EDUCATE • TRAIN • RESEARCH • PUBLISH

TRENCHLESS NORTH AMERICA

The Official Magazine of the North American Society for Trenchless Technology

WINTER 2026 TECHNICAL EDITION

NASTT 2025 NO-DIG NORTH REPORT

NO-DIG NORTH PROJECTS OF THE YEAR

NASTT 2026 NO-DIG SHOW PREVIEW

WINTER 2026
Volume 16 • Issue 1

EDUCATE • TRAIN • RESEARCH • PUBLISH

TRENCHLESS NORTH AMERICA

The Official Magazine of the North American Society for Trenchless Technology

WINTER 2026 – VOLUME 16, ISSUE No. 1

28 NASTT 2025 NO-DIG NORTH IN VANCOUVER THE BEST YET!

Against the scenic backdrop of the North Shore mountains, Vancouver Harbour and historic Stanley Park, the seventh annual NASTT No-Dig North Conference reached a new high water mark for Canada's premier trenchless technology event, with over 1,000 delegates enjoying three full days of networking and and an expanded five tracks of over 80 peer-reviewed presentations.

FEATURES

DEPARTMENTS

A to B PUBLISHING INC.
662 Dudley Avenue
Winnipeg, MB R3M 1R8

EDITORIAL:
Andrew Pattison
204.275.6946
marcomap@shaw.ca

ADVERTISING SALES:
Bert Eastman
204.997.6371
bert@atobpublishing.com

Wayne Jury
204.803.1300
waynej@atobpublishing.com

harper media
your social media strategy & web marketing partner
700 - 200 Main Street
Winnipeg, MB R3C 1A8

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

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

Canada Post Publications Mail Agreement #43839013
Return undeliverable Canadian addresses to: **marcomap@shaw.ca**

WELCOME TO THE WINTER 2026 TECHNICAL EDITION OF TRENCHLESS NORTH AMERICA

Periods of Transition Bring Fresh Perspective

Dear NASTT Members and Trenchless Advocates:

Welcome to the Technical Issue of Trenchless North America! I am so glad to connect with you through these pages during an exciting and important time for NASTT. As Interim Executive Director of NASTT, our organization's focus is simple and unwavering. Our commitment is to YOU, the trenchless technology industry and our NASTT members, and to ensure NASTT continues to support, serve, and elevate the work you do every day.

This technical issue is a celebration of what makes our industry so strong. Inside, you will find articles and technical papers that highlight innovation, problem-solving, and the forward momentum of trenchless technology across North America and beyond. These stories reflect real projects, real challenges, and real progress, and they showcase the expertise and creativity that continue to move our industry ahead. I encourage you to explore these pages and take away ideas you can apply directly to your own work.

Recently we had the opportunity to come together for the NASTT 2025 No-Dig North and International No-Dig conference, presented in partnership with ISTT. The success of this event was a powerful reminder of the global impact of trenchless technology and the value of international collaboration. Seeing professionals from around the world share technical knowledge, lessons learned, and innovative solutions reinforced just how connected our industry truly is. From engaging technical sessions to meaningful conversations on the exhibit floor, the event showcased the strength of our industry on a global stage. (see pgs 28-33)

As we look ahead, there is a lot to be excited about. Planning is underway for the upcoming NASTT 2026 No-Dig Show, and while this is just a light preview, I can share that our team is focused on delivering technical content, revamped networking opportunities, a nearly sold-out exhibit hall already, and an overall experience that truly reflects the needs of our members. Your feedback continues to shape our direction, and we are committed to listening and evolving alongside the industry.

Periods of transition often bring fresh perspective, and this moment is no different. NASTT remains strong, forward focused, and deeply connected to its members. As Interim Executive Director, my priority is stability, transparency, and ensuring that members remain at the center of every decision we make.

Thank you to the volunteers, contributors, and advocates who help NASTT continue to grow and thrive. Your passion and involvement make this organization what it is. I hope you enjoy this technical issue and feel proud of the innovation and impact represented within its pages.

Jessie Clevenger

Jessie Clevenger, Interim Executive Director
North American Society for Trenchless Technology (NASTT)
jclevenger@nastt.org

"An exciting and important time for NASTT."

"NASTT continues to support, serve, and elevate the work you do."

"As we look ahead, there is a lot to be excited about."

PUMP SOLUTIONS FOR EVERY FLUID APPLICATION

When your project demands reliable fluid handling, Sunbelt Rentals provides comprehensive pumping equipment rentals, expert support, and 24/7 service for construction, industrial, and emergency applications. From dewatering to bypass pumping, our solutions ensure efficient fluid handling and maintain project integrity, keeping you on track and within budget.

EXPLORE OUR PUMP RENTAL SOLUTIONS AND SYSTEM DESIGN SERVICES AT SUNBELTRENTALS.COM

SCAN HERE TO LEARN MORE

STRENGTH, DIVERSITY, AND TECHNICAL EXCELLENCE!

Dear NASTT Members, Volunteers and Trenchless Advocates,

On behalf of the NASTT Board of Directors, I want to thank you for your continued commitment to our association and to the advancement of the trenchless industry across North America and beyond. Your engagement, expertise, and willingness to share knowledge are what allow NASTT to remain the leading voice for innovation, education, and collaboration in our industry.

As we begin the new year, I am pleased to highlight the Winter edition of Trenchless ***North America magazine***, which reflects the strength, diversity, and technical excellence of our membership. This issue features a recap of the 2025 No-Dig North & ISTT International No-Dig conference, held in October in Vancouver. This event brought together professionals from across the globe to exchange ideas, showcase innovation, and celebrate outstanding achievements in trenchless technology. The energy, collaboration, and technical depth on display in Vancouver were a testament to the growing global impact of our industry.

This edition also includes full reprints of two outstanding technical papers that highlight the Canadian Project of the Year award winners. These projects represent the ingenuity, problem-solving, and technical rigor that define trenchless solutions. By sharing these papers in full, we continue NASTT's mission to elevate best practices, promote knowledge transfer, and provide our members with practical insights they can apply in the field and in future project planning.

"The leading voice for innovation, education, and collaboration."

In addition to looking back, the Winter issue offers a preview of what's ahead at the upcoming No-Dig Show in Palm Springs, California, taking place March 29 through April 2, 2026. The No-Dig Show remains our flagship event and a cornerstone of professional development for the trenchless community. Attendees can expect a robust technical program, an expansive exhibit hall, and new opportunities to connect with peers, clients, and industry leaders. Whether you participate as an attendee, presenter, exhibitor, or volunteer, your involvement helps shape the direction and relevance of this premier event.

"A cornerstone of professional development."

By popular demand, we are excited to offer a golf tournament in Palm Springs being held on Sunday, March 29. This 120-player scramble is more than just a day of birdies, beverages, and networking; it's a chance to invest in the next generation of trenchless technology leaders. Proceeds of the event will support the NASTT Education Fund, fueling scholarships, student programming, education, and complimentary No-Dig Show attendance to our Student Chapter members of NASTT.

None of NASTT's successes would be possible without the dedication of our members and volunteers. From developing technical content and serving on committees to mentoring emerging professionals and supporting chapter initiatives, your contributions strengthen our organization at every level. I want to thank you for the time, expertise, and passion you bring to NASTT.

As we look ahead, I encourage you to stay engaged, continue sharing your knowledge, and take advantage of the educational and networking opportunities NASTT provides throughout the year. Together, we are advancing trenchless technology and building a stronger, more connected industry.

Thank you for being an essential part of NASTT.

Sincerely,

Greg Tippett

Greg Tippett P. Eng., Board Chair
North American Society for Trenchless Technology (NASTT)

with

Tiffanie Mendez

SUNBELT
RENTALS

Tiffanie Mendez is the National Director of Sales for Sunbelt Rentals, Pump Solutions, and believes the future of the trenchless industry lies in preparing tomorrow's new leaders today. A longtime energetic and cheerful mainstay of the No-Dig Show Planning Committee and Technical Program Committees since 2016, Tiffanie has been particularly passionate about student programs and the student chapters associated with NASTT. Bringing energy and excitement to the cause Tiffanie is a driving force behind the NASTT Education Committee working purposefully to foster the upcoming generation of young trenchless professionals. She recently completed a six-year term serving on the NASTT National Board of Directors, which included time as Secretary and Officer-At-Large, always bringing a "Can Do Attitude with Care".

Fittingly, Tiffanie was awarded the 2022 NASTT Chair Award for Distinguished Service, which recognizes trenchless professionals who have provided NASTT and the trenchless industry with meritorious, prominent and long-standing service. She was acknowledged as a true reflection of what a volunteer can do within NASTT, improving prestige and engagement within the organization. Tiffanie holds a BSBA from Northern Arizona University and an MBA, General Management from California State University, East Bay.

Tiffanie shares her well informed perspective on the current state of the trenchless technology industry, and the bright prospects ahead for the future generation of trenchless technology leadership.

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

I started in irrigation design and sales in Yuma, AZ, working with liquid-handling equipment for agriculture. Attending Cal Poly's ITRC courses from 1999–2001 gave me a strong foundation in hydraulics and pump systems. As our business expanded into industrial markets, those same principles of physics applied to municipal and wastewater systems. That early experience taught me the value of adaptability and collaboration – skills that remain essential for safe, reliable infrastructure.

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

In 2005, I moved to Northern California for a role that combined agriculture and construction sales. I worked closely with contractors on projects ranging from stormwater management to levee restoration. I became fascinated with pipeline rehabilitation and sewer bypass work – an area that was rapidly evolving with new methods and materials. It reinforced for me how innovation, teamwork, and shared expertise drive progress in this industry.

> "Trade schools should offer trenchless-specific programs."

> "Early experience taught me the value of adaptability and collaboration."

How did you first get involved with NASTT? What are some of the goals and initiatives you would like to see NASTT pursue?

My involvement began in the early 2000s, supporting and exhibiting at trade show booths. Later, as a regional sales manager, I coordinated our exhibits for regional NASTT conferences. In 2016, I joined the NASTT program committee and have been active ever since. Looking ahead, I'd love to see NASTT create more student competitions and foster inclusive opportunities for undergraduates. Students represent the future of trenchless technology, and inspiring them early ensures a safer, stronger industry built on shared values.

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?

The industry faces a growing skills gap as experienced professionals retire and fewer young people enter the trade. While engineering and project management roles are holding steady, we need more emphasis on skilled labor. Trade schools

"Our work improves communities and supports safety and sustainability."

should offer trenchless-specific programs so students see the opportunity for meaningful, hands-on careers. Aging infrastructure demands urgent attention, and while technology like AI can assist, it cannot replace the human expertise and teamwork required for safe, complex pipeline rehabilitation work.

