and thank our members and volunteers for their support. I want to personally thank all of you that have taken an interest in joining one of our 40-plus committees. We now have good representation of municipalities, gas utilities, manufacturers, contractors, and engineering firms on these committees to contribute up to date good practice courses and publications. If you or your company are involved with CIPP, Pipe Bursting, HDD, Gas, Laterals, or Grouting, then I recommend that you get involved with that committee and represent the technology within the courses and publications.

NASTT’s mission and vision are “to continuously improve infrastructure management through trenchless technology” and “to be the premier resource for knowledge, education, and training in trenchless technology.” With education as our goal and striving to provide valuable, accessible learning tools to our community, one of the things of which we are most proud at NASTT is that even during uncertainty we have been able to grow. Recently, we welcomed our latest Regional Chapter to the NASTT family and completed our representation of the entirety of North America. NASTT is so excited to announce that we now have our first chapter in Mexico! You can read all about them in the pages of this issue. We are also eagerly anticipating the upcoming No-Dig North conference! The Canadian Chapters are hosting the second annual No-Dig North in Vancouver, BC, November 8-10. The show will consist of two days of technical paper presentations and industry exhibits in the trenchless technology field. Pre-event Good Practices Courses will also be available. The event will be held at the Vancouver Convention Centre. Visit [nodignorth.ca](http://nodignorth.ca) for all the details, information also on page 57.

For more information on our organization, committees, and member benefits, visit our website at [nastt.org](http://nastt.org) and please feel free to contact us at [info@nastt.org](mailto:info@nastt.org).

*Alan Goodman*

Chair  
North American Society for Trenchless Technology (NASTT)

The background of the advertisement is a photograph showing the silhouettes of three workers wearing hard hats inside a large, circular tunnel. The tunnel's interior is lined with corrugated metal, and bright light is streaming in from an opening at the end, creating a dramatic, high-contrast scene.

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## NASTT Welcomes Mexico Regional Chapter!



### MEXTT Chapter the 12th NASTT Regional Chapter

August 3, 2021, was a significant day for North American Society for Trenchless Technology (NASTT) as the 12th and latest Regional Chapter was formed, covering the 32 states of Mexico.

Matthew Izzard, NASTT Executive Director and Alan Goodman, Chair of the Board of Directors, met with founding members Sergio Alvarado (Underground Construction Equipment Mexico), Chapter President; Adrian Cordero (Tubepol), Chapter Vice-President; Itzel Mora (Tubemas), Secretary; and Caesar Alvarado (Hammerhead), Executive Officer for the inaugural meeting of the NASTT Mexico Regional Chapter – MEXTT.

**“We are very excited about the future growth of our association... for the benefit of infrastructure in Mexico.”**

– Sergio Alvarado, President, MEXTT

The addition of this Chapter offers complete coverage of the North American continent for NASTT with Mexico joining the three Canadian and eight United States Chapters in the Society.

The NASTT Board, under Craig Vandaele, formed an initiative group to create the Mexico Chapter, with Board Members Tiffanie Mendez and Alan Ambler central to its development and working with Itzel Mora to engage volunteers in the creation of the new chapter.

This culminated in the inaugural meeting and formation of the Regional Chapter Board to provide local engagement to the members in developing trenchless technology knowledge and education.



*MEXTT Chapter President Sergio Alvarado is excited to form the new Regional Chapter and publicize the benefits of trenchless technology across Mexico*



MEXTT Chapter President Sergio Alvarado, and NASTT Executive Director Matthew Izzard sign the Agreement for the new NASTT Mexico Regional Chapter. Looking on, holding the Mexican flag (l-r) Itzel Mora, Secretary MEXTT Chapter, Alan Goodman, NASTT Chair, and Adrian Cordero, MEXTT Vice President

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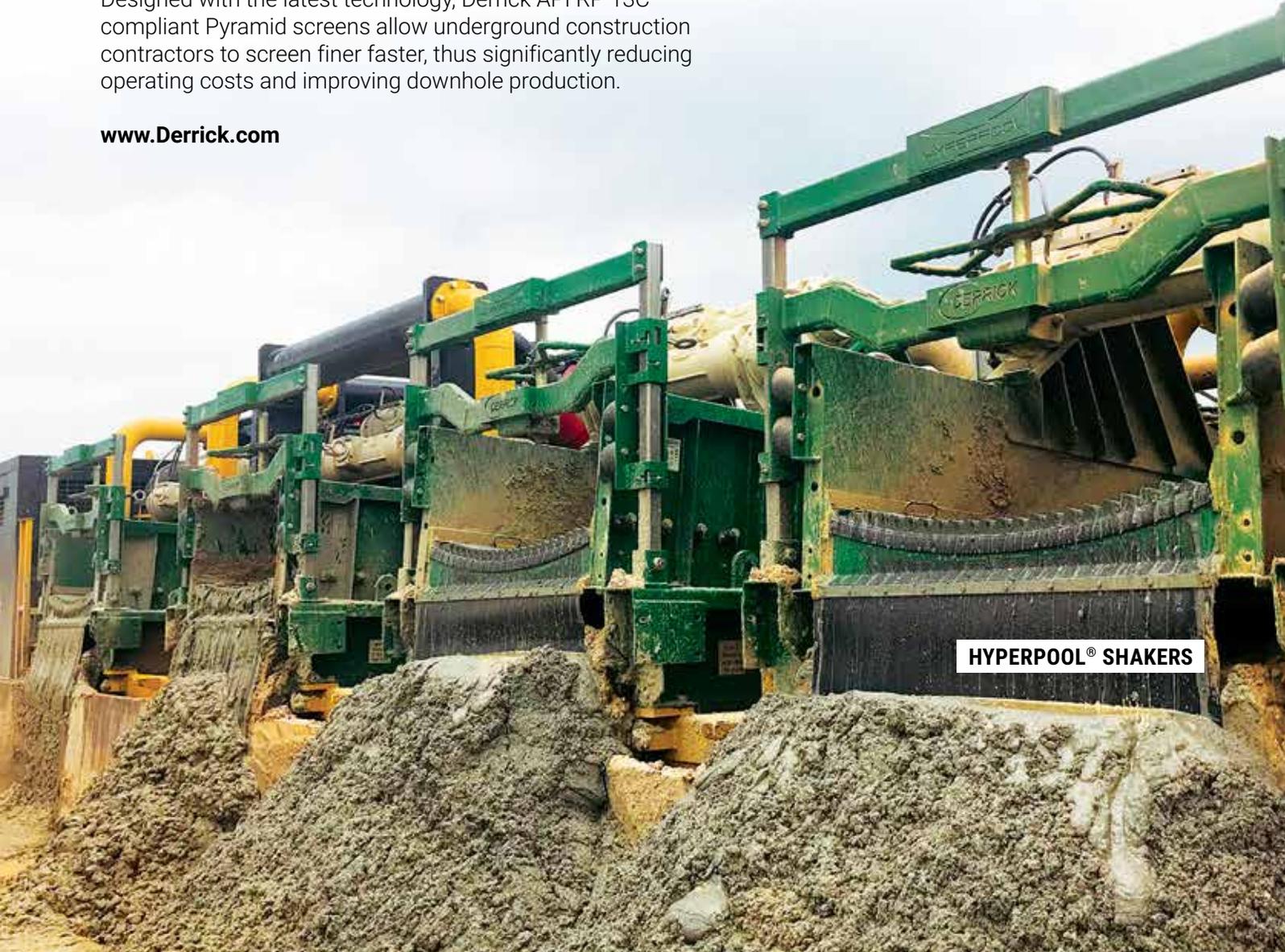


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*“Watch this Mexico Chapter grow!”*

*– Alan Goodman, Chair, NASTT*

MEXTT President, Sergio Alvarado commented: “I am very grateful for the opportunity to be one of the founding members and to be elected president of MEXTT, as well as recognizing my colleagues Itzel Mora, Adrian Cordero, Eduardo Ortegon and Cesar Alvarado who are part of this executive board.

We are very excited about the future growth of our association, and we will be preparing our work plan in the short, medium and long term to publicize the benefits that we can bring to our members through the different existing trenchless technologies for the benefit of the projects of infrastructure generated in Mexico.”

NASTT Chair, Alan Goodman added: “NASTT has been blessed to work with five incredible people that are passionate about bringing trenchless technology to every corner of Mexico. On the historic day of August 3rd, 2021 the Mexico Chapter was formed and inaugurated into NASTT. Whether it be new installation or rehabilitation the Mexico Chapter wants to educate all sectors (municipalities, state agencies, utilities, contractors, and engineering firms) in all industries including water, sewer, gas, power, fiber and telecommunications. Watch this Mexico Chapter grow, and we can’t wait to learn more about the future conferences and Good Practices Courses offered in Spanish.”

An opening webinar to outline the Mexico Chapter’s activities, introduce members and how to be involved is planned for early 2022 followed by in-person events. This includes the delivery of NASTT’s Introduction to Trenchless Technology Good Practices Courses, translated to Spanish with the assistance of grant funding from International Society for Trenchless Technology (ISTT). Work is also starting on a website and a new membership magazine entitled “**NASTT Mexico!**”, and many other initiatives. If you are interested in being involved, please contact us at [www.info@nastt.org](mailto:www.info@nastt.org).

In expanding their activities and delivery of trenchless technology education in Spanish to a wider audience, NASTT and MEXTT look forward to another exciting Chapter in NASTT history.

*“The addition of this Chapter offers complete coverage of the North American continent for NASTT with Mexico joining the three Canadian and eight United States Chapters in the Society.”*



*¡Viva NASTT México!*



*Proud members of the new MEXTT Board Executive team, getting ready to further the growth of trenchless across Mexico (l-r) MEXTT President, Sergio Alvarado (Underground Construction Equipment Mexico), MEXTT Secretary, Itzel Mora (Tubemas), and MEXTT Vice President, Adrian Cordero (Tubepol)*



## NASTT 2022 No-Dig Show Scholarships Available for Municipal & Public Utilities

*Municipal and public utility scholarship opportunities are still available to attend the NASTT 2022 No-Dig Show, April 10-14 in Minneapolis, Minnesota.*

In 2013, NASTT established the No-Dig Show Municipal & Public Utility Scholarship Award Program to provide education and training for employees of North American municipalities, government agencies and utility owners who have limited or no training funds due to economic challenges. In past years, over 100 applicants were awarded the scholarship annually.

NASTT's Municipal & Public Utility Scholarships have gone to over 1250 people since the inception of the scholarship program, and it continues to build momentum. With an entire conference dedicated to trenchless technology, this scholarship offers public agencies the opportunity to participate, and experience, the *world of trenchless*. It's an opportunity perhaps entirely missed were it not for the award directly impacting an agency's bottom line. Submit your application today - this is a chance public agency representatives shouldn't pass up!

Selected scholarship winners will be awarded Full Conference and Exhibition registration to the NASTT 2022 No-Dig Show. Also available are one day conference registrations which include full access to all exhibits and technical paper sessions. Selected applicants will also be eligible to receive complimentary overnight accommodations for three nights at the host hotel. The scholarship applications are reviewed by a committee of NASTT volunteers and awarded based upon the supplied responses.

To apply for the scholarship, complete the application online at [nastt.org/no-dig-show/municipal-scholarships](http://nastt.org/no-dig-show/municipal-scholarships) on or before November 1, 2021. Applicants are not required to be NASTT members. For more information about the NASTT No-Dig Show visit [www.nodigshow.com](http://www.nodigshow.com) and [www.nastt.org](http://www.nastt.org).