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?

We can do better. Outreach should start at high schools, career colleges, and universities to showcase the variety of roles available – technical and physical alike. Many paths lead to rewarding careers in trenchless without requiring advanced degrees. By sharing our vision and values, we can help students see the purpose and stability this industry offers. It will take all of us in industry now committing our time and passion to create this education and awareness for young people and students around trenchless career need and opportunity.

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

The shortage of skilled labor remains our greatest challenge. On the positive side, trenchless methods are now widely recognized as essential for meeting population growth and capacity demands. This acceptance reflects years of collaboration and education across the industry – a shared effort that continues to strengthen our collective future.

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

I value the opportunity to specialize and contribute as a subject matter expert. I am, grateful for the relationships I have built through collaboration – whether with clients, vendors, or peers. The industry relationships are deeply rewarding. Most of all, I appreciate the sense of purpose: knowing our work improves communities and supports safety and sustainability for generations to come.

Using Directional Drilling to Install an Earth Grounding System

Trenchless Grounding™

By: Tim McClure, R&R McClure Excavations Pty Ltd
(USA & Canada Partner: CLAD Trenchless Grounding)

Trenchless Grounding™ is a new system that is changing the way electrodes and conductors are installed within the horizontal layers of the Earth, improving efficiency and resilience for modern electrical infrastructure.

Until now, earth grounding has remained relatively unchanged for the last couple of centuries. Since the mid 1700s an electrode has been driven directly into the ground to electrically connect with the best soil layer. However, the Earths sedimentary layers formed over millions of years do not always favor this method and vertical installations are often subject to partially or completely missing the most conductive layer, leading to high impedance and resistivity. In some cases, hundreds of additional meters and deep driven electrodes are required to achieve the target soil resistivity for an earth grounding system.

Patented in the USA, Australia, Europe and Canada, the Trenchless Grounding System uses directional drilling (HDD) to install the earth system which can be used to connect with many different high voltage (HV) and low voltage (LV) assets including, Power Poles, Transformers, Substations, Energy storage, Single wire earth return systems (SWER) and Communication Towers. It can also be used on renewable energy sites such as Solar, Hydro Electric, Wind and Geothermal energy.

By directing and steering underground, the electrode and conductor can be installed substantially within the geological layer providing the most favorable ground resistivity. The Trenchless Grounding system also measures and tests the total resistivity while installation progresses in real time.

After reaching the target resistance the conductor is connected to the electrical network and energized. As the system does not require a bore exit hole, completion of construction is only required at the point of electrical connection.

Goldfields region of central Victoria Australia has hot summers and is prone to brushfires

Case Study, Australia

The Goldfields region of central Victoria Australia has many different types of geology, including hard packed clay, shale, sandstone, and ironstone with quartz veins. The area is also known for hot summer conditions above +40C degrees, and is prone to bushfires. In winter this area also experiences flooding from heavy rains which creates erosion. R&R McClure was engaged to upgrade and extend the High Voltage (HV) earth grounding on an existing pole-mounted transformer using the Trenchless Grounding system. The site was located on steep terrain with access limited only to within the existing power line easement. The ground conditions consisted of dry clay, sandstone, iron stone and quartz which are known for high grounding resistivity and difficulty installing electrodes.

An all-condition rock drill with dual rods was mobilized to the work site with a 5 blade PDC cutting bit. The drill rig was set up within the existing powerline easement at safe approach distances from existing underground and overhead powerlines.

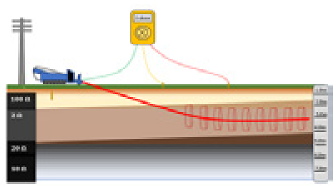
"Efficiency and resilience for modern electrical infrastructure."

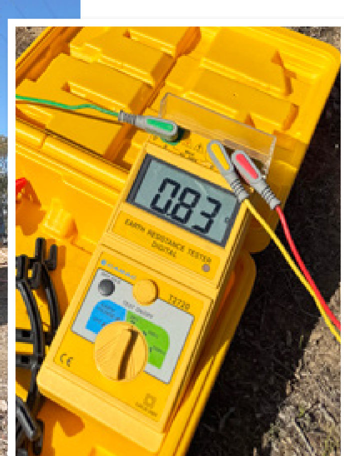
"The system does not require a bore exit hole."

Bare conductor was installed with bentonite, providing stability and electrical connection

Using conventional walkover locating equipment, drilling commenced from the surface. Within 9 meters (29.5 feet) of drilling, while passing through the varying clay and sandstone layers, we started to experience active reduction of resistivity. This means that the layers typically known for the high resistivity were being drilled through, exposing a more favorable geology.

Using the Trenchless Grounding system, real time measurements were taken and the total resistivity was recorded as the installation progressed. At 6 meters (19.7 feet) in depth, the directional drill was steered within the layer providing the lowest resistivity. A total length of 45 meters (147.6 feet) was installed at an optimized length with a final resistivity of 1.0 ohm.





Resistivity measurements were taken as the installation progressed

As part of the Trenchless Grounding system, the bare conductor was installed with bentonite, providing geological stability and electrical connection. The earthing system was then inspected and tested for the final resistivity ready to be energized.

Bakerfield, California, USA

Very Excited working with our new USA Partners!

CLAD

In 2025, Trenchless Grounding was installed for the first time in the USA by our partners CLAD Trenchless Grounding. Using a 6-ton HDD drilling rig and a 19mm(3/4-inch)/2 bare copper conductor, the Trenchless Grounding system successfully achieved a 5 ohm (Ω) total resistivity in sugar sand. The bore hole was stabilized using bentonite for filtration control and pressure grouting of the bore hole.

CLAD Trenchless Grounding is the official Partner covering this Patented technology in the USA and Canada, transforming the way industry installs earth grounding.

***Tim McClure** is from Australia with over 30 years' experience within the electrical, water and communication industries. Known for his hands on expertise and forward-thinking approach, Tim has been pivotal in shaping the Trenchless industry using new techniques and methods. Tim is also the inventor of the Trenchless Grounding system, receiving an Abbott Innovative Products award in Denver 2025 and New Technology of the Year with the ASTT in Melbourne 2025. Tim has also presented papers with the NASTT and enjoys supporting new and technologies within the Trenchless industry that strengthen local communities.*

USA & Canada: www.cladtrenchlessgrounding.com
USA & Canada: admin@cladgrounding.com
AUSTRALIA: tim@trenchlessgrounding.com

NO-DIG SHOW RETURNS TO THE COACHELLA VALLEY IN BEAUTIFUL PALM SPRINGS CALIFORNIA!

MARCH 29-APRIL 2 | PALM SPRINGS, CA
NASTT NO-DIG SHOW 2026

The NASTT No-Dig Show is returning to Palm Springs in 2026, the first time since 2018! Known for its incomparable beauty and stunning scenery, Palm Springs is a unique and highly accessible destination for the world's premiere trenchless technology conference – the NASTT No-Dig Show. The 2026 show promises to be the most successful yet, with 7 tracks of technical sessions over the course of three days, highlighting innovative trenchless projects from around the world. A unique opportunity to connect with the Contractors, Manufacturers, Engineers, Educators, and Utility Owners who have helped shape the trenchless industry. Join us in the beautiful Sonoran Desert to celebrate the continued growth of the underground construction industry.

The Spring/2026 edition of NASTT Trenchless North America will feature a comprehensive overview of the 2026 No-Dig Show including the technical program schedule and full listings of all networking events.

Maureen Carlin, Ph.D. Trenchless & Tunneling Infrastructure Practice Leader at Garver is the NASTT 2026 No-Dig Show Planning Committee Chair. Here is what Maureen has to say about the upcoming conference:

I've been a member of NASTT since 2011 when I was a student, and I'm honored to be this year's Chair of the Show. This is going to be the premier event for No-Dig. I've been to 15 of these and this is looking to be the best of all of them! I'm super excited and proud to support the Western Region of NASTT and to explore all things trenchless in the desert!"

- Maureen Carlin, Ph.D., Garver, 2026 No-Dig Planning Chair

The NASTT No-Dig Show is returning to Palm Springs in 2026 - first time since 2018!

For more information on attending the NASTT 2026 No-Dig Show, visit: www.nastt.org/no-dig-show
Registration is now open and if you register by March 1, you can save with the Early Registration Discount.

PALM SPRINGS CONVENTION CENTER, CA

THE EVENT SPACE

Immerse yourself in the vibrant energy and natural beauty that define Palm Springs as you explore our state-of-the-art venue. Boasting 261,000 square feet of flexible meeting space, our versatile layout boasts spacious exhibit halls, elegant ballrooms, and well-equipped meeting rooms, ensuring every event finds its perfect fit.

NASTT GOLF TOURNAMENT

MARCH 29-APRIL 2 | PALM SPRINGS, CA
NASTT NO-DIG SHOW 2026

- **CIMMARON GOLF COURSE, PALM SPRINGS**
- **MARCH 29, 2026**
- **8:00AM – 1:30PM**

Join us for the NASTT Golf Tournament — a lively and laid-back tee time with a powerful purpose. This 120-player scramble is more than just a day of birdies, beverages, and networking; it's a chance to invest in the next generation of trenchless technology leaders. Proceeds of the event will support the NASTT Education Fund, fueling scholarships, student programming, education, and complimentary No-Dig Show attendance to our Student Chapter members of NASTT.

Let's raise the bar and some funds — one swing at a time.

PLATINUM/PRESENTING
SPONSORSHIP
1 Available

GOLD
SPONSORSHIP
2 Available

SILVER
SPONSORSHIP
3 Available

BREAKFAST
SPONSORSHIP
1 Available

HOLE
SPONSORSHIP
12 Available

TRANSPORTATION
SPONSORSHIP
2 Available

LUNCH
SPONSORSHIP
1 Available

TEE
SPONSORSHIP
SOLD OUT!

AWARD
SPONSORSHIP
2 available

BEV CART
SPONSORSHIP
2 Available – 2 drink tickets

For further information, and
Sponsorship Pricing & Details Contact:
Jessie Clevenger (jclevenger@nastt.org, 440-534-9630)
www.nastt.org/no-dig-show/golf-tournament/

Scan the QR code for golf tournament full details!

Call for Abstracts

SUBMISSION DEADLINE: APRIL 8

The North American Society for Trenchless Technology (NASTT) is now accepting abstracts for its 2026 No-Dig North conference in Calgary, AB at the Calgary TELUS Convention Centre, November 2-4, 2026. Prospective authors are invited to submit a 250-word abstract outlining the scope of their paper and the principal points of benefit to the trenchless industry.