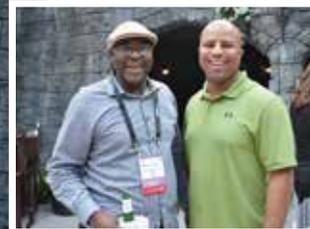
*“The show provided many opportunities to network with contractors, consultants, and decision makers within municipalities and utilities across the United States and Canada.”*

*– Joseph Barnes, Johnson County Wastewater*

*“This event allows you to meet and talk with manufacturers, installers and end users who are not normally the case at other shows.*

*Thank you for the opportunity.”*

*– Joe Devito, Beaufort Jasper Water and Sewer Authority*



*Each year NASTT hosts a reception for the Municipal Scholarship recipients to network with each other and kick off the conference.*



## The NASTT 2022 NO-DIG SHOW **MUNICIPAL & PUBLIC UTILITY SCHOLARSHIP PROGRAM**

The NASTT 2022 No-Dig Show Municipal & Public Utility Scholarship Award has been established to provide education and training for North American municipalities, government agencies and utility owners who have limited or no travel funds due to restricted budgets.

Selected applicants will be awarded complimentary **full conference registration** to the NASTT 2022 No-Dig Show in Minneapolis, Minnesota, April 10-14, 2022. 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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with

**Marty Paris P.E.**

*Marty Paris, P.E. is a Vice President at Kimley-Horn and Associates, Inc. in Dallas, Texas, and is a longtime member of NASTT who has presented and served as a Track Leader with the No Dig Conference on multiple occasions. Marty has more than 28 years of design experience with a focus on rehabilitation and trenchless methods, including pipe bursting, cured-in-place, sliplining, horizontal directional drilling, and microtunneling.*



**Kimley»Horn**

### **What first inspired you to become interested in construction & engineering field, particularly underground construction?**

My father was a plumber, and occasionally we would have a backhoe in our backyard. When I was about five years old, my dad made me an underground fort by excavating a trench a couple of feet deep and placing plywood over the top. The trench had turns and an opening at each end. It was a great place to hide when playing with friends. Not sure if this is what inspired me, but it is a great underground memory.

### **Outline your experience of first being introduced to trenchless technology methods and applications.**

In the summer of 1993, I needed six more hours to complete my Bachelor of Science in Civil Engineering at the University of Texas, so I signed up for the only two summer electives available that would satisfy my degree requirements. Both were in geotechnical engineering, and one of them was focused on tunneling with Dr. Priscilla Nelson. At the time Dr. Nelson was consulting on the Superconducting Super Collider (SSC) project in Waxahachie, Texas. The SSC was a 14-foot diameter tunnel planned to be constructed in a ring with a circumference of 52 miles. Listening to Dr. Nelson talk about this project with great enthusiasm made an impression on me. Unfortunately, the SSC project was canceled by Congress in October 1993 after the completion of about 14 miles of tunnel. Ironically, the engineering firm that I joined was hired to help with the closure of the project, and I was assigned to go to Waxahachie to perform environmental site visits for about four weeks. My first real experience with trenchless technology design came in the summer of 1994 on a project for Dallas Water Utilities (DWU). The Coombs Creek Wastewater Rehabilitation project included about 3,200 linear feet of small diameter wastewater mains in four residential locations. My supervisor at the time

had just attended a NASTT conference, and he brought back literature on things like pipe bursting, cured-in-place lining, and fold-and-form linings. As I worked on the preliminary design reports for the wastewater mains, we realized that open cut replacement would be very disruptive to the neighborhoods and homeowners, so we began to evaluate the use of some of the trenchless technology methods. Approximately half of the wastewater mains ended up being rehabilitated or replaced using trenchless methods, and I was able to go out in the field and observe the installations. One particular 6-inch clay tile main ran between houses next to a swimming pool, large trees, a retaining wall, and power poles. I was amazed when I went out to observe the construction; the contractor was able to complete the installation within about four hours with only the entry pit excavation and a few hand excavations for the service laterals.

### **How did you first get involved with NASTT and what are some of the benefits?**

I began attending NASTT conferences and trainings in the late 1990s and in the last few years have had the opportunity to speak at the No Dig Conference and volunteer as a moderator and track leader. NASTT is a great organization for technical education and resources. I have also been able to grow my network of trenchless professionals at NASTT events. On multiple occasions, I have reached out to colleagues that I met at No Dig to ask questions and seek advice on specific project challenges.

### **What are your thoughts on the current state of the trenchless industry? What areas do you see evolving in STEM education and post-secondary academics?**

I have seen a lot of growth in the trenchless industry over the past 20 years, but I still see significant opportunity for growth.



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There are still many areas in the U.S. where trenchless construction methods are underutilized due to lack of exposure and understanding. There is also a lot of growth opportunity related to technology advancements. Every year I discover new products or methods that are being developed to solve underground construction problems. A good example is the Direct Pipe Method, which combines horizontal directional drilling and microtunneling. I am looking forward to using this method in the future.

I am excited about the focus on STEM education that I have seen over the past several years, but one of the challenges is connecting the theoretical to the practical. Students want to see the impact their education can make on society, so it is important to connect the math and science to real-world applications all along the way. I have seen the impact that an internship makes in an engineering student's success at school and in their future career, so I think that more hands-on experience during academic education would be beneficial.

***Is the trenchless industry generally doing a good job of attracting young professionals? What do you think can be done to better engage students and young professionals in the trenchless industry?***

Just like my supervisor introduced me to trenchless technology my first year out of school, our young engineers need to be introduced to technical aspects and the industry through conferences and trainings. As our water/wastewater team in Dallas grows, we invite manufacturers and contractors to come to our office to talk about trenchless products and methods. We also schedule construction site visits to take our young engineers out in the field to see the products and methods in action.

***Biggest challenges facing the trenchless industry today? Has acceptance and understanding of trenchless technology improved?***

The biggest challenges I typically face are clients who have had a bad experience with a trenchless method or product. The bad experience can be due to poor design, poor implementation, or just the wrong application. It is important to remember that one size does not fit all in the trenchless industry. When a client has one bad experience, it is difficult to convince them to use that method or product again, even if it is the best and most cost-effective alternative. I believe that acceptance and understanding of trenchless technology has improved and more owners understand the significant benefits of reducing disruption and the time for construction, in most cases. However, continued education and promotion of best practices is critical to advancing the industry and its acceptance in areas that have not yet adopted trenchless technology.

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

Over the past 28 years, I have had the privilege of working on numerous trenchless technology projects, and I have discovered that every project is unique in one way or another. I really enjoy the challenge of evaluating and designing rehabilitation or replacement projects and working with my colleagues and coworkers to provide a solution that is cost-effective and minimizes disruption to the public. Several years ago, I received a call from DWU about an emergency project in one of their parks. A 36-inch wastewater interceptor had major corrosion in the crown and needed to be replaced. However, the park had just completed the construction of three new softball fields right over the wastewater main. The next day, I met with DWU's emergency contractor on the site, and we were able to identify the project constraints. Within the next few weeks, we came up with a design that used pipe bursting, cured-in-place, and open cut in different areas to minimize disruption, minimize risk, and optimize cost. It was a fast-track collaboration that was constructed successfully—those are the kind of projects that I really enjoy.

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Photo is courtesy of Onsite Central Ltd



## Dynamics of an Advancing Pipe Ramming Industry

### Trenchless Method is Gaining Traction

By: Matt Olson PE, Lithos Engineering

Selecting a well-suited trenchless method for anticipated ground conditions is paramount to tunneling success. Subsurface investigations detecting the presence of groundwater, dense soils, and cobbles and boulders prove challenging for successfully completing trenchless installations. Often, techniques that allow for relatively efficient removal of cobbles and boulders, such as hand mining or auger boring, do not work well in saturated conditions where the ground behavior is anticipated to run, flow, or ravel quickly; risk of encountering an unstable face is high in these ground conditions. Similarly, trenchless methods that are well suited to balance soil and groundwater pressures are typically not as well suited for excavating cobbles and boulders and are generally more economically impactful in comparison to other trenchless methods. Risk of gravel or cobbles binding and stopping tunneling equipment, or a boulder becoming an obstruction are high for this situation. One trenchless method that is gaining industry traction in dense, cobble/boulder rich, and saturated ground conditions is pipe ramming.

Pipe ramming uses a hydraulic or pneumatic hammer (See Photo 1) to drive an open-ended steel casing horizontally, engulfing soil as it advances. The large opening of the casing and high impact energy of the hammer lowers risk of getting stopped by an obstruction, as boulders can often be engulfed, deflected, or even broken. While pipe ramming does not directly allow the operator to adjust tunnel face pressures, the soil engulfed within the casing, commonly known as the soil plug, provides its own lateral resistance and can counteract lateral soil and groundwater pressures at the face to a variable degree. Soil plugs work well when they are of sufficient length to develop the required resistance; however, special care is often required at the start of a pipe ram drive. Should anticipated face pressures or standup time necessitate, ground improvement outside the shaft and/or an artificial soil plug can be installed within the first casing segment to provide the necessary lateral resistance to start the drive. Recently, several pipe ramming installations through cobble and boulder rich, saturated ground have been successfully completed by initially counteracting soil and groundwater pressures in this way.

The Willamette Water Supply Program Raw Water Facilities (RWF\_1.0) project (Project) in Wilsonville, Oregon is a recent



Photo 1 - Pipe ram equipment using a hydraulic hammer to install an 84-inch steel casing on the Willamette Water Supply Program Raw Water Facilities project in Wilsonville, Oregon

project example where pipe ramming was successfully used in these challenging ground conditions. Key stakeholders on this project included: Willamette Water Supply Program (Owner); Black and Veatch (Prime Engineer); Staheli Trenchless Consultants (Trenchless Engineer); Kiewit Infrastructure West Co. (General Contractor); James W. Fowler Co. (JWF) (Trenchless Subcontractor); and IHC IQIP, Geo2 Engineering B.V., Bender Consulting, LLC, Pacific Foundation, and Lithos Engineering, LLC (Trenchless Subcontractor Engineering). The project involved installation of an 84-inch outside diameter, 1.25-inch-thick steel casing for a distance of 265 feet, used to house a 66-inch steel pipe for pressurized raw water transmission. The crown of the casing crossed approximately 20 feet below the observed high-water mark of Arrowhead Creek, a tributary to the Willamette River.

Ground conditions baselined for the Project subsurface consisted of Fill, Willamette Silt, and Troutdale Formation. Baseline ground conditions for the tunnel installation included full face Troutdale Formation for the entirety of the drive length. Troutdale Formation typically consists of weathered siltstone with interbedded sandstone and claystone, frequently weathered



Photo 2 - Watertight secant pile shafts were used for launch and reception of the pipe ram (PHOTO COURTESY OF WILLAMETTE WATER SUPPLY PROGRAM)

to the consistency of stiff soil, with occasional pebble conglomerate beds, and was described to contain clay, silt, sand, gravel, and cobbles with a relative consistency ranging from medium stiff to hard. The contractor needed to be prepared to handle any number or distribution of cobbles and boulders up to 36 inches in the longest dimension. Ultimately, JWF encountered eight boulders in excess of 36 inches in diameter. Groundwater was baselined approximately 21 feet above tunnel crown outside the launch shaft and approximately 16 feet above the tunnel crown outside the reception shaft.

Numerous techniques were used to facilitate the successful installation within the anticipated ground conditions and other site and project constraints. Watertight, secant pile shafts were installed to provide safe access for tunnel work and to resist the high lateral loading and uplift forces associated with retained saturated soil (See Photo 2). Shafts were fitted with rubber seals around the exit and entry locations to provide a flexible gasket to control groundwater and contain lubricant within the tunnel annular space. The steel casing was fitted with a stout cutting shoe at the leading edge specifically designed to withstand impact with baselined cobbles and boulders. JWF estimated the ramming forces, including an estimate of the dynamic ramming forces to more accurately model installation forces inherent to pipe ramming operations and select appropriate tooling and materials.

The original breakout plan involved installing soil nails through the headwall and secant pile shaft into the soil within the tunnel zone. Calculations were made to ensure the soil nail bond strength could resist the anticipated soil and groundwater pressures. During construction, the soil nails were not able to be installed to the length required to achieve the necessary bond length. The team re-grouped and decided to develop an artificial plug using sandbags to counteract the soil and

groundwater pressures during breakout. Further, the minimum soil plug length required throughout casing advancement was calculated so JWF could perform intermediate cleanouts without sacrificing stability at the tunnel heading.