The abstracts must be submitted by April 8 online:

nastt.org/no-dig-north

No-Dig North is owned by the North American Society for Trenchless Technology (NASTT), a not-for-profit educational and technical society established in 1990 to promote trenchless technology for the public benefit. For more information about NASTT, visit our website at nastt.org.

NASTT 2026 No-Dig Show Scholarships Provided to Municipal & Public Utilities

Municipal and public utility scholarships cover registration and accommodations costs for over 150 delegates attending the 2026 No-Dig Show, March 29 - April 2 in Palm Springs, California

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. Over 150 applicants are awarded the scholarship annually, with a total of over 2,000 scholarships since the inception of the program.

Who Do You Want to Meet at No-Dig 2026?

Doing business with municipal agencies and public utilities is crucial to the trenchless industry. NASTT's Municipal & Public Utility Scholarship brings hundreds of decision-maker agency representatives in-person to the No-Dig Show. Since its inception, over 2,000 delegates have been onsite looking for solutions to their infrastructure challenges that you can provide. CONNECT WITH THEM AT NO-DIG!

Register today to secure these future customers! Join us at the Palm Springs Convention Center, March 29 - April 2, 2026. Visit https://nastt.org/no-dig-show to register today!

"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

"I found the sessions interesting and gained a lot of useful information to bring back to my community. I had such a narrow view of Trenchless Technology before the show, and now see it in a clearer fashion and in a larger light. The exhibits were interesting and I found many products or ideas that directly related to what I deal with on a day to day basis."

– Matt Overeem, Village of Wilmette

NASTT 2026 NO-DIG SHOW MUNICIPAL & PUBLIC UTILITY SPONSORSHIPS

Albuquerque Bernalillo County Water Utility Authority
ARROW Utilities
Aurora Water
Baltimore City DPW
Bureau Of Reclamation
Center for Underground Information Research and Education
Central Contra Costa Sanitary District
Cincinnati MSD
Citizens Energy Group
City and County of Honolulu
Department of Environmental Services
Collection System Maintenance
City and County of San Francisco –
Department of Public Works – Bureau of Engineering
City and County of San Francisco Public Utilities Commission
City of Anaheim
City of Aurora
City of Baltimore
City of Bend
City of Chandler
City of Columbus
City of Columbus – Columbus Water & Power
City of Dallas
City of Dallas, Dallas Water Utilities
City of Dollard-des-Ormeaux
City of Durham
City of Eugene
City of Fontana
City of Fort Lauderdale
City of Fruitland, Idaho
City of Glendale, Arizona
City of Glendale, Califorina
City of Greeley, Colorado Water & Sewer Department
City of Haltom City
City of Horace
City of Kannapolis
City of Ketchikan Public Works Department
City of Lancaster
City of Los Angeles
City of Los Angeles – Bureau of Engineering,
Department of Public Works
City of Los Angeles, Bureau of Engineering
City of Lynnwood- Public Works
City of Medicine Hat
City of Memphis
City of Minneapolis
City of Minneapolis Public Works
City of Minneapolis Public Works – Surface Water & Sewers
City of New Bedford, Massachusetts
City of Omaha
City of Omaha Public Works
City of Ottawa
City of Redmond
City of Renton
City of Rochester Hills
City of Saginaw
City of San Jose
City of Simi Valley
City of Ukiah
City of Vancouver
City of Vancouver WA – Public Works
City of Vancouver, WA
Clackamas County – Water Environment Services
Clean Water Services
Colorado River Municipal Water District
County of Santa Cruz
DC WATER
Denver Water
Eastern Municipal Water District
EPCOR Utilities
EPCOR Water Canada
EPCOR Water Services Inc.

Fort Collins-Loveland Water District
Greater Augusta Utility District
Green Bay Metropolitan Sewerage District
Gwinnett County Department of Water Resources
Hillsborough County BOCC
Hillsborough County Government, Public Works Department
Maryland Department of Transportation, State Highway
Administration
Metro Water Recovery
Miami Dade Coty Department of Transportation and
Public Works
Milwaukee Metropolitan Sewerage District
Municipality of Princeton
National Grid
Norwich Public Utliities
Oakland County Water Resources Commissioner's Office
Onondaga County Department of Water Environment
Protection
Orange County Sanitation District
Oregon Department of Transportation
Pacific Gas and Electric (PG&E)
Peel Region
Pima County
Pima County Regional Wastewater Reclamation
Port of San Diego
Public Service Electric and Gas (PSE&G)
Rural Municipality of East St Paul
Saint Paul Regional Water Services (SPRWS)
Salt Lake City Department of Public Utilities
San Antonio River Authority
San Francisco Public Utilities Commission
Santa Cruz County
SD1 (Sanitation District #1) of Northern Kentucky
Seattle Public Utilities
Selma Kingsburg Fowler – County Sanitation District
Snyderville Basin Water Reclamation District
South Fort Collins Sanitation District
The City of Calgary
The Corporation of the City of Markham
Town of Gilbert
Town of Grimsby
Town of Lexington, MA
Town of Normal, IL
Town of Sylvan Lake
Township of Langley
Trabuco Canyon Water District
Trinity River Authority of Texas
Upper Montgomery Joint Authority
Vallecitos Water District
Washington Suburban SanitaryCommission (WSSC)
WSSC Water
Xcel Energy

NASTT Offers the Best Professional Instruction from Leading Experts in the Field of Trenchless Technology

NASTT offers multiple in-depth, high quality courses each year in cities throughout North America covering targeted trenchless topics including CIPP, HDD, pipe bursting, laterals and new installation methods. You will find that our course content is of the highest quality as the material is thoroughly peer-reviewed for consensus-based information and non-commercialism. We often hear from attendees how pleased they are with the high-level of information and instruction offered by our experienced course instructors. We continually strive to improve the quality of the entire educational experience for our attendees through course evaluations and feedback. Earn valuable Continuing Education Units (CEUs) for your participation.

NASTT's Good Practices Courses

Cured-in-Place Pipe (CIPP) Good Practices Course - The NASTT CIPP Good Practices Course was updated in 2025. The course provides a comprehensive overview of gravity sewer CIPP rehabilitation from planning, through design, project implementation, and verification. It also provides an overview of CIPP in pressure applications and in sewer lateral programs. Major updates in design include both the most current ASTM F1216- Appendix X1 releases, ASCE MOP 145 and an overview of the soon to be released AWWA Design Appendices for Pressure Pipe Design of CIPP. Other enhancements include environmental and safety aspects of CIPP, including the latest research on VOC management.

Direct Steerable Pipe Thrusting Good Practices Course - NASTT's newest course for Direct Steerable Pipe Thrusting (DSPT) is an 8-hour course covering good practices for design and construction. The course is ideal for owners, engineers, and contractors interested in learning about the DSPT technology, its applications, and limitations. The course includes a discussion of the development of DSPT including Horizontal Directional Boring, Direct Pipe®, and Prime Pusher. It also includes an overview of the process and DSPT specific equipment. Other discussion items include: feasibility studies to facilitate design and construction, geotechnical considerations, geometric design, steel pipe design, work space requirements, construction sequencing, permitting, and contracting.

Horizontal Directional Drilling (HDD) Good Practices Course – Recently updated, the all new HDD Good Practices Course is based on the 2024 release of the 5th Edition of NASTT's *HDD Good Practices Guidelines*. Here are some of the exciting updates you can expect from this revised course: Expanded geotechnical investigation recommendations; Revised recommendations for bend radius considerations; Discussion of new US Army Corps requirements for HDD crossings under levees; Significant changes to recommendations for guidance, surveying, and tracking of HDD pilot holes; Significant changes to construction considerations, including noise abatement, intersect method,

drilling in rock, pipe fabrication and support, and inspection of HDD projects.

Advanced HDD Good Practices Course - HDD: Calculations & Advanced Design Good Practices Course based on advanced modules from the recently released 5th Edition of NASTT's HDD Good Practices Guidelines. The 4-hour Focus on HDD Design course is geared toward industry professionals that have an understanding of the basics of HDD construction. This session focuses on advanced design considerations that are specific to Horizontal Directional Drilling (HDD) projects. The presentation includes a detailed look at geotechnical conditions and potential risks related to ground conditions, as well as a discussion of contract document considerations. The course also includes an in-depth discussion of the various calculations that are needed to assess and mitigate risks when designing HDD crossing geometries, including: hydrofracture risk analysis, pull back and pipe stress calculations for various pipe materials, and settlement risk evaluations. These calculations are often required to secure permits from departments of transportation, railroad owners, environmental agencies, and flood control agencies, among other stakeholders.

Laterals Good Practices Course - The NASTT Laterals Good Practices Course is completely revamped and updated! This newly revised course will be offered at the NASTT 2026 No-Dig Show in Palm Springs. The course offers a clear understanding of the problems and relevant issues unique to sewer laterals throughout the United States and Canada. It explains available options for inspection, cleaning, evaluation, and repair of sewer laterals from a public and private perspective. With the rapid advancement of trenchless technology, municipalities and contractors are looking for more solutions with less impact and disturbance to homeowners and city streets.

New Installation Methods Good Practices Course - The NASTT New Installation Methods Good Practices Course is geared to address numerous trenchless methods commonly used in North America to install new pipe and conduit. This will include: auger boring, pipe ramming, pipe jacking and pilot tube methods. The target audience is contractors, municipal and utility employees, consulting engineers, inspectors and industry practitioners.

Pipe Bursting Good Practices Course - Pipe bursting is the perfect process to replace an existing line with a completely new, larger pipe — with minimal excavating. This construction technique is recognized as one of the only methods of trenchless rehabilitation that replaces an existing line with a completely new pipe, providing a total pipe replacement and allows for the replacement of an existing pipe with a new line of equal or larger diameter — to maintain or increase flow capabilities.

To learn more about all the courses offered by NASTT and view upcoming dates, visit https://nastt.org/training/upcoming-events/. Join us in Palm Springs at the NASTT 2026 No-Dig Show where the courses will be taught in person. Learn more and register here: https://nastt.org/no-dig-show/registration/.

Join Us for the Newly Revised Laterals Good Practices Course

MARCH 29-APRIL 2 | PALM SPRINGS, CA

NASTT NO-DIG SHOW 2026

The NASTT Laterals Good Practices Course has been completely revamped and updated. This revised course will be offered at the NASTT 2026 No-Dig Show in Palm Springs!

This course offers a clear understanding of the problems and relevant issues unique to sewer laterals throughout the United States and Canada. It explains available options for inspection, cleaning, evaluation, and repair of sewer laterals from a public and private perspective. With the rapid advancement of trenchless technology, municipalities and contractors are looking for more solutions with less impact and disturbance to homeowners and city streets.

Visit nastt.org/no-dig-show for more information

Vermeer and Tecniwell Partner for High-Pressure Pump Solutions

Vermeer has announced a global expansion of its distribution partnership with Tecniwell s.r.l., a leading manufacturer of high-pressure pump systems. Building on a successful partnership in the Europe, Middle East and Africa (EMEA) region, this agreement makes select Tecniwell-branded high-pressure pump packages for the horizontal directional drilling (HDD) industry exclusively available through the Vermeer dealer network worldwide.

This expanded alliance enhances the Vermeer pipeline product lineup, offering contractors a comprehensive solution that includes maxi rig drills, reclaimers and high-pressure pump packages.

"Expanding this partnership allows us to offer a more complete equipment solution to pipeline contractors globally," said Benny Melse, product manager for Vermeer. "Tecniwell has a proven track record of producing robust, high-performance pumps. By pairing their pumps with Vermeer drills and reclaimers, our dealers can provide customers with a packaged solution backed by the localized service and support they expect."

At launch, the product offering includes the Tecniwell HDD 1500 and HDD 2500 high-flow triplex mud pumps. The HDD 2500 delivers a continuous flow rate of up to 754 gal/min (2,850 L/min) and pressure of up to 1400 psi (95 bar). The smaller HDD 1500 can produce a max flow rate of 322 gal/min (1,215 L/min) and up to 1450 psi (100 bar). Both models are available with multiple diesel and electric power options to meet regional regulations and jobsite needs.

The partnership leverages Tecniwell's 37 years of expertise in developing pumps for demanding applications like jet-grouting. This engineering is now optimized to meet the specific demands of HDD applications.

"Vermeer is a leader in the HDD industry, and we are excited to grow our partnership with their extensive global dealer network," said Paolo Ferrari, sales manager at Tecniwell. "This

alliance allows us to bring our specialized HDD pump packages to a wider market, helping contractors work more efficiently."

Products will be manufactured at the Tecniwell facility in Italy and will feature the Vermeer yellow and black color scheme. The pumps come with an industry leading standard 1-year/1,800-hour warranty, and the triplex pump body is backed by a 3-year, 6,000-hour warranty.

For more information, please contact your local Vermeer dealer specializing in pipeline HDD equipment.

About Vermeer Corporation

Vermeer delivers a real impact on the way important work gets done through the manufacture of high-quality underground construction, agricultural, surface mining, tree care and environmental equipment. With a reputation for being built tough and built in a better way, Vermeer equipment is backed by localized customer service and support provided by independent dealers around the world. To learn more about Vermeer, products, the dealer network and financing options, visit www.vermeer.com.

infraStruct
PRODUCTS AND SERVICES

Turning a Groundbreaking Trial into a Proven Success

By: Robert Epp, infraStruct Products and Services

Richmond, British Columbia presents some of the most challenging subsurface conditions for excavation in Western Canada. Built on unconsolidated, glacially deposited deltaic sands and influenced by a consistently high, tidally affected groundwater table, even shallow excavation has historically been difficult to control. Conventional solutions—particularly sheet piling combined with aggressive dewatering—are often relied upon to manage these conditions. However, sheet piling is not always feasible due to utility conflicts, regulatory restrictions, vibration risk, and the potential for ground loss or damage to adjacent infrastructure.

Before full construction could proceed at this site, **infraStruct** first needed to determine whether groundwater could be isolated and soil stabilized at depth **without relying on sheet pile shoring**. Phases 1 and 2 were therefore undertaken as structured proof-of-concept trials under live roadway conditions to evaluate whether SoiLok permeation grouting could reliably stabilize these soils and control groundwater below sea level. Early work focused on developing a repeatable injection methodology, including vertical perimeter bulbs to confine treatment, horizontal injections to form a groundwater cutoff below the pipe invert, refined probe spacing, and adjusted gel times to limit resin migration. A dedicated test section confirmed bulb geometry, treatment continuity, and achievable depths. While resin consumption was higher than initially anticipated, the trials demonstrated something never before achieved in Richmond: stable, dry excavation well beyond four feet in a tidal, high-water-table environment.

Two months later, Phase 3 returned to apply the proven methodology at full scale. The remaining challenge was a critical roadway intersection where new pipe had already been installed up to, and beyond, the crossing—leaving a short center section unconnected. Progress had stalled due to an unlocatable 200 mm gas main crossing the alignment. Regulatory constraints prohibited sheet piling in this area, removing the only conventional means of soil and groundwater control. As a result, the Client engaged **infraStruct** to condition the soil so construction could proceed.

Proof-of-concept trial under live roadway conditions

Vertical perimeter treatment bulbs were installed around the excavation footprint, extending from surface to below the target invert elevation. Groundwater at the site sat approximately one metre below finished grade, and the work area itself was already roughly 0.5 metres below sea level, influenced by tidal fluctuations from the nearby Pacific Ocean. Horizontal injections were then completed within the enclosed footprint to create a treated base layer. Together, the vertical walls and horizontal floor formed a fully encapsulated treatment zone—effectively isolating groundwater and preventing inflow and infiltration.

With the treated zone in place, excavation proceeded using a conventional shoring cage installed from surface and hydro excavation within the conditioned footprint. Excavation advanced to approximately 4.5 metres directly into the water table without groundwater intrusion, soil sluffing, or disturbance to adjacent roadway structure or buried utilities. While contingency plans included active dewatering, none was required.

"An impossible condition became a controlled excavation."
— Glenn Votkin, President, infraStruct Products and Services

As excavation progressed, careful control of cage alignment and verticality allowed the contractor to achieve the clearances required for proper pipe installation. This provided sufficient working room to haunch the pipe with granular material, compact to specification, and complete backfill without compromise. From a constructability standpoint, the conditioned soil behaved predictably, reducing schedule risk and eliminating the need for reactive measures often associated with groundwater breakthrough or sheet pile obstruction.

Material efficiency also improved during Phase 3 as injection spacing and gel times were refined, reducing overall resin usage while maintaining full stabilization.

"This project shows there is a viable alternative when sheet piling is not possible or introduces more risk than it solves."
— Glenn Votkin President, infraStruct Products and Services

While completed at a roadway scale, the implications extend far beyond this site. Tunnelling contractors, large-diameter pipeline specialists, and designers working in tidal zones or high-groundwater corridors should take note. Where sheet piling and dewatering are constrained or carry unacceptable risk, soil conditioning offers another path forward. What began as a field trial has now become a proven, repeatable solution one that redefines what is possible in Richmond soils and similar environments across Canada.

Vertical perimeter treatment bulbs were installed

Robert Epp, is VP of Business Development for infraStruct and currently serves as Chair of the NASTT-BC Regional Chapter.

Key Steps to Keeping Hydro Excavation Trucks Running Their Best

Purchasing a hydrovac is a major milestone. For construction or utility operations, hydro excavation is the safest and most precise digging method available, transforming how crews expose utilities, trench, and work in complex underground environments. While adding a hydrovac to your fleet is a smart investment, the real value comes from how well that machine is maintained over time.

A hydrovac's performance and longevity depend on consistent care, proper operation, and access to reliable service. From regular inspections to operator training and seasonal upkeep, every step plays a role in protecting long-term value.

To maximize performance and extend operational life, there are a few key ways to ensure consistent, high-quality performance.

Adding a hydrovac to your fleet is a smart investment

1. **Stay up to date with maintenance needs.** Consistent maintenance is one of the most important factors in maximizing a hydrovac's lifespan. Regular inspections and adherence to manufacturer recommendations ensure the equipment continues to perform safely and efficiently. Dealing with issues early can prevent minor problems from becoming major expenses. A shop repair is far less costly than an equipment failure on the job.

   Seasonal upkeep is especially critical. In freezing conditions, follow the winterization process of draining the water system. While in warm weather, it is essential to keep machines free of dust and buildup.

2. **Become familiar with proper operating procedures**. Proper operation is vital for both crew safety and the longevity of the equipment. Operators should understand recommended pressure levels, flow rates, and how different soil types affect excavation performance. Communication between fleet managers and operators, along with ongoing operator training, is essential to prevent avoidable incidents and maintain efficiency. TRUVAC offers a range of operator resources that help crews stay in the know.

3. **Use the right tools and accessories**. Every jobsite has its challenges, and using the correct tools and accessories makes all the difference. With many add-ons to choose from, selecting the right equipment critical. Account for factors like soil type and site conditions when selecting parts. Knowing the truck's model is also essential when ordering parts or troubleshooting a problem. Mismatched or incorrect accessories lead to decreased performance and can cause strain on the truck.

4. **Rely on support networks.** Even the most reliable equipment benefits from ongoing support. TRUVAC's nationwide dealer and service network provides the expertise and assistance needed to keep hydrovacs performing at their best. From expert technicians to genuine parts, this network is designed to help fleet owners stay productive and minimize downtime.

Hydro excavation is the safest and most precise digging method available

Owning a hydrovac is an investment in safety, precision, and productivity. The key to protecting that investment is the steps taken after purchase. By following consistent care routines and capitalizing on the expertise of trusted support networks, crews can be ready for the challenges of any jobsite.

With decades of expertise and a nationwide service network, the TRUVAC team understands what it takes to keep hydro excavation equipment performing its best. Visit **TRUVAC.com** to learn more.

Mi-Tech and J.D. Hair & Associates Announce StrategicMerger to Expand Service Capabilities

J.D. Hair & Associates, Inc., a trusted leader in trenchless, geotechnical and structural engineering, has merged with Mi-Tech Services, Inc., a full-service engineering, design, and construction services firm. The combined organization will operate under the Mi-Tech name and immediately deliver an expanded suite of services to clients.

This strategic merger marks a major milestone, combining decades of expertise across trenchless, structural, utility and infrastructure engineering, design, and construction. United under the Michels Family of Companies, an international leader in energy and infrastructure construction, the combined firm is positioned to deliver unmatched capabilities and value to clients.

"By joining forces, we are not only expanding Mi-Tech's technical capabilities, but we are also enhancing the value we deliver to customers through broader service offerings and increased opportunities for advanced alternative delivery solutions," said Pat Michels, President and CEO of Michels Corporation.