Implementation of dynamic monitoring of pipe ramming performance metrics during casing advancement enabled JWF to monitor hammer energy transfer efficiency, track stresses within the steel casing, estimate the skin and face resistances to advancement, and digitally record advancement rate throughout the drive. These measurements could be correlated with the pre-construction drivability calculations to check for reliability in the submitted calculations and predict issues related to equipment or material capacities.

The Project is a state-of-the-art pipe ramming installation, calling upon the industry's collective experience across the trenchless, geotechnical, and mechanical disciplines to engineer and construct a steel casing installation through subsurface conditions requiring innovative strategies to mitigate a high risk profile. In the end, the casing was installed and 1.8 inches right and 1.3 inches below design line and grade, respectively, and allowed for installation of the carrier pipe meeting specification requirements. Dynamic modeling of pipe ramming forces allowed for proper selection of tooling and materials. Breakout and mid-drive calculations of the soil and groundwater pressures and ability of the soil plug to resist these pressures provided confidence that over-excavation or face failure would not occur, and safe working conditions could be maintained. Real time recording of the dynamic forces allowed for JWF to monitor the performance of the operation and adjust their means and methods to improve performance as necessary. Risk mitigation tactics such as these will facilitate advancement in the pipe ramming industry. Continued industry calibration of soil plug calculations and dynamic drivability analyses will add confidence to using pipe ramming for projects with challenging subsurface conditions such as those described herein. Hats off to the Project stakeholders for working together to accomplish yet another successful project and advancing the capabilities of the trenchless industry.



*Matthew Olson PE has experience in trenchless construction including design, construction inspection and management, feasibility studies, geotechnical investigations, preparation and review of contract documents, and cost estimates. His work history as a contractor and consultant provides a valuable perspective regarding methods that increase construction efficiencies and minimize project risk for trenchless operations.*

## Get Involved. Get Connected. Get Ahead. Get More.

When you choose to volunteer with NASTT, you'll gain exposure, build your competencies, gain leadership experience, give back to the profession and make your mark within the NASTT community.

Volunteer and get involved with short-term projects like award selection, help plan events, provide guidance for lifelong learning opportunities or inspire the future of the profession through student and educator focused committees.

Get more from your NASTT membership when you get involved! Visit <https://nastt.org/membership/volunteer/> to sign up for one of NASTT's volunteer opportunities.



### AWARD SELECTION

Award Selection committees complete their work during a short time frame, typically one to three months and involves includes online review of applications and supporting materials, virtual meetings and online discussion.

**Abbott Innovative Products & Services.** Reviews applications prior to the upcoming NASTT No-Dig Show. Judges on site: attend the Innovative Products Forum; visit finalists for additional information and Q&A at exhibit booth; and deliberate to select winners in each category.

**Municipal & Utility Scholarship Selection.** Evaluates applications and selects scholarship award recipients to receive complimentary housing and registration the upcoming NASTT No-Dig Show. Sign up now for the 2022 selection process.

**Outstanding Paper.** Reviews and scores finalists for Outstanding Paper Award. The Outstanding Trenchless Paper Award commends authors of the best NASTT No-Dig Show papers each year. Sign up now to review papers from the 2022 No-Dig Show.

**Ralston Young Trenchless Achievement Award Selection.** Evaluates nominees and selects recipient of the annual Ralston Young Trenchless Achievement Award which applauds savvy members under 36 who have demonstrated excellence early in their career. Champions the award to various audiences and prospects. Prerequisite: minimum 10 years in the industry.



### EVENT PLANNING

Event planning committees help guide the development and implementation of work plans by actively participating in meetings, contributing to discussion, brainstorming, sharing innovative ideas and championing events.

**Educational Fund Auction.** The Educational Fund Auction Committee helps coordinate activities to make the Educational Fund Auction a success. Responsibilities may include donation solicitation, auction promotion and attending the in-person event (if you can). Funds raised through the auction are allocated to NASTT educational programs including, student and municipal scholarships, publications and training courses.

**NASTT No-Dig Show Technical Program Committee.** Evaluate technical papers submitted for presentation. Ensure a standard of excellence, non-commercial content and the advancement of NASTT member value at the No-Dig Show. Determine and support event objectives, success measures, format and activities and champion the conference to the trenchless community.

- Serve as a member of the main committee.
- Volunteer as a Track Leader and manage a specific track of the No-Dig Show technical program. Peer-review papers and presentations to ensure non-commercial, quality content, provide feedback to authors and coordinate communication from paper acceptance through presentation.
- Act as a session moderator to support session success on site. Open to municipal or public employees only.

**NASTT No-Dig North Technical Program Committee.** Review and select papers. Help plan and coordinate the show on site. No-Dig North is hosted by the NASTT Canadian Chapters. January - November | virtual and in person

### STUDENT & UNIVERSITY OUTREACH

Student and university focused initiatives encourage students to pursue careers in trenchless technology and promote strong relations between NASTT and universities with trenchless-minded curriculum.



**Argent Memorial Scholarships.** Reviews applications and selects recipients for the Argent Memorial Scholarship. Regularly

reviews criteria, application and selection processes and program management.

**Educational Outreach/University Curriculum.** Explores proposal, investigates viability of development and implementation of a collegiate-level trenchless technology curriculum to provide in partnership with colleges and universities. Conducts research/market analysis, risk assessment, develops business plan and makes recommendation to NASTT Board of Directors.

**No-Dig Student Scholarships.** Reviews available funding and selects recipients for the NASTT No-Dig Show Student Scholarships. Regularly reviews criteria, requirements and selection processes.

**Student Chapters.** Reviews applications and selects recipients for the NASTT Student Chapter Activity Grant. Regularly reviews criteria and application and selection processes. Supports Student Chapter development.

**Student Competitions.** Actively pursues college and university student engagement through student competition development, judging and award distribution.

## EDUCATION & CONTENT DEVELOPMENT



Trenchless education committees ensure the trenchless community has accessible life-long learning opportunities that include high quality, relevant, content in order to obtain the knowledge and skills necessary for success.

**Digital Strategy.** Provides recommendations on content, format and development of NASTT websites and online platforms to enhance communication and awareness and provide a must-see professional resource for the trenchless community.

**NASTT Publications.** Reviews, discusses and recommends potential and new publications and training courses. Develops RFPs, solicits authors and provides peer review of submissions to ensure quality and non-commercial publication. Provides production oversight as needed. Subject areas include:

- IPP • Gas • Grouting • HDD • Laterals
- New Installations • Rehabilitation

**Pipe Bursting Center for Excellence.** Provides leadership in education, standards, training and elevating the profile of the method throughout the construction industry. Works to refine best practices and acts as a resource and forum for utilities, contractors and manufacturers to share information and continue to move the pipe bursting method forward.

**Virtual Training.** Works to develop instructor-led live and on-demand content for the trenchless marketplace in order to support skill and career development, increase knowledge and understanding and provide in-house training.

## MORE WAYS TO GET INVOLVED

Didn't find what you're looking for? Want to take your participation to the next level? There are more ways to get involved including these opportunities:



- Author for Good Practices and specialty area books
  - Content Provider: Career development (articles, checklists, video)
  - Content Provider: Industry articles for Trenchless North America magazine
  - Content Provider: Business development tools and soft skills for advancement (articles, checklists, video)
  - NASTT Student Chapter liaison
  - Session moderator (virtual or in person)
  - Speaker for webinars or in person training
- Subject for Trenchless North America Q&A. Share your trenchless story, thoughts on the profession, special accomplishments in this member profile.

## LEADERSHIP

NASTT members with a history of involvement can make an impact and give back to the profession as a NASTT leader. NASTT and chapter officers and board members are nominated and elected by members.

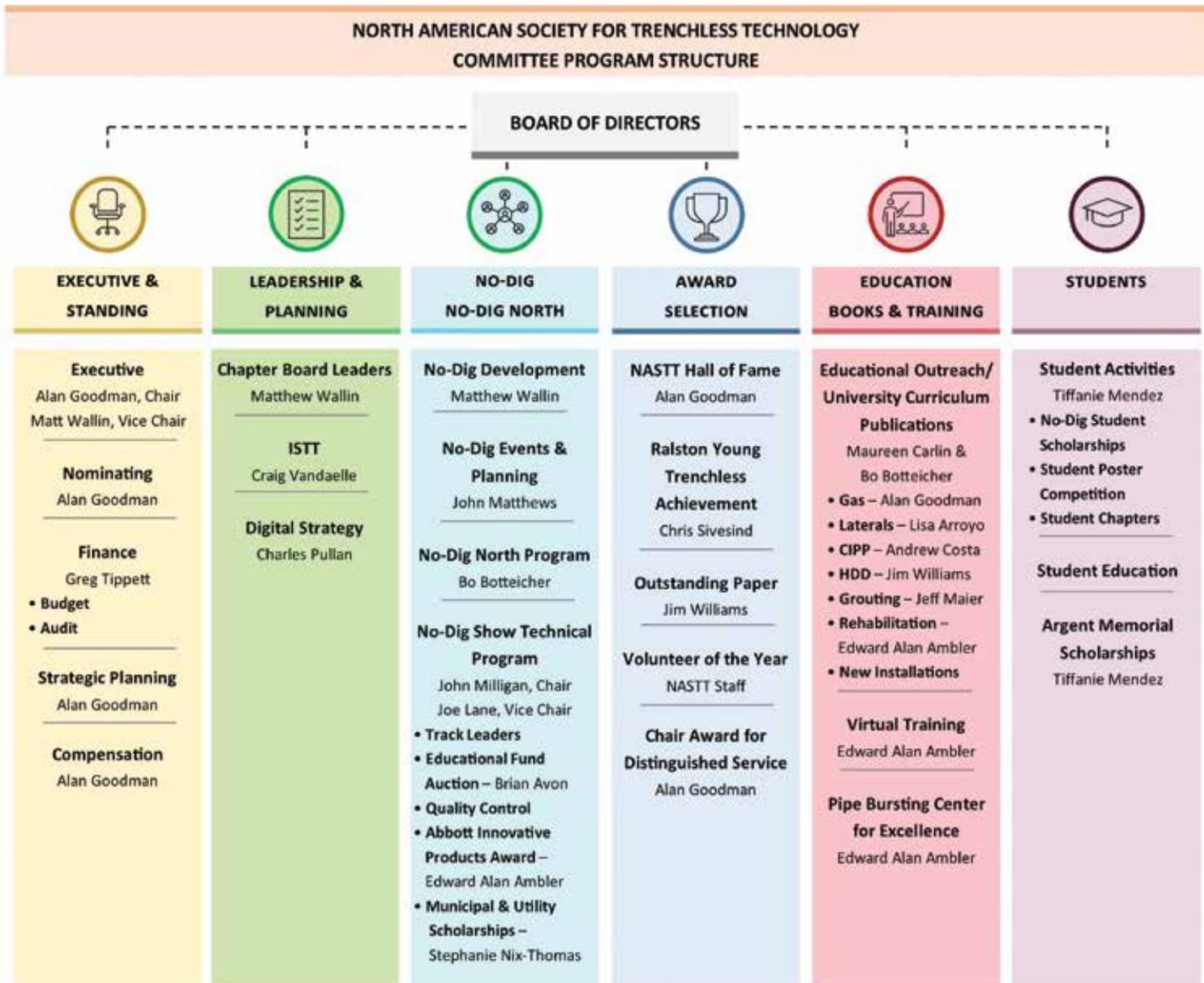


The committee chair role and other leadership positions, such as members of executive level and standing committees, are appointed positions.

## GETTING STARTED

Review the committee chart for an area that interests you or chairs you have a connection with. Then visit <https://nastt.org/membership/volunteer/> to get involved or contact Carolyn Hook at [membership@nastt.org](mailto:membership@nastt.org).