Mi-Tech was founded in 1985 as Data-Tel Communications. In 1999, Michels acquired Data-Tel and renamed it Mi-Tech Services, Inc. Since then, Mi-Tech has grown to more than 200 employees across eight offices and has expanded its services to include telecommunications, energy design, surveying, land services, laboratory services, and a variety of construction services.

J.D. Hair & Associates was founded in 1987 and is widely recognized as a pioneer in trenchless engineering and design, specializing in horizontal directional drilling (HDD) and underground infrastructure solutions. J.D. Hair & Associates was acquired by Michels in 2021 and has since expanded its portfolio to include geotechnical and structural engineering services. The firm has grown to 35 employees across four offices and was recently recognized by Trenchless Technology as one of the Top 50 Trenchless Engineering Firms in North America.

The newly integrated firm is positioned to deliver comprehensive support across multiple industries, with a sharp focus on efficiency, constructability, and long-term value. As part of the Michels Family of Companies, Mi-Tech partners with an internationally respected team to provide end-to-end solutions for complex, multi-faceted projects, upholding the highest standards of safety, quality, and performance.

Tim Babich, previously Vice President of Engineering at Michels, has been appointed President of Mi-Tech. Since joining Michels in 2018, Babich has brought nearly two decades of engineering and construction expertise to the organization. Most importantly, all employees from both firms have been retained and unified within the combined organization, ensuring seamless continuity of service and safeguarding the deep institutional knowledge that clients trust and depend on.

"Merging J.D. Hair & Associates with Mi-Tech is a natural evolution of our shared commitment to quality, safety, and sustainability" Babich said. "Together, our team brings complementary expertise that enables us to address complex utility and infrastructure challenges with greater resources, efficiency, and innovation."

About Michels:
Established in 1959 in Brownsville, WI, Michels is an international leader in energy and infrastructure design and construction. Through organic growth, strategic acquisitions, and an understanding of our customers' current and future needs, Michels has expanded into the civil, energy, energy transition and renewables, foundations, marine, mission critical, transportation, and water and wastewater industries. Our Core Values of safety, environment, dedication and teamwork, integrity, social responsibility, and sustainable operations guide our actions, regardless of the type of work being performed. We build solutions for safe, modern infrastructure throughout the world. Our engineering, design, procurement, and construction services are supported by 9,000 people, 18,000 pieces of heavy equipment, more than 50 offices in the United States, and operations in Canada, Australia, and Europe. In 2025, Michels was named the 38th largest contractor on the Engineering News-Record (ENR) Top 400 list.

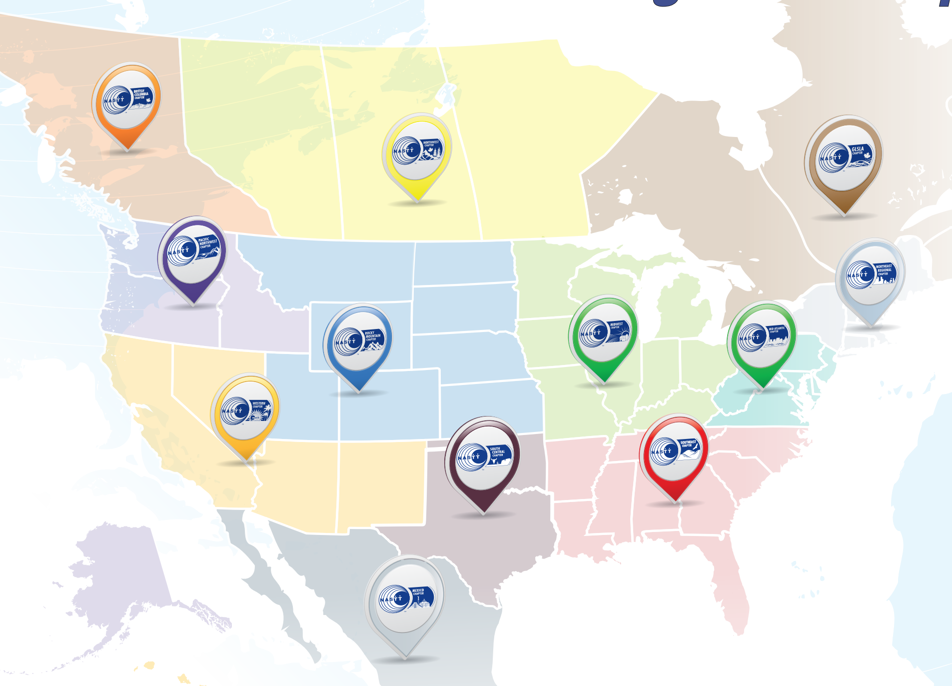
INSPECT
CLEAN
REPAIR
RELINE
REINSTATE

NORTH AMERICAN SOCIETY *FOR* TRENCHLESS TECHNOLOGY

NASTT REGIONAL CHAPTERS

Regional Issues, International Support

Contact Your Regional Chapter Today.



The grassroots of NASTT is a network of 12 Regional Chapters throughout the United States, Canada and Mexico. Regional Chapters network at the local level, share infrastructure challenges and develop new ideas. Regional Chapters hold various events throughout the year, and like NASTT, are dedicated to the advancement of trenchless technologies for the benefit of the public and the environment.

With your NASTT membership you are automatically enrolled not only in the national and international organization, but also in your Regional Chapter. So join today and get to know the “local heroes” that are making their communities better places through the innovative engineering solutions of trenchless technologies.

REGIONAL CHAPTERS

educate • train • research • publish

British Columbia
nastt-bc.org
British Columbia

Great Lakes, St. Lawrence & Atlantic
glsla.ca
Ontario, Quebec, New Brunswick, Prince Edward Island, Nova Scotia, Newfoundland and Labrador

Mexico
nastt.org/about/regional-chapters/mexico/
United Mexican States

Mid-Atlantic
mastt.org
Delaware, Maryland, New Jersey, Pennsylvania, Virginia, West Virginia and District of Columbia

Midwest
mstt.org
Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio and Wisconsin

Northeast
nenastt.org
Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont

Northwest
nastt-nw.org
Alberta, Manitoba and Saskatchewan

Pacific Northwest
pnwnastt.org
Alaska, Idaho, Oregon and Washington

Rocky Mountain
rmnastt.org
Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah and Wyoming

South Central
scnastt.org
Oklahoma and Texas

Southeast
sestt.org
Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee and Puerto Rico

Western
westt.org
Arizona, California, New Mexico, Nevada and Hawaii

NASTT.ORG

2025
OCTOBER 27-29 | VANCOUVER, BC
NO-DIG NORTH
& ISTT INTERNATIONAL NO-DIG

SEVENTH ANNUAL NO-DIG NORTH CONFERENCE 2025 IN VANCOUVER THE BEST YET!

Underground Infrastructure Sustainability with Trenchless Technology in Canada

Against the scenic backdrop of the North Shore mountains, Vancouver Harbour and historic Stanley Park, the seventh annual NASTT No-Dig North Conference attained a new high water mark for Canada's premier trenchless technology event.

Record-setting attendance of over 1,000 delegates throughout Canada and from across North America gathered together to enjoy a three full days of networking and and an expanded five tracks of over 80 peer-reviewed presentations on New Installations and Rehabilitation providing sustainable and cost-effective trenchless solutions for buried infrastructure. Over 140 exhibits showcased a wide range of trenchless and condition assessment technologies that deliver cost-saving opportunities for municipal and utility construction projects.

Held in conjunction with the ISTT 2025 International No-Dig, the NASTT No-Dig North, October 27 – 29 at the elegant Vancouver Convention Centre was another highly successful and prominent showcase of leading edge trenchless technology solutions. There were numerous unparalleled opportunities for networking and personal access to industry experts, connecting the Contractors, Manufacturers, Engineers, Educators, and Utility Owners engaged in advancing the footprint of trenchless technology in Canada.

Following the ISTT Chairman's Dinner Sunday evening at the top of snowy Grouse Mountain on Vancouver's North Shore, and the Monday round of meetings for the Canadian NASTT Regional Chapters, the full conference kicked off into high gear with the Exhibit Hall Opening and Networking Reception Monday evening. Delegates exhibitors and guest gathered together for a welcome evening of drinks and appetizers greeting old friends and making new connections.

Another networking highlight was the Opening Breakfast and Keynote Address Tuesday morning featuring Mike Leclair, Vice President - Major Projects and LNG with FortisBC, who provided details on the Eagle Mountain — Woodfibre Gas Pipeline project. He expressed appreciation for the input received from Indigenous Nations, local organizations, and community members who invested their time and expertise into developing this critical environmentally sensitive project.

Suitably, the crowning event at No-Dig North was the black-tie Gala Awards Dinner Tuesday evening, with cocktail reception, plated dinner, awards ceremony and great opportunity for networking with the global trenchless community. The annual ISTT Awards were presented and the two NASTT No-Dig North Project of the Year winners were honoured. The Project of the Year New Installations category was awarded to "Long Distance Microtunneling in Calgary Avoids Landslide Hazard for the Nose Creek Project" (see pgs 34-43), and the Project of the Year Rehabilitation was awarded to the "99 Avenue Sanitary Trunk Rehabilitation" project (see pgs 44-53).

With record-setting attendance, the NASTT No-Dig North 2025 Conference showcased the vibrant and rapidly growing trenchless technology industry in Canada, again demonstrating that trenchless technology offers both innovative rehabilitation and technically advanced replacement options for communities and utilities looking for cost effective, non-disruptive and greener infrastructure solutions. This success again reinforced the stature of No-Dig North as Canada's preeminent underground construction conference.

Congratulations to Conference Co-Chairs Robert Epp, infraStruct Municipal Services and Craig Vandaelle, Michels for organizing such an informative and well-attended conference. Accolades are also due to the Technical Program Committee Co-Chairs Mafe Pinzon, Amrize Building Materials and Dr. John Matthews at Louisiana Tech University for assembling a very comprehensive, varied and educational technical program lineup which showcased the broad range of Canada's trenchless expertise.

NASTT AND ISTT thank all delegates for their participation in a highly successful seventh annual 2025 No-Dig North. We wish to extend our appreciation to all volunteers, presenters, moderators, and attendees for their participation, time and effort. A special note of thanks also goes out to our valued Sponsors & Exhibitors.

No-Dig North is the largest trenchless technology conference in Canada where municipalities, contractors, consulting engineers, public utilities, industrial facilities, and damage prevention professionals attend to learn new techniques that will save money and improve infrastructure. Aniticpating more success at the NASTT 2026 No-Dig North will be held, November 2 – 4 at the Telus Convention Centre in Calgary AB. Another exciting can't-miss event for trenchless professionals across Canada and throughout North America!