## NASTT Volunteer Committee Structure



# NASTT Celebrate Trenchless Awards



NASTT Celebrate Trenchless Awards recognize the multitude of ways that individuals and companies contribute significant time, energy and intellect to developing trenchless technology and fostering its success. The awards celebrate innovators, champions, volunteers and emerging leaders who have made a substantial impact in the industry.

Why nominate yourself or a colleague?

- **Sales.** Awards are an opportunity to stand out from your competitors.
- **Attract talent.** Motivated employees want to work for the best companies. Awards increase your stature among new recruits.
- **Build name recognition.** Even if you don't win, you or your organization will become familiar names known for excellence, initiative and ingenuity.
- **Growth.** Awards should be an essential part of your growth strategy for your career, corporate funding, succession planning and revenue.

The application window is open now for several awards.

## Nominate a Standout Young Professional for the Ralston Young Trenchless Achievement Award

Applauding savvy NASTT members under 36 who have demonstrated excellence early in their career by making valuable contributions to the trenchless technology industry, the Ralston Young Trenchless Achievement Award recognizes members whose talent and ability are the future of trenchless.

You do not have to be a NASTT member to nominate; but, only NASTT members are eligible for the award. Self-nominations are allowed. *Student members are not eligible.*

**Read more at [nastt.org/awards](https://nastt.org/awards) and apply by December 3, 2021.**

## NASTT No-Dig Show 2022: Focus on INNOVATION

**The Abbott Innovative Products & Services Award** celebrates 2022 NASTT No-Dig Show exhibiting and sponsoring companies with state-of-the-art product or services making a significant impact in advancing the trenchless industry in the areas of rehabilitation or new installation. Applicants can apply in one or both categories. Applicants must be an exhibitor or sponsor *who will be on site* in Minneapolis. There is no separate fee to enter.



**Apply by January 31, 2022 online at [nastt.org/awards](https://nastt.org/awards).**

Finalists and winners receive:

- Top-tier exposure in person and online;
- International recognition throughout the US, Canada and Mexico;
- Industry affirmation from a panel of NASTT judges and members;
- Team inspiration through nationwide validation of their hard work; and
- Elevated brand identity that attracts the finest talent.

That means...

- Winners and finalists are featured in NASTT distributed press release and NASTT publications.
- Winners are honored with an exhibit booth banner and personalized award at the NASTT No-Dig Show.
- Winners receive winner logos to use on company websites and sales and promotional materials.
- Winner and finalist presentation recordings posted on NASTT website following No-Dig Show. (See the 2021 presentations online at <https://talk-trenchless.nastt.org/home>.)
- Winner's photos will be shared across NASTT social media channels.
- Winners and finalists who are NASTT members receive a digital ribbon on their NASTT online community profile.

If you have any questions, contact Carolyn Hook at [chook@nastt.org](mailto:chook@nastt.org)

# NASTT Membership

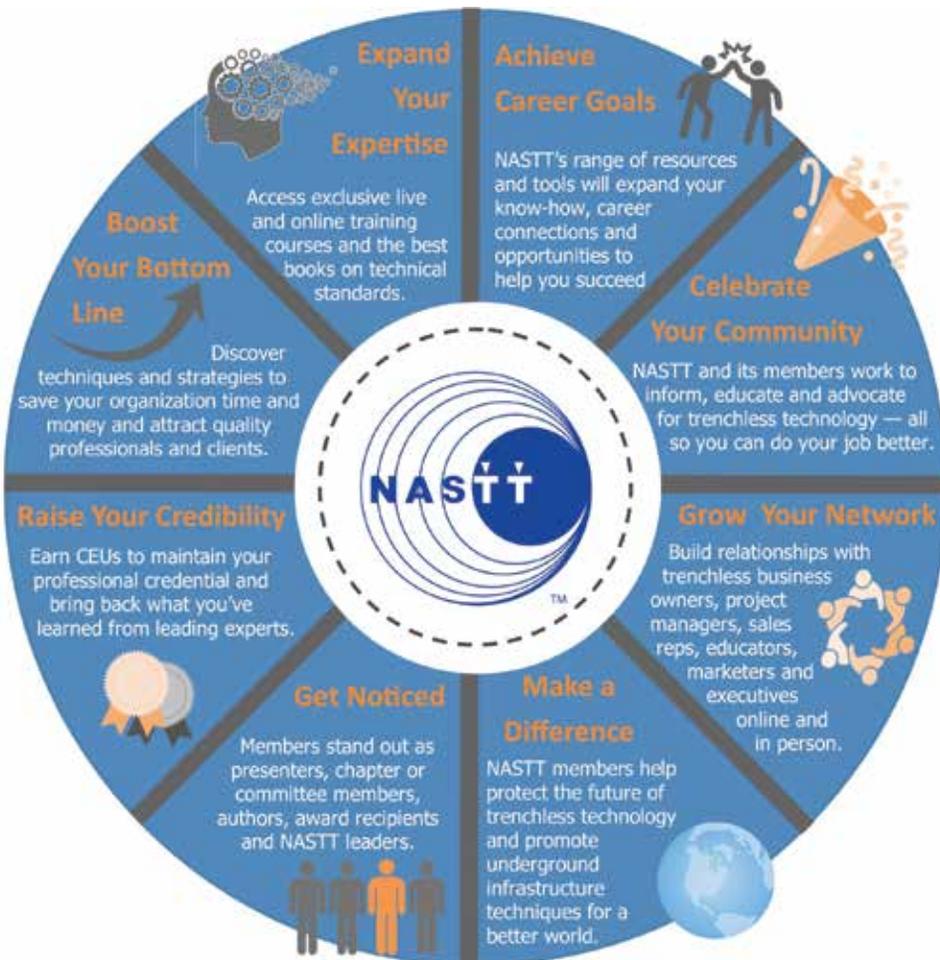
*“NASTT membership allows me to learn about the latest technologies in the industry. Because of NASTT I have a pretty stacked tool belt that helped me bring innovative approaches to addressing infrastructure concerns both as a municipal consultant and in the public sector. And experience with trenchless technologies helped give me a “leg-up” over other candidates for the position I currently hold.”*

– Eric Schuler, City of Oneida

## Who are NASTT Members?

From small businesses to global enterprises and entry-level, young and future professionals to CEOs and presidents, NASTT equips and empowers its members to thrive in their careers. Across Canada, the United States and now Mexico, NASTT members are connecting over trenchless technology and its related industries.

NASTT has something for everyone connected to the trenchless profession. Looking at professional titles, NASTT members are CEOs, business owners, laborers, professors, sales professionals and more.



*“I joined because with municipalities' underground infrastructure coming to its end of design life during a time when municipalities are consolidating and have limited capital budgets, the only solution to keep things flowing is via trenchless methodologies. NASTT is the place to be – the place to obtain the knowledge necessary to support our municipalities into the future.”*

– Greg Tippett, Stantec Consulting Ltd.

## TOP 5 MEMBER ROLES by TITLE



NASTT is stronger than ever with new and improved programs, services and tools to help expand your know-how, career connections and opportunities. A dynamic range of career content, online member interaction, job resources, educational courses, expertise-building publications, give-back opportunities, career building recognition and networking events are designed to support your specialty area, role and career stage.

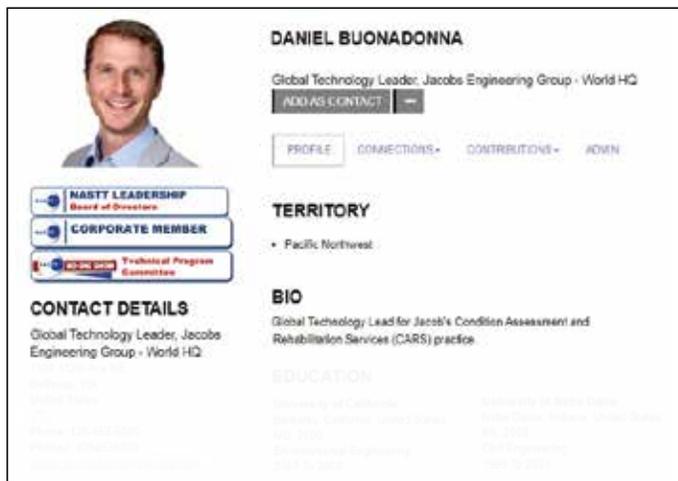
## NASTT Group Membership

Corporations, government organizations, utilities, colleges, universities and training centers can join as a group and be recognized as premier supporters of NASTT and for their commitment to advancing trenchless technology. Group membership includes:

- Group rate pricing on membership
- Bulk purchase rates on books
- Recognition online, at events and in various publications
- Exclusive member-only exhibitor rates at NASTT No-Dig Show.
- Member priced registration at NASTT No-Dig, No-Dig North and select events.
- NASTT Elite monthly industry news, business development tips and management insights.



## NASTT Member Directory



NASTT members can find contact information for members in the searchable NASTT Online Directory at <https://www.talk-trenchless.nastt.org/home>. Add your photo, bio, work and education history to showcase your professional life, accomplishments, skills and interests.

*“Being a NASTT Group Corporate member gives us credibility in the industry. NASTT is the best trenchless forum in the world to learn trenchless methods and connect with clients and teaming partners. It is the best way for our younger staff to get their training and experience, and to build presentation skills. Whether it’s rehab or new installations, NASTT helps our professionals in both areas.”*

– Kenneth G. Sorensen, Kleinfelder, Inc.

## About the NASTT Member List

NASTT offers special recognition to its Corporate and Government, Utility and Education member in appreciation of their ongoing promotion of NASTT and the industry. The member lists are as of September 2021. Only NASTT members who have elected to have their names listed are included. Do not use this list for purposes such as advertising, solicitations, and mass communications.

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*“I joined NASTT because of the value of its membership and its dedication to bring trenchless technology to the forefront of every project. This is the only organization that brings such a high caliber of engineers, owners, manufacturers, contractors, and students together.”*

*– Alan Goodman, HammerHead Trenchless Equipment*

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**ClockSpring|NRI**  
**John Hepfinger, President**  
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**Gaelyn S. Cunningham,**  
**Senior Marketing Manager -**  
**Pipe Solutions**  
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 ecopipeliner.com



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 elginseparationsolutions.com  
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 ellingsoncompanies.com



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 emagineered.com  
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 hammerheadtrenchless.com  
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 trisales.net

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 trinityproducts.com  
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## Two Cents...

Trenchless North America presents a new column where we ask four NASTT members a question about the industry and post responses to share how trenchless industry professionals are responding to trends, innovations and events. Interested in participating? Contact Carolyn Hook at [chook@nastt.org](mailto:chook@nastt.org).



**No one knows how long the pandemic or the disruptions it caused will last. That means organizations need to learn – both on the fly and after the pandemic ends – to increase their agility and resilience. Whether pandemic related or not, what strategies are you rolling out for your organization to evolve?**



**NATIONAL PLANT SERVICES**  
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**Michelle D. Beason, PE**

Regional Manager, Principal Engineer  
National Plant Services, Inc., A Carylton Company  
Hayward, California

I believe that education, employee retention, and government infrastructure funding initiatives are critical to ensuring the growth and success of our industry. The most important resiliency factor facing National Plant Services, Inc. (NPS), and every company, is employee retention. During times of uncertainty or industry downturn/disruption, employee retention is critical to ensure we don't lose trained employees that will be vital when normal workload levels return. Fortunately, we have always been able to outsource our trained technicians to our sister Carylton companies experiencing higher workloads. The greatest opportunity for the growth of NPS is through innovation and new service offerings. Government funding packages will also help generate and facilitate more critical rehabilitation projects. We at NPS are vocal industry proponents for maintenance and trenchless rehabilitation services. We educate and guide our clients on available technologies that will solve their system maintenance and repair issues, which can be funded through expanded government infrastructure assistance programs.