Jari Kaukonen was honoured with the ISTT Lifetime Service Award for his outstanding contributions

Members of the Squamish First Nation welcomed delegates to the Gala Awards Dinner

Opening Breakfast was a great networking opportunity featuring the Keynote Address from Mike Leclair, Vice President - Major Projects and LNG, FortisBC

ISTT Chairman's Dinner held Sunday evening at the snowy peak of Grouse Mountain in North Vancouver

Over 140 trenchless exhibits offered close-up personal access to industry experts and unparalleled networking opportunities





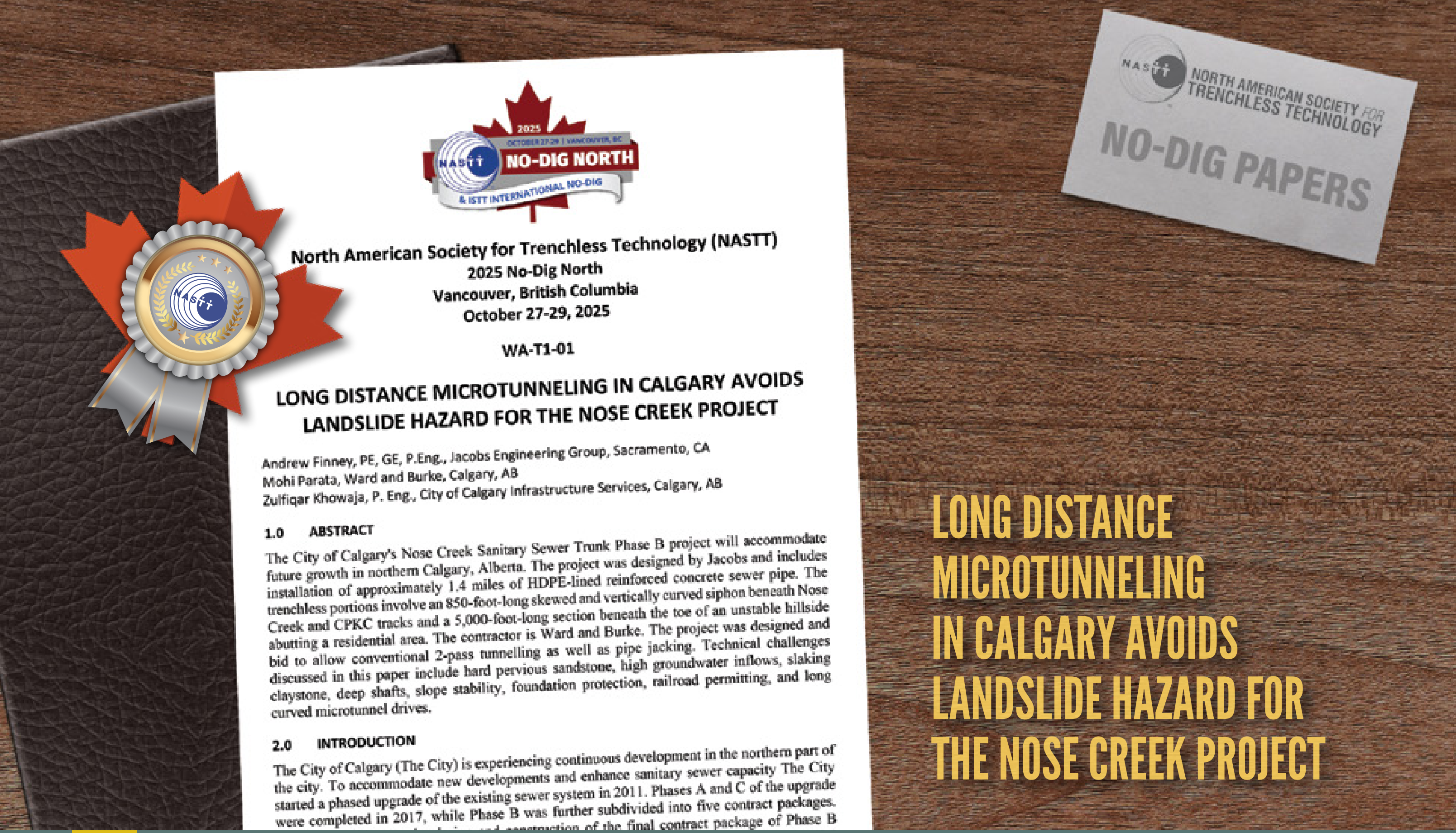


Over 1,000 delegates enjoyed three full days of over 80 presentations in five tracks from notable industry leaders

No-Dig North & the ISTT International No-Dig offered attendees and volunteers the face time with colleagues from across the globe that is so vital to our industry!

For information on
NASTT 2026 NO-DIG NORTH
November 2-4 in Calgary AB,
please visit:

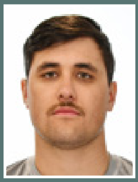
https://nastt.org/no-dig-north



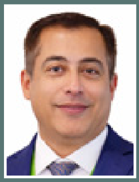
LONG DISTANCE MICROTUNNELING IN CALGARY AVOIDS LANDSLIDE HAZARD FOR THE NOSE CREEK PROJECT

AUTHORS

Andrew Finney, PE, GE, P.Eng
Jacobs Engineering Group,
Sacramento, CA



Mohi Parata
Ward and Burke,
Calgary, AB



Zulfiqar Khowaja, P. Eng.
City of Calgary Infrastructure Services,
Calgary, AB

1.0 ABSTRACT

The City of Calgary's Nose Creek Sanitary Sewer Trunk Phase B project will accommodate future growth in northern Calgary, Alberta. The project was designed by Jacobs and includes installation of approximately 1.4 miles of HDPE-lined reinforced concrete sewer pipe. The trenchless portions involve an 850-foot-long skewed and vertically curved siphon beneath Nose Creek and CPKC tracks and a 5,000-foot-long section beneath the toe of an unstable hillside abutting a residential area. The contractor is Ward and Burke. The project was designed and bid to allow conventional 2-pass tunnelling as well as pipe jacking. Technical challenges discussed in this paper include hard pervious sandstone, high groundwater inflows, slaking claystone, deep shafts, slope stability, foundation protection, railroad permitting, and long curved microtunnel drives.

This paper was selected as Outstanding Project of the Year – New Installations from all the presentations at NASTT 2025 No-Dig North in Vancouver BC. NASTT No-Dig Papers are available for download, free to members, at www.nastt.org

2.0 INTRODUCTION

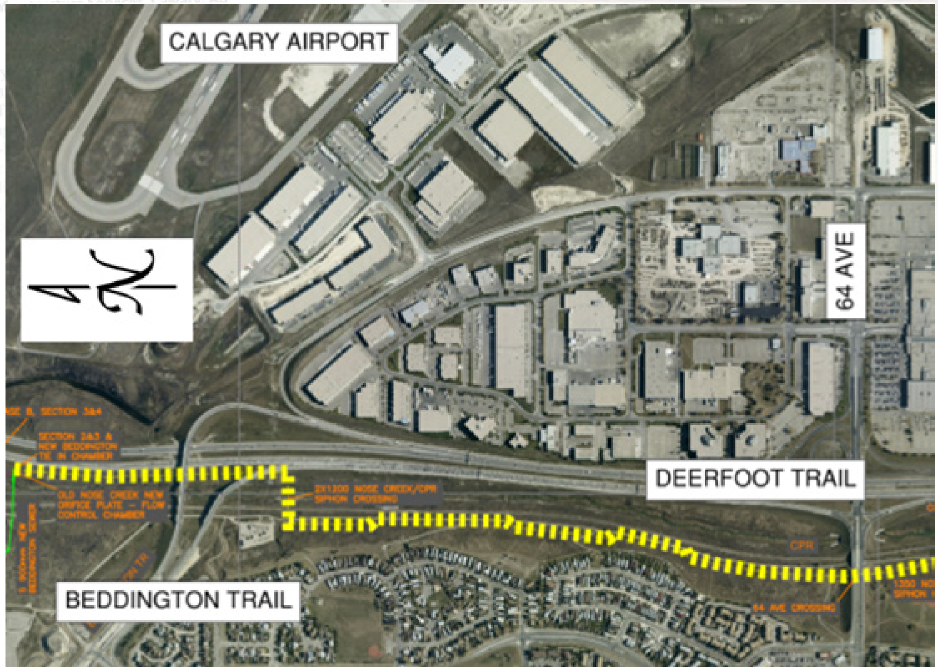


Figure 1. Phase B Contract 4 alignment (Note: North is to the left)

The City of Calgary (The City) is experiencing continuous development in the northern part of the city. To accommodate new developments and enhance sanitary sewer capacity The City started a phased upgrade of the existing sewer system in 2011. Phases A and C of the upgrade were completed in 2017, while Phase B was further subdivided into five contract packages. This paper addresses the design and construction of the final contract package of Phase B (Contract 4), which includes construction of a twinning sewer for approximately 1.4 miles (2.3 kilometres) and consisting of reinforced concrete sewer pipe with an HDPE liner, as seen in Figure 1. Of the approximately 7,400 feet (ft) of Contract 4, approximately 5,000 ft (1,501 meters [m]) was installed using trenchless methods along the west bank of Nose Creek, which is a current record single-drive length for 66-inch (in) (1,650-millimeter [mm]) pipe, while another 850 ft (260 m) of 60-in (1,500-mm) pipe was installed using trenchless methods beneath Nose Creek.

3.0 PROJECT DESIGN

The original concept for Phase B (Contract 4) utilized primarily open trench installation of the sewer pipe on the east side of Nose Creek, with trenchless methods planned to cross Nose Creek and 64th Avenue. Thurber Engineering LTD (Thurber) completed a preliminary geotechnical assessment in 2009 that addressed all of Phase B from 32nd Avenue NE in the south to 144th Avenue N.E in the north (Thurber, 2009). The report provided a summary of the geotechnical investigations carried out within the study area and included relevant available geotechnical data for use during conceptual design.

As the project progressed into preliminary design an asset value management (AVM) process was undertaken using a route selection tool to rank potential route combinations, weighted for the following five main categories: economic, social, environmental, timescale risk, and technical risk. The tool generated a matrix and provided an associated weighting for each route. The AVM process provided a guidance framework for identifying the detailed route. The final route was selected after receiving stakeholder input and City review and is shown in Figure 1 above.