**CETCO**

**Michael Kleespies**

GM, Drilling– North America  
CETCO | American Colloid Company  
Toronto, Ontario

Like many companies, CETCO Drilling Products has utilized more tools to increase communication with customers and internally. This includes both virtual video platforms as well as the development of online resources for our customers. As we navigate out of the pandemic, these tools coupled with face-to-face visits allow our team to quickly react to any need. We also focused on innovation. Producing new products that allow contractors to increase their drilling efficiency allows CETCO to continue to grow along with the trenchless industry.



**David Ohayon, P.Eng.**  
Market Development Manager  
IPEX, Inc.  
Oakville, Ontario

IPEX is part of the Aliaxis group, a global manufacturer of plastic piping systems focused on delivery of water and energy. Prior to March 2020, Aliaxis was integrating more tools and technology to bring different global divisions together in an effort to enhance collaboration across multiple business initiatives. As such, global teams have been created to enhance innovation and business development across all categories where we participate, including in the trenchless industry. This has primarily been made possible by the accelerated adoption of online video and collaboration platforms such as MS Teams, Zoom and Google Suite.



**Eduardo Ortegon Williamson**  
Director  
FLOW Renovación de Tuberías  
Monterrey, Mexico

The pandemic was disruptive for the industry and particularly for us. It made us rethink the way we were doing business and put us in a permanent "alert mode." This was, for sure, something positive, as it forced us to pursue new opportunities more aggressively. We looked for new customers in markets that we were not actively tracking relying on all the resources and the relationships we could. For our existing customer base, as new necessities arose, we responded with increased flexibility offering new services to meet those needs. Now that some time has passed, we will focus on identifying and nurturing long-term customers and big projects that can provide ongoing business and regular cash flow in order to invest in expanding and serving our clients.



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## Robbins develops Rectangular Rock Mining Machine for Flat Invert

*Successful Employment of Mine Development Machine in Fresnillo, Mexico*

Robbins' latest innovation is making good headway on a non-circular tunnel excavation in hard rock. The rectangular TBM, known as the MDM5000 (standing for Mine Development Machine with dimensions of 5.0 m x 4.5 m) is capable of excavating a flat tunnel invert for immediate use by rubber-tired vehicles. Employed by Mexico's oldest silver mine, Fresnillo Plc, the MDM5000 is boring a mine access tunnel in andesite and shale with quartz intrusions that has defied earlier attempts using roadheaders. The successful operation is the result of extensive discussions between Robbins, who designed and supplied the machine, with TOPO machinery and Fresnillo Plc. View the video of the machine in action here.

"We decided to work with Robbins for their experience. A lot of people have tried to provide these kinds of machines but nobody has done it. Robbins used their experience and their skills to provide us with a rectangular profile machine," said Fidel Morin, Projects Superintendent for Fresnillo Mine.

The technology is not only useful for the mining industry, but also for many applications in civil tunneling. While other machines have been developed for soft ground, the MDM5000 represents the first successful foray into rectangular hard rock tunneling.

"We're very pleased to add non-circular tunneling to our wheelhouse of solutions that continues to include TBMs, conveyors, cutters, and more. We see applications for the MDM wherever a rectangular profile is needed, such as train tunnels requiring a flat invert. In a traditional circular tunnel, the invert is filled or an invert segment is needed, but with the MDM 30 percent less rock is required to be removed from the profile," said Robbins President Lok Home.

With more than 1,700 m of advance thus far at rates up to 52 m in one week and 191 m in one month, the MDM is significantly faster than drill & blast excavation. "We're making history. Fresnillo is always looking for new technology, and we believe that the usage of the MDM5000 is going to be something extremely successful, not only for our company but also for the industry," said Morin.

The MDM5000 has undergone major component enhancements during the course of its successful bore at Fresnillo mine. It was first transported to the -695 m level of the mine and underwent final assembly and launch in a cavern, where sections of the MDM were moved by crawlers and pieces were lifted by hoist. The machine is now boring a 270-degree spiral to end above the original tunnel. It will then be backed up to the original tunnel and continue driving straight ahead.



*The MDM5000 (standing for Mine Development Machine with dimensions of 5.0 m x 4.5 m) is capable of excavating a flat tunnel invert in hard rock.*



*Developed by Robbins for use in rock up to 200 MPa UCS, the MDM5000 excavates with a reciprocating cutterhead and swinging cutterhead motion to create a rectangular cross section tunnel.*



A crew member operates the MDM5000 in Fresnillo, Mexico from a state-of-the-art, air-conditioned control cabin using touch screen technology.



Robbins Field Service personnel inspect the cutting face of the MDM5000 tunnel operation. To date, the machine has bored more than 1,700 m at rates up to 52 m in one week and 191 m in one month.



The MDM5000 is particularly useful wherever a rectangular profile is needed, such as train tunnels requiring a flat invert. The rectangular profile requires 30% less rock to be removed as compared with a circular cross section. PHOTO CREDIT: FRESNILLO PLC

Developed for use in rock up to 200 MPa UCS, the MDM5000 utilizes disc cutter technology proven on traditional, circular TBMs. During excavation a reciprocating cutterhead and swinging cutterhead motion create a rectangular cross section tunnel.

The MDM offers a number of advantages over drill and blast. MDM tunneling has advance rates roughly twice those of a drill and blast heading, and results in smooth tunnel walls, less overbreak, and minimized ground support. The increased advance

rates are partly due to the machine's continuous progress, unlike drill and blast operations where crews must exit the tunnel during blasting for safety. In addition, simultaneous ground support installation further increases overall advance rates compared with drill and blast operations that must install ground support sequentially.

View the machine boring at Fresnillo mine:  
<https://youtu.be/mgFopWaf220>



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## Total Equipment, Inc. Expands Vermeer Industrial Representation in the Caribbean, Rebrands to Vermeer Caribbean

Total Equipment, Inc., a full-line Vermeer Industrial dealer headquartered in Puerto Rico, today announced it has acquired the rights from Vermeer Southeast to represent the Vermeer Industrial product line in over 20 islands south of Cuba, from Jamaica to Trinidad & Tobago, and including the ABC islands (Aruba, Bonaire and Curaçao).

Under the leadership of Charles de Armas, Total Equipment has represented Vermeer Corporation's sales, service, and parts in Puerto Rico since 2014. With this acquisition, Vermeer Total Equipment's name will be discontinued, and the new entity will conduct under the brand name of Vermeer Caribbean under the leadership of Total Equipment, Inc. Vermeer Southeast will keep ownership and continue to serve the territories of Turks and Caicos, Cayman Islands, Bermuda, and The Bahamas.

"As we expand our representation of Vermeer into new territories, we are excited to continue serving the customers who depend on us today in Puerto Rico, Dominican Republic, US Virgin Islands and Haiti, while also partnering with the professionals who are doing the important work to drive progress in the other islands of the Caribbean" said Charles De Armas, Total Equipment, Inc owner and Vermeer Caribbean dealer principal. "This is an exciting chapter for us as we build on our strong legacy in the region and grow our footprint under the new Vermeer Caribbean brand."

De Armas has been in the equipment industry for more than 30 years. He began his career by following the steps of his father, Jose de Armas, who founded in 1965 Compresores & Equipos Inc. (C&E), which grew into a well-known rental equipment

company in the southern United States and Caribbean. In 2008 Charles assumed leadership of the organization under the Total Equipment Inc. name.

As Vermeer Caribbean expands its territory, the dealership will offer the full line of Vermeer industrial equipment and full-service operations in the region with current company headquarters in Puerto Rico, a commercial office in Dominican Republic and future investments for service centers and inventory in selected islands in the region.

"Total Equipment Inc. and Vermeer Southeast have been great partners known for providing dependable support to Vermeer customers across the Caribbean islands for some time," said Herb Waldhuetter, managing director of Vermeer Latin America. "With significant infrastructure and natural resource management investments being made across the region, we are excited for what this new alignment and the investments being made across these two dealerships will do to give our customers an even stronger network of Vermeer equipment, service and support they need to get important work done in smart, efficient ways."

### About Vermeer

Vermeer delivers a real impact on the way important work gets done through the manufacture of high-quality underground construction, surface mining, tree care, environmental and agricultural equipment. With a reputation for being built tough and built in a better way, that equipment is backed by localized customer service and support provided by independent dealers around the world.



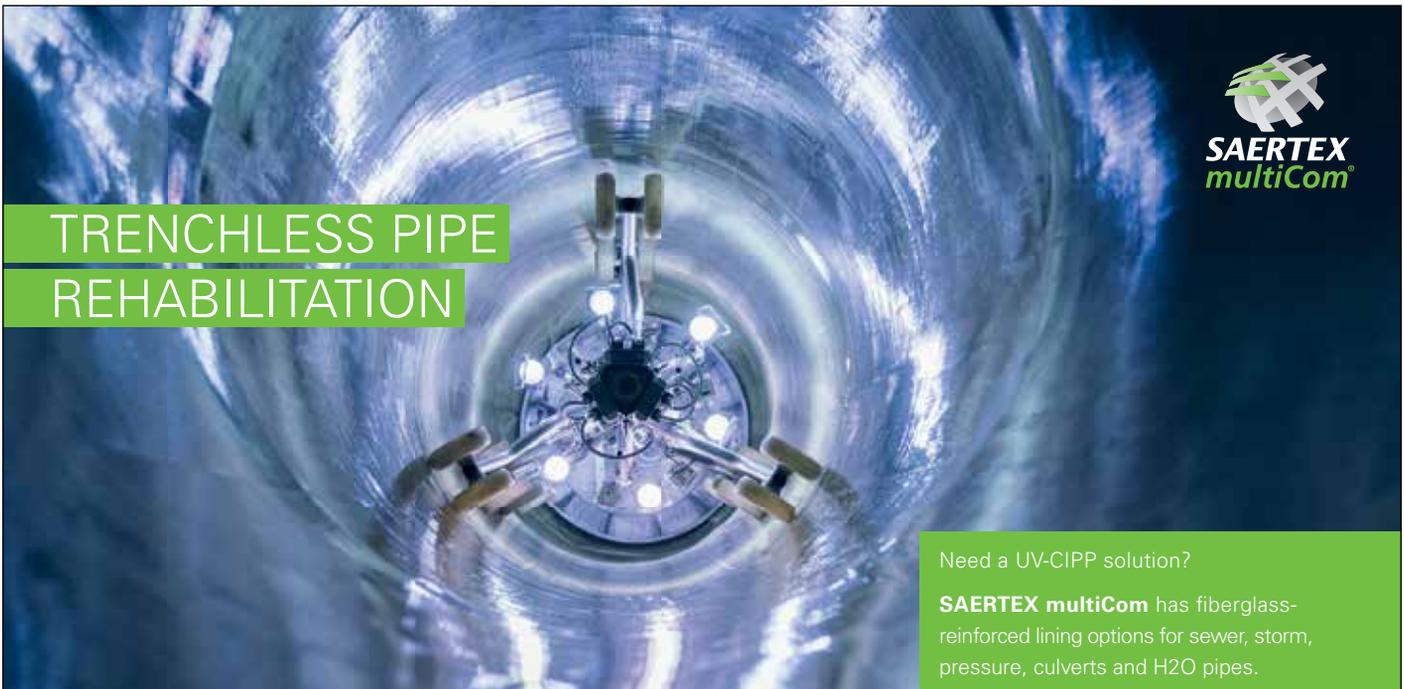
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## Stark Manufacturing Workforce Partnership Certified

Barbco, Incorporated is pleased and honored to share the press release from the Stark County Manufacturing Workforce Development Partnership announcing that the SCMWDP has been officially recognized by the Ohio Manufacturer's Association (OMA) as its fourteenth manufacturing industry sector partner.



Shown are the 4 founding manufacturing members of the SCMWDP. Pictured left to right are: Thomas Schmidt from Barbco Inc., Mike Hoffman from Lindsey Precast, Jim Batchelder from M.K. Morse and Allen Green from H-P Products Inc.

Barbco's Thomas W. Schmidt is a co-founder and current Vice President of this esteemed collection of local manufacturers. Mr. Schmidt started laying the groundwork for this organization in 2019 when he reached out the Canton Regional Chamber of Commerce, the Stark Economic Development Board, MAGNET, and OMA concerning his desire to get local manufacturers to pool their resources together to share industry best practices and to collaborate on projects of mutual interest and benefit.

### About Barbco, Inc.

Barbco, Inc. ([www.barbco.com](http://www.barbco.com)) is HDD manufacturing company based in East

Canton, OH. The company's line of Auger Boring Machines, its FlexBor and TriBor technology position the company to continue its leadership position in developing superior equipment that meets strict environmental guidelines ensuring a better, safe environment.

Barbco continues its relentless pursuit and commitment to build environmentally safe and innovative equipment. To that end, Barbco also received yet another patent for the technologically advanced and environmentally safe FlexBor tooling and technology.



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IPP Solutions' first product was a polyurea two-part resin which was highly successful. As part of a continuing effort to constantly bring new and better products to customers, IPP is excited to announce the introduction of a new polyurea epoxy hybrid resin **PipeCaster Flex Aqua** - a breakthrough in protective coating technology with one of a kind tri-hybrid chemistry **PipeCaster Flex Aqua** protects infrastructure from chemical and microbial attack while remaining safe and stable for waste and potable water lines. Not only can this Epoxy resin withstand the harshest and most severe

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wastewater environments it is also approved for potable water systems. **PipeCaster Flex Aqua** is certified as a USDA bio-based product and is ANSI 61 certified for potable water applications. The new product has been put through extensive testing in (SWAT) severe wastewater analysis testing ASTM G 210. **PipeCaster Flex Aqua** has been tested and proven in many various applications including concrete, steel, water and wastewater lining, potable water tanks, reservoirs, basins, and piping, primary and secondary containment clarifiers, digesters, aquatic wildlife habitat and concrete waterproofing.

While spray lining for small diameter pipe is still in its infancy the technology is exploding into the marketplace with demand for installers and applicators accelerating daily. IPP solutions is committed to bringing you only the very best products and solutions. You can sleep at night knowing that the equipment you use and the resin you install are manufactured in the United States with the best technical support in the business and replacement parts readily available. IPP Solutions is committed to helping their contractors achieve success in the marketplace every day.



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### Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

Joe Royer, GeoTree Solutions, LLC, Spartanburg, SC  
 Bill Sharpe, Inland Pipe Rehabilitation, LLC, Columbia, SC

#### 1. ABSTRACT

In the fall of 2017, the City of Columbia, South Carolina placed a publicly bid project for major upgrades to a critical water treatment plant (WTP). The scope of work included the rehabilitation of multiple existing brick arch storm water culverts ranging from 4'x6' to 8'x8'. Columbia Water did a comprehensive investigation of the rehabilitation options available, including a 2012 pilot study, and selected a geopolymer mortar spray-applied system as the means for structural rehabilitation. The project consisted of three separate culverts, originally constructed in the 1820s within the treatment plant, that carried stormwater runoff underneath the emergency water reservoir, clear well, and canal before discharging into the Broad River. This paper includes a summary of the rehabilitation technology selection process along with details of the special provisions in the specifications; the design and rehabilitation of the culverts which occurred over a 3-week period; an overview of the quality control performed as part of the project; construction details; and lessons learned.

#### 2. INTRODUCTION

The City of Columbia is the capital of South Carolina and is located entirely within Richland County. The Columbia Canal Water Treatment Plant, along with the second Lake Murray Water Plant combine to make up the major treatment operations for Columbia Water. Columbia Water maintains the drinking water treatment, distribution and storage systems that services the City of Columbia and major portions of Richland County, some parts of Lexington County, and other local communities. The combined Columbia Canal and Lake Murray plants have a 150 MGD capacity and



# COLUMBIA CANAL BRICK ARCH TUNNEL GEOPOLYMER LINING IN SOUTH CAROLINA

## AUTHORS

**Joe Royer**

GeoTree Solutions, LLC  
 Spartanburg, SC

**Bill Sharpe**

Inland Pipe Rehabilitation, LLC,  
 Columbia, SC

## 1. ABSTRACT

In the fall of 2017, the City of Columbia, South Carolina placed a publicly bid project for major upgrades to a critical water treatment plant (WTP). The scope of work included the rehabilitation of multiple existing brick arch storm water culverts ranging from 4 x 6 feet to 8 x 8 feet. Columbia Water did a comprehensive investigation of the rehabilitation options available, including a 2012 pilot study, and selected a geopolymer mortar spray-applied system as the means for structural rehabilitation. The project consisted of three separate culverts, originally constructed in the 1820s within the treatment plant, that carried stormwater runoff underneath the emergency water reservoir, clear well, and canal before discharging into the Broad River. This paper

This paper was awarded Paper of the Year - Rehabilitation at the 2021 NASTT No-Dig Show in Orlando. NASTT No-Dig Papers are available for download, free to members, at [www.nastt.org](http://www.nastt.org)

includes a summary of the rehabilitation technology selection process along with details of the special provisions in the specifications; the design and rehabilitation of the culverts which occurred over a 3-week period; an overview of the quality control performed as part of the project; construction details; and lessons learned.

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

## 2. INTRODUCTION

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In 2017 the City of Columbia began a nearly \$45 Million overhaul and renovation of its downtown Columbia Canal Water Treatment Plant. The upgrades of the WTP were in addition to the project to repair the adjacent Columbia Canal, which breached during the historic flooding of October 2015. This 100-year flood turned out to be 10 times worse than expected and caused the greatest crisis in the water department's history. The historic weekend deluge saw more than 24 inches of rain and flooded most of the metropolitan area, claiming nine lives in Richland County alone and causing more than \$500 Million in damages. (LeBlanc, 2016). During the flooding the nearly 200-year-old Columbia Canal wall gave way, forcing the first ever system-wide, boil-water advisory. Costs of repair quickly grew to \$100 Million. The levels of the Broad and Congaree rivers rose more than 12 feet above normal levels and water rushed into the Columbia Canal. Dating back to the 1820s, the canal once served as a shipping lane for cargo. A hydroelectric plant was added in the 1890s, which was still supplying power to the grid up to the time of the flood. The canal is also the source of water to the treatment plant's 60-million-gallon reservoir. While

a temporary dam was installed by the National Guard to restore the City's water supply, a long-term rehabilitation solution was required to restore and service the needs of the community.

This paper reviews the history of the Columbia Canal, the adjacent water conveyance systems and the Water Treatment Plant, and the rehabilitation of critical sections of the water conveyance tunnel using a spray-applied geopolymer mortar. It includes a review of the design, preparation and rehabilitation of the conveyance tunnel, lessons learned and quality control for the project.

## 3. TUNNEL HISTORY & REHABILITATION OPTIONS

The City had known that the canal was a critical point of concern and had been working to understand and test rehabilitation options since the late 1990s. While sections of the canal are open channel, other sections included brick arch tunnels that range in size from 4 x 6 feet to 8 x 8 feet and are used to carry runoff under the emergency water reservoir prior to discharge into the Broad river. These sections fell under the operation of the

water treatment plant specifically and were not part of the larger repair of the open channel canal.

The existing storm water conveyance tunnels were originally constructed of brick and granite arched pipes as shown in Figure 1. The City began to investigate the options for restoration and rehabilitation of the tunnel, many of which were quickly decided to either not be feasible or practical as a repair. CIPP was ruled out due to both the size and the shape of the tunnel, and it was determined slip-lining would restrict the area of flow too greatly due to the changing size and shape of the structure. They also decided against other custom-grouted liners due to cost, lead time, and construction duration.

In 2011, the City learned of a new technology, geopolymer mortar spray-applied rehabilitation, that was being marketed to the City by an existing contractor, Inland Pipe Rehabilitation (IPR). The technology offered a geopolymer mortar to structural repair and line large diameter structures. Based on the timing, constructability and cost consideration, the City decided to do a pilot project using the technology.



Figure 1. Internal view of the existing granite and brick tunnel prior to rehabilitation

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina



Figure 2. Completed pilot project example after installation (left) and 5-year inspection (right)

## 4. 2012 PILOT PROJECT

In late summer of 2012, the City of Columbia under Pizzagalli Construction Company, the general contractor for the wastewater treatment plant rehabilitation, sub-contracted a 440 linear foot section of 72 x 60-inch concrete and stone tunnel to IPR. It was the City's first project with spray-applied geopolymers and offered the City a long-term look at the technology. Prior to specifying the remainder of the storm water conveyance tunnel running under the WTP, the City conducted a complete inspection of the pilot project and found the structure to be unchanged since its installation five years prior. Figure 2 shows a side by side comparison of the post-construction inspections completed in 2012 and a subsequent inspection conducted in 2018.

## 5. GEOPOLYMER ADVANTAGES AND DESIGN METHODOLOGIES

Geopolymer is a term originally coined by French researcher Joseph Davidovits to describe a class of "cement" formed from aluminosilicates. While portland cement (OPC) relies on the hydration of calcium silicates, geopolymers form by the condensation of aluminosilicates. The kinetics and thermodynamics of geopolymer networks are driven by covalent bond formation between

tetravalent silicon and trivalent aluminum. The molar ratio of these key components along with sodium, potassium and calcium have been shown to affect set-time, compressive strength, bond strength, shrinkage, and other desired properties. In various parts of the world, this type of material is also industrially known as "alkali-activated cement" or "inorganic polymer concrete." (Davidovits, 2011) Geopolymers provide comparable or better performance to traditional cementitious binders in terms of physical properties, such as compressive or tensile strengths, but with the added advantages of significantly reduced greenhouse emissions, increased fire and chemical resistance and reduced water utilization. (Buchwals, 2006) Historically, trial applications of geopolymers were first used in some concrete applications by Glukhovskiy and co-workers in the Soviet Union post-WWII; the geopolymer was at the time known as "soil cements." (Alonso, 2001) The use of geopolymers in modern industrial applications is becoming increasingly popular based on their intrinsic environmental and performance benefits.

The structure of a geopolymer is a cross-linked inorganic polymer network consisting of covalent bonds between aluminum, silicon and oxygen molecules

that form an aluminosilicate backbone with associated metal ions. While any specific geopolymer structure, such as the one represented in Figure 3, will be significantly more complicated based on the chemical makeup of the starting raw materials, the generic structure shown provides an excellent representation of how a geopolymer network is constructed. In contrast, OPC is a hydrated complex of small molecules that are not covalently bonded but associated. This is shown in a simplified structure in Figure 4. OPC itself is sufficiently complex; the structure shown in Figure 4 is only a basic representation of the molecules. No long chain, covalently bonded backbone or network structure exists in standard cementitious materials.