In 2011, Thurber followed up with a Contract 4 Geotechnical Assessment for the portion of Phase B from Beddington Trail to 32nd Avenue NE (Thurber, 2011). At this time the alignment had been relocated to the west side of Nose Creek to afford better access to the installed pipeline which was originally bounded by the creek and Alberta Transportation's Deerfoot Trail and due to the presence of high voltage power lines, a future widening of Deerfoot Trail, and the potential for high speed rail tracks.

3.1 Slope Stability Concerns

Subsequent to the 2011 Geotechnical Assessment, Thurber identified a risk of slope instability during open cut trenching north of 64th Avenue NE. Specifically, Thurber noted that the subdivision at the top of the hillside west of the alignment and north of 64th Avenue NE was constructed on the site of an old quarry. Inspection of historical aerial photography suggested to Thurber the potential that uncontrolled side cast fill was present on the hillsides west of the alignment and that this fill could be destabilized by the planned 50-foot (15-m) deep trench planned for the trunk sewer. In 2013 the City of Calgary authorized Thurber to assess the stability of the slopes to the west of the planned the sewer alignment. Thurber drilled two test holes at the top and bottom of the slope at two locations and conducted two test pits about halfway up the slope at each location.

Thurber's subsequent evaluation (Thurber, 2014a) identified that an open cut would require 1H:1V (horizontal:vertical) slopes to maintain stability, resulting in a trench width of approximately 65 ft (20 m) at the top. Thurber was concerned that deep excavation at the toe of the steep slopes may destabilize the existing uncompacted soil slopes, resulting in distress to the slope and the homes above, and possibly displacement and failure of the trench below. For the traditional open cut sloped trenches, Thurber's assessment showed that factors of safety for the undrained (short term) condition ranged from 1.5 to 2.5, indicating that the slopes should be stable if excavation, pipe installation, and backfilling were completed as a rapid continuous operation leaving no section of the trench open for more than a few days. However, factors of safety for the drained (long term) condition ranged from 0.89 to 1.1, an indication that the slopes could become unstable if the excavation is left open and unsupported for too long. With the proposed 1H:1V slopes the trench width was also predicted to encroach into the adjacent Canadian Pacific Kansas City (CPKC) right of way (ROW). Thurber also evaluated the stability of a shored and braced trench option and determined that this option was feasible and was not predicted to result in slope movement.

In addition to the stability concerns, an existing 24-in (600-mm) diameter water main runs along the toe of the slope approximately 15 ft (5 m) to the west of the centreline of, and parallel to, the proposed trunk sewer. This waterline could be shut down and taken out of service during trunk sewer construction but would need to be replaced if it conflicted with the open cut construction.

Jacobs evaluated several alternatives including a fully shored trench, a partially shored option where the 625 ft (190 m) of stable trench was installed at 1H:1V with braced shoring for the remainder of the 4,575ft (1,310 m) of pipe, and a conventional tunnel. There were 16 manholes planned for this segment of the alignment (inclusive of the segment ends). Jacobs recommended to The City to consider increasing the manhole spacing to 300 m to reduce the number of required manholes to six. Regardless of the reduction in manhole construction, an option to use pipe jacking to install the pipe beneath the steeper sections of the alignment was eliminated because of the need for multiple deep construction shafts to launch and receive a tunnel shield and to accommodate the multiple manholes. Complicating the open cut and shored options was the lack of trench-adjacent stockpile storage area, which required removal and near-site storage of the spoils. Jacobs recommended to The City that the 5,000-foot (1,501-m) portion on the west side of Nose Creek and the CPKC tracks be installed via conventional tunnelling. The tunnel was extended slightly to the south to incorporate the already-planned undercrossing of 64th Avenue NE and a curve in the alignment was added to remain a suitable distance outside the CPKC ROW to allow shaft construction. The planned curve north of 64th Avenue NE had a radius of 2,300 ft (700 m) and a curve length of 900 ft (275 m).

3.2 Groundwater Investigation

The original concept for the shorter Nose Creek crossing was to tunnel the crossing within a zone of relatively impervious claystone using an open face rotary wheel TBM. The alignment was selected to provide additional depth of cover within the bedrock beneath Nose Creek under the assumption that the tunnelled horizon would be free of significant quantities of groundwater. Thurber performed field hydraulic conductivity tests (slug tests) in monitoring wells located on either end of the proposed crossing and the results indicated relatively high conductivity within the bedrock on the west side (2.1×10^{-2} centimetres per second [cm/s]). Because the potential for high hydraulic conductivity and tunnel water inflows was a concern, at Jacobs' recommendation The City authorized Thurber to conduct two supplemental pumping tests in two new production wells installed at the ends of the Nose Creek crossing in 2013 and to observe the results in the existing monitoring wells as well as in four new monitoring wells. All of the production and monitoring wells were screened below the original depth investigated in 2011 in the anticipation that a relatively impervious deeper bedrock zone could be identified.

The results of the pumping tests were interpreted by Thurber and presented in Thurber, 2014b, and were analysed independently by Jacobs using the software MLU (MicroFEM, 2009) which accounted for the varied pumping well and monitoring well completion depths. The results from the Jacobs analysis were in reasonable agreement with those presented in Thurber, 2014a and suggested that the hydraulic conductivity of the deeper bedrock at the west end of the crossing was on the order of 2.3×10^{-3} cm/s. While at the east end the pumping test results suggested a conductivity of 5.8×10^{-5} cm/s. Both values were also in excellent agreement with the results from the original borehole tests reported in Thurber 2011. In addition, Jacobs concluded that the groundwater was not in direct communication with the water within Nose Creek. The results at the west end indicated that the vertical permeability was on the order of 500 times less than the horizontal permeability.

The results suggested that the upper sandstone bedrock at the Nose Creek crossing, and particularly at the west end of the crossing had a relatively high hydraulic conductivity. This conclusion was also relevant to the north end of the longer tunnel beneath the slide-prone area.

3.3 Tunnel Inflows

The hydraulic conductivity data obtained in the aforementioned tests were used to estimate the steady state inflow for the tunnel alignment based on the method described by Heuer (1995 and 2005). Heuer's method is a semi empirical relationship that uses a reduction factor to adjust the results of the closed form radial flow equation originally developed by Goodman et al (1965). In the Heuer calculation method a histogram of the permeability data is used to prorate the total length of the tunnel into segments with different hydraulic conductivity values. The length of each segment is representative of the frequency

HDPE PE4710 PIPE

The Best Choice For Water Systems

	TOP 10 Features and Benefits	HDPE	D. Iron
1	**Applications:** Potable Water (Lead Free), Raw Water, Reclaimed Water, and Wastewater ***References: AWWA C901, C906, C151, & NSF 61 + Health Effects of HDPE Pipes and Fittings for Potable Water Applications, NSF 2024***	✓	✓
2	Open Cut Construction: Design and install per AWWA Standards and Manuals eliminating thrust blocks ***Ref: AWWA M55, M41 + MAB-3, MAB-6***	✓	✓
3	Trenchless Construction: Material of choice for HDD, Pipe Bursting, Sliplining, and Compression Fit ***Ref: ASTM F585, F1962, F3508 + MAB-5, MAB-7, MAB-11***	✓	X
4	**Fully Restrained Joint-Free System:** Minimize need for fittings to facilitate horizontal and vertical deflections ***Ref: AWWA M55, M41***	✓	X
5	**Longevity & Corrosion:** Pipes, Fittings, and Joints have the least potential for corrosion or tuberculation ***References: Durability and Reliability of Large Diameter HDPE Pipe for Water Main Applications, EPA/WRF/WERF 2025 + Critical Need for*** Corrosion Management in the Water Treatment Sector, NACE 2019 + PPIPACE.com + Long-Term Aging of Polyethylene Pipes, UKWIR 2020	✓	X
6	**Flow Capacity:** New pipes have similar flow capacity per AWWA Standards and Manuals ***References: AWWA M55, M41 and PPIPACE.com***	✓	✓
7	**Water & Energy Conservation:** Fused Joints have zero allowable water leakage and zero infiltration ***Refrences: AWWA M55, M41 + ASTM F2620, F3190, F3565 and MAB-1, MAB-2, MAB-8***	✓	X
8	**Cost Effective:** Has the lowest initial cost, lowest life cycle cost, and lowest restoration cost for trenchless installations ***References: Life Cycle Analysis of Water Networks, CSIRO 2008 + Annual Drinking Water Quality Report for 2014, Kittery Water District, 5/31/15***	✓	X
9	**Resilient:** Ability to resist water hammer and ground movements due to droughts, freeze/thaw, earthquakes and hurricanes with the ability for flow control and squeeze off ***References: Recent Earthquakes: Implications for U.S. Water Utilities, WRF 2012 + Polyethylene Pipeline Performance Against Earthquake,*** Kubota 2018 and MAB-9, MAB-10	✓	X
10	**Permeation/BTEX:** Pipes and elastomeric joints need to be properly engineered for contaminated conditions ***References: AWWA C901/C906 and C111/C151, Sec. 4***	X	X

MUNICIPAL ADVISORY BOARD

Additional information including MAB-3 Model Spec Guide can be found at www.plasticpipe.org/mabpubs of the assigned hydraulic conductivity within the overall histogram. In addition to the radial inflow, Heuer's method also predicts tunnel heading inflows based on an assumed length of influence behind the tunnel face, the groundwater head, and a heading factor, coupled with the assumption that the most pervious materials will be encountered in the face.

The groundwater inflows for the Nose Creek Crossing and the Main Tunnel were predicted to be too high to be manageable, and additional measures were implemented in the design to address the relatively high permeability of the bedrock. The design required the implementation of effective heading dewatering using vertical wells in combination with the use of gasketed tunnel liner plate for initial ground support. The goal of the well dewatering is to manage tunnel heading inflows, while the purpose of the gasketed liner plate is to minimize or eliminate the need to continuously dewater the remainder of the completed tunnel length exclusive of the heading.

In order to estimate the dewatering requirements, Jacobs created a numerical model of the project site using the finite-element package MicroFEM (MicroFEM, 2013). The MicroFEM model grid was approximately 10 km on each side with seven model layers. Based on a regional groundwater report the average annual recharge rate was assumed to be 3 mm per year. NoseCreek was conservatively assumed to be in hydraulic connection with the underlying aquifers so that leakage from the creek could occur if groundwater levels were drawn down below the creek stage. The MicroFEM model was used to compute steady-state groundwater levels in and surrounding the target dewatering area. The model results suggested the steady-state flow required to dewater the entire Nose Creek crossing was on the order of 475 gallons per minute (gpm) (30 liters per second [L/s]). This assumes all of the crossing alignment is dewatered simultaneously. A second analysis was performed to evaluate a similar required drawdown of an area of sandstone located approximately 1,200 ft (350 m) south of the western limit of the Nose Creek crossing. The second analysis suggests flow to dewater the band of pervious sandstone would be approximately 300 gpm (19 Lps).