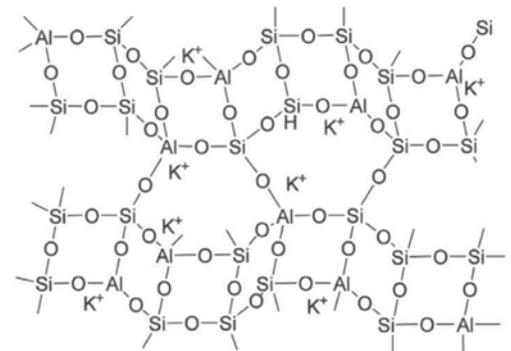


Figure 3. Example of aluminosilicate molecular geopolymer structure (Davidovits, 2011)

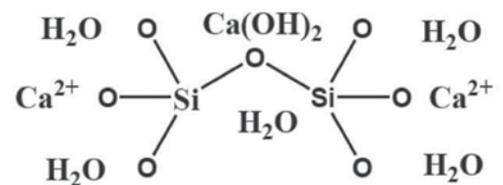


Figure 4. Simplified example of molecular structure of hydrated OPC

Geopolymers for trenchless pipeline repair have been commercially available since 2011. These materials are typically formulated for field performance requirements, specifically the physical and chemical requirements for rehabilitating sewer and stormwater structures, which are defined by the pipeline owner or engineering consultant. Water is added

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

ABSTRACT

Test Method	Property	Duration	Typical Minimum Values
ASTM C39	Compression Strength	1 Day	2500 psi
		28 Day	8000 psi
ASTM C78	Flexural Strength	1 Day	600 psi
		28 Day	1200 psi
ASTM C496	Tensile Strength	28 Day	800 psi
ASTM C666	Freeze Thaw	300 Cycles	98%
ASTM C882	Bonding Strength	1 Day	900 psi
		28 Day	2500 psi
ASTM C1090	Shrinkage	28 Day	0.00%

Table 1. Example Geopolymer Mortar Physical Properties

to the geopolymer at the job site where the mix is then centrifugally, or hand sprayed inside a properly prepared existing structure. The exact formulation of most products is considered a trade secret, but geopolymers contain a mixture of the standard materials that are used in the production of calcium-aluminosilicates. Other components include, but are not limited to, blast furnace slag, reactive silicas, metal oxides, mine tailings, coal fly ash, metakaolin, calcinated shale, natural pozzolans and natural/processed zeolites. (Koo, 2015) Additional bio-based admixtures are included in the formulation to allow the composite material to set-up quickly and easily hydrate with a single addition of water. The “just add water” aspect of this class of geopolymer has been specifically developed to avoid typical alkaline activation mechanisms and the order of addition complexities of traditional geopolymers, which have significantly limited the ability of most contractors and asset owners from using geopolymers commercially. The material is mixed the same as standard cementitious material and no special curing or top coating is needed in most standard applications. A summary of the physical

properties of geopolymers required for sewer rehabilitation is detailed in Table 1.

While no international standard for design of spray-applied liners exists, significant scientific work has been presented and published on the topic specific to geopolymer liners. First and foremost, it is well accepted that geopolymer liners behave in either a semi-rigid or rigid method, and because the rigid models are more conservative, they are often preferred for use. Geopolymers do not behave as flexible pipes and therefore standards such as ASTM F1216 which are based on flexible pipe design methodologies, or other similar standards, that rely on buckling of the structure as a failure mechanism are not applicable. (Royer, 2018)

The most comprehensive work on design methodologies and actual testing of completed structures for spray-applied systems has been conducted on geopolymer materials. The critical concern for design is the generation of initial cracks inside the structure in a longitudinal direction, as this is the structural failure mode that is needed

to be analyzed. (Garcia, 2015). Previously published work has shown that the critical design factors should be the ASTM C78 Flexural Strength value of the geopolymer. It is important to understand that while many in the industry are familiar with the design methods contained in ASTM F1216 which rely on a ASTM D790 measurement of the flexural elastic modulus this is not equivalent to the elastic modulus values that are typically testing for geopolymer or other cementitious materials under ASTM C469. The elastic modulus of rigid cementitious materials is measured in compression and are several orders of magnitude larger than the flexural elastic modulus of plastic materials. No standard exists to measure the flexural elastic modulus of geopolymer or other cementitious materials as it is typically not a controlling design parameter. It is critical to understand this variation in measurement and that elastic modulus values obtained by ASTM D790 for flexible plastic materials cannot be compared or substituted for elastic modulus values obtained by ASTM C469 for rigid cementitious or geopolymeric materials.

The design for the Columbia Canal Water Conveyance Tunnel project was based on previous research that showed a conservative design method for this type of structure could include an assumed flexural moment at the internal side of the arched crown. This methodology is based on a moment analysis of a partial ring where the maximum moment at the crown is  $0.0062Pr^2$ , where P is the pressure of the distributed beam load applied (Watkins, 2000). The flexural strength  $SF = Mc/I$ , where  $I = t^3/12$ ; where c is the distance from the inner surface to the neutral axis of the liner (lever arm). Typically, in a new pipe the neutral axis will be found at the center of the pipe wall. However, because the load transfer between the existing structure and the cement mortar liner is difficult to quantify, it has been assumed that  $c = t$  (i.e. the neutral axis is at the interface between the liner and the host pipe), which is a conservative assumption. Where N is the

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

$$t = \sqrt{\left(\frac{0.0744q_t r^2 N}{S_F C}\right)}$$

(1)

safety factor, C is the ovality reduction factor presented in ASTM F1216 to account for ovality of the existing host pipe and  $q_t$  is the total load on the structure. (Royer, 2019)

## 6. PROJECT BIDDING & SPECIFICATION

In order to expedite funding of the conveyance tunnel rehabilitation, the scope was included as part of a competitive low-bid project for a \$45 million plant upgrade. Inland Pipe Rehabilitation (IPR) was selected by the low-bid general contractor, Adams-Robinson, based largely on three factors – prior experience with the pilot project on this conveyance tunnel, good standing relationship with the City, and proximity of their office to the jobsite to reduce mobilization costs.

Based on the applicable loads and physical properties of the geopolymer mortar the design thickness was determined to

be 1.5 inches for the 54 x 66-inch pipe sections and 2.25 inches for the 96 x 96-inch sections. The design was prepared by a registered professional engineer in the State of South Carolina as required per the contract specifications. An example of the as-built drawings for the existing tunnel found in the bidding specification are shown in Figure 5.

## 7. PROJECT CONSTRUCTION & BY-PASS

Once the project was awarded to IPR, the project team mobilized to the job site in June of 2019. The contractor chose GeoSpray® geopolymer mortar produced by GeoTree Solutions as the lining product. The full project consisted of lining 120 linear feet of 54 x 72-inch arched brick pipe and 455 linear feet of 96 x 96-inch arched brick pipe. While the bidding specifications showed a brick structure, much of the existing material had granite blocks in the lower section of the pipe and brick in the arch. Many sections had severe deterioration. Examples of the existing pipe conditions can be seen in Figures 6 & 7. In order to apply a geopolymer liner, all active water flow must be stopped, including infiltration. The existing structure had in some cases nearly 24 inches of granite or brick, this material had either

significant areas of missing mortar or areas where mortar was likely never present. To stop the active infiltration, injection grouting with hydrophobic grouts was performed in problem areas. Additionally, once grouted and cleaned, the entire structure was pressure washed and prepared for lining.

Prior to any work starting a temporary bypass was installed. At the North tunnel and East tunnel locations a retention pond was built with sandbags upstream of the tunnel. A two-inch electric submersible pump was dropped into the pond. The discharge of the pump was attached to a two-inch PVC pipe, which was attached to the brick wall of the tunnel for 70 feet discharging the water into the pipe downstream beyond the repair area. All voids in the floor were drained from upslope to down slope, then low strength flowable fill was poured into the voids to level the existing conveyance tunnel floor. Next the two-inch PVC pipe was dropped to the floor until the walls were hand sprayed with the geopolymer repair mortar then reattached to the tunnel wall while the floor was then hand sprayed with the geopolymer repair mortar.

At the South tunnel a retention pond was built with sandbags upstream of the manhole in the clear-well (our access point) and upstream of the tunnel repair area. A 6-inch Godwin HS 150mm hydraulic pump was installed at ground level at the access point with 40 feet of suction hose attached. Two-hundred feet of rubber discharge hose was attached to the pump head inside the manhole and discharged into the canal. All voids in the floor were drained from upslope to down slope then flowable fill was used to fill voids and level the tunnel invert. These pumps ran until the linear application was complete.

At the downstream discharge to the river a large sandbag dam was constructed in a ditch between the river and the tunnel to keep a possible rising river out of the tunnel. The contractor installed 3-inch and 4-inch pumps with 30 feet of suction hose in the ditch and 150 feet of suction hose

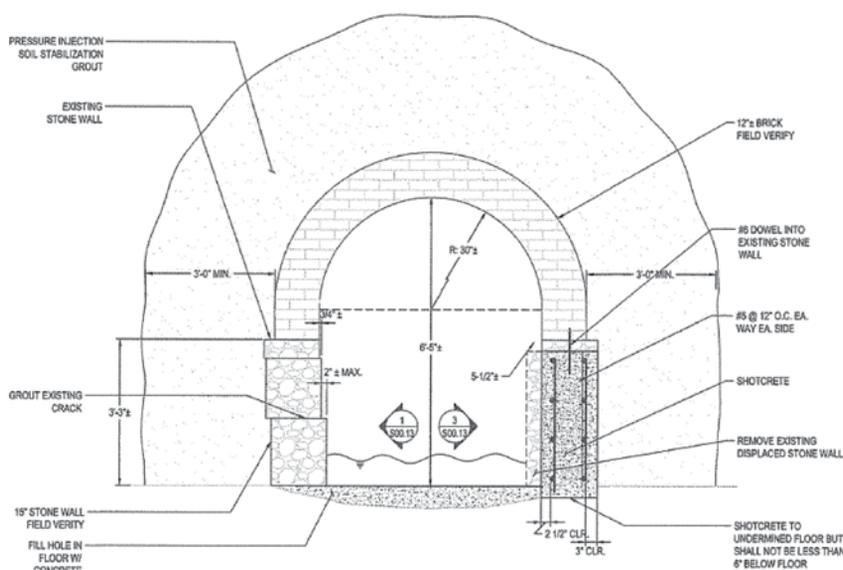


Figure 5. Example of specification drawings for Columbia Canal Tunnel Lining Project

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

ABSTRACT



Figure 6. Existing conveyance tunnel invert with significant erosion of brick and granite



Figure 7. Example of large cracks in existing tunnel

was installed to carry water to the river with filter bags attached to the ends. All pumps were monitored and checked around the clock and ran until the lining was completed.

One of the more challenging aspects of this rehabilitation was the section that runs underneath the treatment plant that had significant infiltration. The original plan was to use a polyurethane injection grout to provide a protective sheet from the soil surrounding the tunnel. However, the recent flood waters left a portion of the tunnel with no surrounding soil, as it was washed off when the dike was breached. Consequently, the contractor elected to first spray the geopolymer lining, then apply an injection grout between the geopolymer lining and interior brick wall.

The project was divided into three sections. The first was approximately 455 linear feet and the other were each approximately 60 linear feet. The first step of the application was to pour a 2-foot thick floor to the structure with a low strength (3000 psi) compressive strength flowable fill concrete. This was necessary to smooth and level the full section of the tunnel floor, allowing improved hydraulics and facilitating hand-sprayed lining operations. Pouring the floor for the whole project

length took two days. Preparation and grouting of each of the sections took approximately one to two days per segment. The finished invert pour is shown in Figure 8.

Once the floor was poured the conveyance tunnel was prepared to receive the lining. The contractor hand-sprayed the geopolymer mortar to create the required design thickness. The material was pumped up to 500 feet after being mixed on the surface, and the thickness was built up over several

applications. Typically, for hand-spray applications, material will first be applied on the tunnel wall near the invert, then on the vertical wall and then on the crown. The final application being applied to the invert. One of the key advantages of this specific geopolymer mortar is that it bonds chemically to itself and doesn't allow for the formation of a cold-joint which may occur on multi-layer applications of other cementitious materials. (Royer, 2018) The 455 linear foot section took eight days to spray and the other two sections took



Figure 8. Completed 24-inch thick poured concrete floor to stabilize the flow and smooth the floor

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina



Figure 9. Hand spray application of the geopolymer lining



Figure 10. Completed lining of the original 96 x 96-inch brick/granite arch tunnel

less than two days each. Figure 9 shows the hand spray application. The full project construction of the conveyance tunnel rehabilitation was completed in under three weeks. Pictures of the completed linings are shown in Figures 10 & 11. After the liner was completed a pressure grouting technique was used to grout behind the lining and stabilize the soil, this required cutting ports into the lining that were then

repaired with the same geopolymer after the grouting was complete.

## 8. Quality Control and Quality Assurance

As with any project, planning, follow-up, inspection, and quality control/quality assurance are critical to getting the desired and specified product. With

geopolymer linings there are typically three critical measures that are important to ensuring the lining is installed as design and specified: (A) thickness, (B) water content and (C) final geopolymer strength.

### (A) Thickness:

To measure the thickness it is common for the contractor to tap the structure with depth screws or depth indicators that are placed about 1/8 inch below the desired thickness prior to lining. These gauges are placed at frequent spacing and various clock positions within the pipe to provide a visual guide that the proper thickness has been applied when all the gauges are covered in the final application. The thickness can also be gauged by the amount of material used. Contractors typically provide an estimated quantity of material that is needed to apply the desired thickness over the structure. The actual quantity used can be verified by the inspector to ensure that the full amount of material was utilized for the lining.

### (B) Water Content:

Water content, or more specifically water to material ratio, is critical to ensuring that the proper material properties are developed. For the geopolymer product

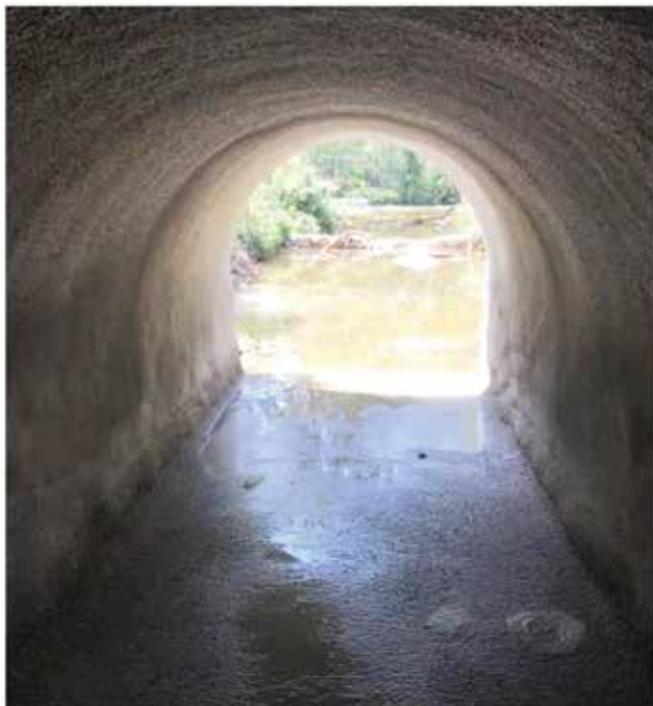


Figure 11. View of the completed lining at the outlet of the tunnel at the Broad River

# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

used on this project, the maximum allowable ratio was 0.20 (i.e. 20 lbs of water per 100 lbs of geopolymer powder). A 3rd party inspector recorded the water settings on the mixing system prior to lining to ensure that excess water was not used.

## (C) Final Geopolymer Strength:

The most critical part of quality control is the measure of fully cured physical properties. It is generally best to measure compressive strength of these samples after 7 and 28 days. The important value is typically 28 days and should meet the required minimums for material properties found in the specification. Materials suppliers should be able to provide the asset owner and engineers with a correlation of compressive strength which easily measured in the field to other physical properties not as easily measured such as flexural strength which is typically the critical design value. It is recommended that ASTM C39 cylinders be used, this measurement is more conservative than the ATSM C109 cube method for geometric reasons. During each day of spraying, six 4 x 8-inch cylinders were taken into the tunnel at the point of geopolymer application. The cylinders were produced by a certified 3rd party technician and tested by an independent laboratory. Two of the

cylinders were tested at 7-days maturity to give an indication of early strength and to verify the testing method, then three of the samples were tested at 28 days. The 28-day samples each exceeded the specified value of 8,000 psi. (The American Concrete Institute – ACI, requires a minimum of three samples for a full test of this type at any maturity time frame.) A final cylinder was held in case of any discrepancies and could be tested at 56 days as necessary.

## 8. 2020 Inspection

An inspection of the completed project was conducted in August of 2020 a full 2 years after the completion of the lining with the contractor and material manufacture. The lining was observed to be performing as designed with no visible cracks or structure concerns. A picture of the lining after 2 years in service is found in Figure 12 and can be compared to the original installation image in Figure 10.



Figure 12. View of the completed lining at the outlet of the tunnel at the Broad River after 2 years of Service

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# Columbia Canal Brick Arch Tunnel Geopolymer Lining in South Carolina

## 9. CONCLUSIONS

The Columbia Canal owned and operated by the City of Columbia has construction dating to the 1820s. In October of 2015 a rain event in excess of the predicted 100-year storm levels damaged the canal and put significant stress on the water treatment plant and the City water supply. After emergency repairs were made by the National Guard to the open channel canal, an overhaul and upgrade of the WTP was undertaken beginning in 2017. One of the key aspects of the project was to rehabilitate and restore the structural strength of the existing brick/granite arched conveyance tunnel that was part of the canal system and diverted storm water away and under the treatment plant. A pilot project with geopolymers that was completed in 2012 supported use of the same technology for the full rehabilitation in 2018. The project included lining approximately 600 linear feet of arched pipe up to 8 feet in size. The preparation and construction of the lining took

approximately 24 days and was completed in the 3rd quarter of 2018.

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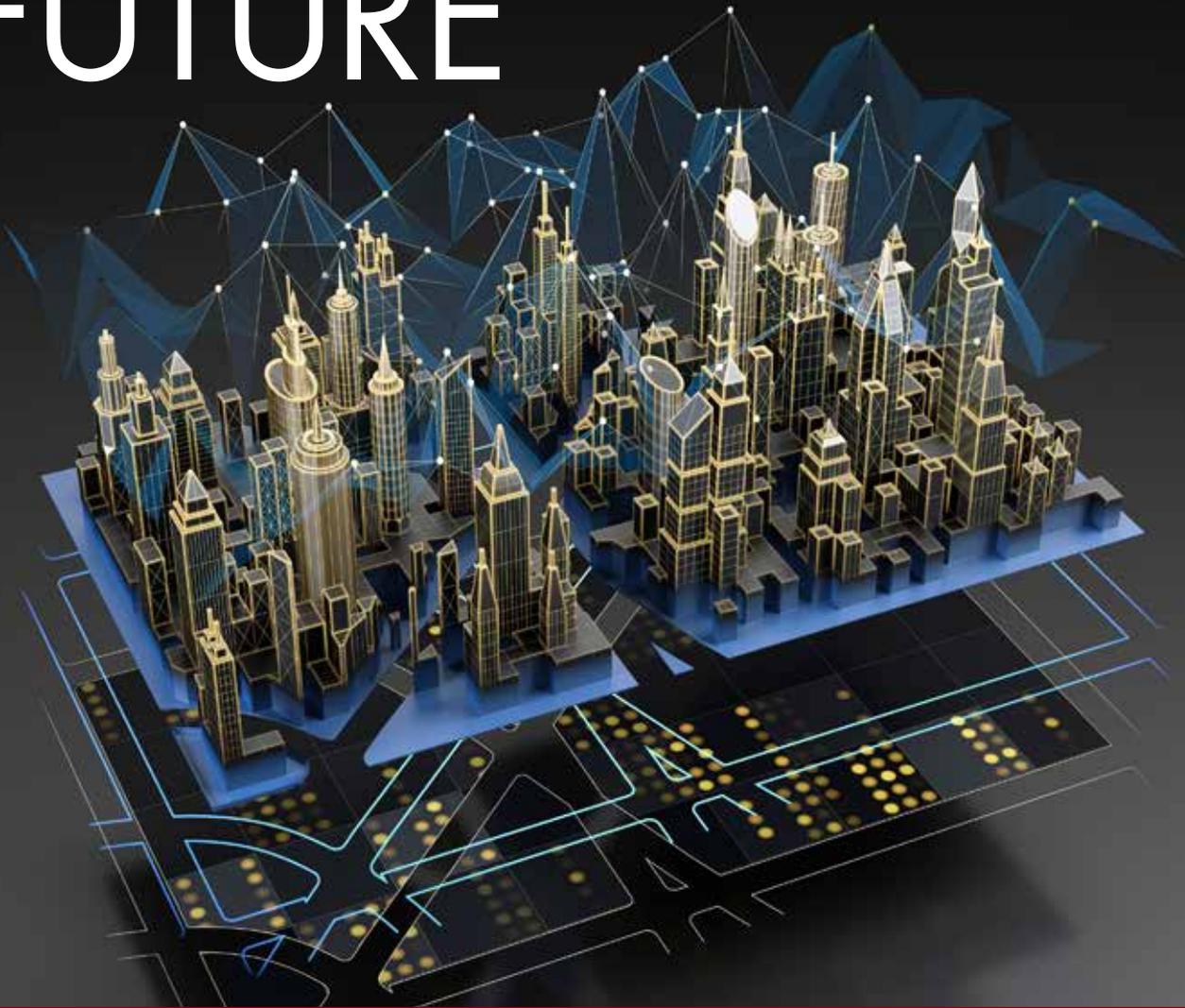
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The NASTT network of 12 regional chapters throughout the United States and Canada offer valuable educational and networking opportunities in your local area. With a single NASTT membership, you're automatically enrolled in the national organization, the international organization (ISTT) and also in your regional chapter. Share your ideas, network with trenchless technology colleagues and find solutions to your construction challenges.



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**British Columbia**  
[www.nastt-bc.org](http://www.nastt-bc.org)

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



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



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Website coming soon!

The Mexico Chapter was established in 2021 and represents the country of Mexico's perspective of the trenchless technology marketplace. MXTT members are currently from the entire country of Mexico.



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Since its inception in 1991, NASTT's No-Dig Show has been the premier North American conference and trade show for the trenchless technology industry. Thousands of professionals from around the globe attend to learn new methods and systems that will save money and improve infrastructure. This conference provides attendees an opportunity to learn trenchless methods, network with peers and gain knowledge from vendors during exhibit hall hours. NASTT's No-Dig Show is the ideal event for municipalities, contractors and engineers.

## Upcoming Conferences, Courses & Events

October 27

### RMNASTT Trenchless Elevated 2021

Denver, CO

November 4

### Mid Atlantic Chapter Webinar

Virtual Event

November 8-10

### No-Dig North

Vancouver, BC

November 15-16

### Northeast Chapter Trenchless Technology Conference

West Point, NY

December 8

### Southeast Chapter Trenchless Technology Seminar

Miami FL

December 10

### ISTT Webinar

Virtual Event



### April 10–14, 2022

Minneapolis Convention Center  
Minneapolis, Minnesota



### April 30–May 4, 2023

Oregon Convention Center  
Portland, Oregon



### April 15-17, 2024

Rhode Island Convention Center  
Providence, Rhode Island



### March 30 - April 3, 2025

Colorado Convention Center  
Denver, Colorado

### What is the cost to exhibit?

NASTT Member Rate:

\$2,300 In-line 10'X10'

\$2,500 Corner/Island 10'X10'

Non-Member Rate:

\$3,800 In-line 10'X10'

\$4,000 Corner/Island 10'X10'

Sponsorships:

There are a variety of sponsorship opportunities for every price range:

- Gala Awards Dinner Event Sponsor
- Closing Luncheon Sponsor
- Mobile App Sponsorship Opportunities
- Pre-Gala Reception Sponsor

To sponsor or exhibit at any of these events, please contact NASTT:

**888-993-9935**

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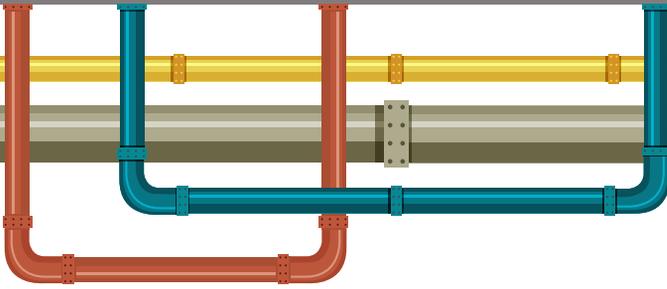
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