It was therefore concluded that in order to complete the proposed undercrossing of the CPR tracks and the creek and the northern-most portion of the longer crossing, it was necessary to dewater the tunnel zone using wells or utilize a tunnelling method suitable for closed-face operation beneath the water, such as earth-pressure balance or slurry methods. This approach would also require the use of watertight shoring methods to prevent the ingress of water into the tunnel shafts. In the bedrock conditions anticipated it would likely require pre-excavation permeation grouting to cut off the water, followed by a system of water control measures at the shafts such as weepholes through shotcrete support and drainage blankets collected in a shaft perimeter sump. If these weepholes, blankets and sumps became blocked by soil or ice the stability of the shaft support could be compromised. Alternative methods of water tight shaft construction are not typical in Calgary and include slurry diaphragm, cutter soil mixed, or secant pile walls.

3.4 CPKC Rail Crossing

For the Nose Creek Crossing, Jacobs was required by CPKC to hire a 3rd party engineering firm to review the proposed trenchless crossing of the CPKC ROW. A significant delay was realized while the review and coordination occurred, primarily related to the skewed nature of the rail crossing and the number and spacing of settlement monitoring instrumentation. The skew of the crossing was approximately 58 degrees from perpendicular and was dictated by the presence of ENMAX substation facilities at the western end of the creek crossing and the need to avoid overpass foundations for the eastbound Beddington Trail to southbound Deerfoot Trail connection at the east end. Settlement instrumentation was required by CPKC in the inaccessible zone between the CPKC tracks and Nose Creek, despite objections from The City and Jacobs. CPKC was also unwilling to grant approval for the use of steel liner plate to serve as a casing, despite the crown being 40 ft (12 m) below the tracks and approximately 25 ft (8 m) below the top of bedrock. Jacobs considered upsizing the initial ground support to allow loading of a steel casing for the first 300 ft (100 m) of the crossing, followed by loading of the carrier pipe. In the end the design was modified to include the use of a conventional TBM jacked at the leading end of a string of casing to the far side of the CPKC ROW, at which point the TBM would be operated as a self-propelled shield and used to install initial ground support with the initial reaction for jacking provided by the end of the contact grouted steel casing.

3.5 Underground Risk Management

Jacobs prepared a Geotechnical Baseline Report (GBR) to contractually define the anticipated subsurface conditions affecting the tunnelled installations. Key ground parameters addressed in the baseline included the swell and slake potential of the claystone bedrock, strength of the soil and bedrock, hydraulic conductivity of the soil and rock materials, groundwater inflow by
reach to an open face shield, cerchar abrasivity of the sandstone, tunnelman's ground classification and standup time, and general soil and rock plasticity.

3.6 Tunnelling Method

As discussed previously, it was anticipated that the trenchless installations would be completed as two-pass conventional tunnels constructed in firm sedimentary bedrock. Jacobs was aware that the pool of tunnelling contractors in central Canada can be more limited than other urban areas given the higher cost of mobilization from British Columbia, Ontario, or the United States. As such the project as-bid included a provision for the construction of an intermediate working shaft at the approximate centre of the main tunnel drive on the west side of Nose Creek. It was recognized that the ability to divide the 5,000-foot (1,501-m) main drive into two drives would allow more competition from contractors interested in completing the main tunnel as a pipe jack. The manhole planned at this intermediate shaft was specified to be constructed as a conventional manhole in the event an intermediate shaft was planned, or as a less invasive predrilled riser manhole and pass-through in the event a single conventional drive was planned for the main tunnel.

Table 1. Request for Proposal Evaluation

Submission Element	Evaluation Criteria	Percent
Price	Proposed price compared to other submissions	30
Project Understanding and Proposed Methodology	Project understanding and methodology are clear. Plans to address quality, constructability, risk, cost control, and innovation.	30
Construction Team	Team has worked together, Project Manager has 10 years experience, Project Superintendent has 15 years experience, H&S Manager has 10 years experience, tunnelling team same as RFPQ submission, and these resources will be dedicated and available for work.	15
Project Schedule	Clear schedule in Gantt Chart format, methodology aligns with timelines, risks and material lead times are integrated, winter construction feasible, detours minimized, and other parties considered.	10
Environment, Social, and Historical Resource Management	Display ability to manage environmental regulations, environmental and social risks considered, coordination with historical and other professionals, and demonstrates strategies that have reduced environmental impacts.	5
Subcontractors Management	Information was provided about all subcontractors with work exceeding 5-percent proposal price, and subcontractor management for completed projects.	5

4.0 PRE-QUALIFICATION

Jacobs supported The City in a pre-qualification process to identify suitable tunnel and pipe jacking contractors who would be allowed to serve as prime or specialty contractors for the upcoming tunnelling contract. Tunnelling projects for the City of Calgary typically follow a Pre-Qualification (RFPQ) and Request for Quotes (RFQ) process, expediting the latter part of the procurement to a quote-only submission from previously pre-qualified contractors.

In the RFPQ the contractor was evaluated against project experience requirements along with requirements for specific project personnel experience for the Project Manager, Superintendent, and Tunnelling Operator. The projects submitted were evaluated based on their relevancy to the Phase B Contract 4 project and included the requirements to demonstrate experience with curved drives. Nine contractors submitted RFPQ materials and seven of the nine were prequalified.

For this project, the RFPQ process was actually followed by a Request for Proposal (RFP) which included evaluation using a weighted scoring of the price submission at 30 percent and the remaining 70 percent evaluated based on the contractor's proposal, as summarized in Table 1.

A team of four (4) evaluators reviewed all RFP submissions. One (1) general contractor and their proposed team were awarded the project.

5.0 CONSTRUCTION

The contract for construction of Phase B Contract 4 was awarded to Ward & Burke Microtunnelling Ltd. (W&B) of Mississauga, Ontario Canada on January 15th, 2024. W&B is a civil engineering contractor specializing in water, sewer, and sanitary services infrastructure design and construction, with specific emphasis on microtunnelling, caisson shafts, and pipeline construction.

After reviewing the contract documents W&B immediately requested The City and Jacobs to consider revising the Nose Creek crossing to include a vertical curve and to eliminate the need for the steel casing. W&B also decided that the main drive could be completed in a single microtunnel drive, constructed completely from the launch shaft.

For the purpose of safely launching and receiving the MTBM, as well as constructing the trenchless pipeline, W&B constructed three reinforced concrete caisson shafts. Ground conditions at the shafts and along the alignment were identified as weak bedrock overlain by Clay. These conditions coupled with ground water made the caisson construction method ideal for this Project. There were many other advantages of using the caisson method for this contract in comparison to other shoring systems, as listed below:

- **Sealed system** - There is no need for dewatering during or after construction. This dramatically reduces the risk of ground deformations during construction. This also provides a dry shaft for tunnel operatives to work in during tunnelling operations.
- **Robust and rigid shaft wall** - The walls are constructed from reinforced cast in-situ concrete. They are extremely robust, more importantly the shoring is rigid. Flexible systems such as slide rail, trench boxes, or sheet piling will deform under lateral earth pressure by as much as a few inches. This deformation under pressure will not structurally fail

Figure 2. View of main tunnel launch shaft looking north (Note: ENMAX substation, CPKC tracks, and Nose Creek shown)

the steel shoring system, however, the deformation zone of influence could be transmitted into the nearby structures creating a potential for settlement induced damage. The concrete shaft wall will not deform under lateral earth pressures. Therefore, keeping the shaft zone of influence to a minimum. This also enhances construction of a thrust block to resist the jacking forces of the microtunnelling machine.

- **Safe entry for tunnels** - The concrete shaft allows for exceptionally safe access/egress to shaft bases while tunnelling. A launch/reception seal system is bolted and sealed directly to the shaft wall prior to MTBM launching/receiving. Once the head of the MTBM passes through the launch seal, it is isolated from the shaft. This allows the face of the MTBM to be pressurized prior to boring through the remaining shaft wall. Thus, the launch of the MTBM is controlled, and the system is never exposed to unsupported ground conditions. In other shaft systems, the steel sheeting/shoring needs to be cut away prior to the start and finish of any tunnel. This is a high risk and potentially dangerous practice. In the non-cohesive saturated grounds, the soil has the potential to “flow” into the shaft once the sheeting is removed. The shaft would continue to fill with flowing soil and water until equilibrium between the inside and outside of the shaft occurred. An uncontrolled large sink hole would develop outside the shoring system, creating a worker, pedestrian, and structural safety hazard.
- **Non-vibration method of installation** - Unlike continuous sheet piling or slide rail no excessive vibration or impact forces are required to install the caisson. The caisson is installed in controlled low impact manner, typically relying on gravity to advance the sinking. This is advantageous, particularly in sensitive locations, where there are multiple services and structures.
- **Single pass system** - The shoring system can provide the final permanent structure walls. The walls of the shafts are cast in situ resulting in a water-tight structure while precast manholes can be difficult to seal at deep levels with high water tables. The cast in situ system eliminates this problem and prevents infiltration. The volume of material to be imported to the manhole location is greatly reduced providing increased environmental benefits.
- **Circular Shaft** – A circular shaft is hugely beneficial when constructing multiple tunnel drives from one shaft as you can tunnel in any direction. This allowed W&B to construct two microtunnels at 138-degrees from each other by simply removing the frame after the first drive, rotating it, and reinstalling it.

5.1 Nose Creek Main Drive

W&B employed a Herrenknecht AVN1500 with an upskin kit to install the 66-in (1,650-mm) inside diameter (ID), 80-in (2,050-mm) outside diameter (OD) Sanitary Sewer. The 5,000-foot (1,501-m) tunnel was constructed in ground conditions ranging from stiff clay/weak claystone to Sandstone with a uniaxial compressive strength of up to 13,500 pounds per square in (psi) (95 megapascals) and the entire alignment was under the water table. For these reasons a mixed face cutting head was fitted to the MTBM. This cutting head is extremely robust with large openings at the face and disc cutters making it suitable for a range of ground conditions.

W&B used a telescopic jacking frame with a total capacity of 2,000 tons (1,800 tonnes) to advance the 66-in (1,650-mm) ID pipe with an axial capacity of 1,450 tons (1,312 tonnes). During the construction planning stage of the project W&B calculated the expected jacking forces for the full drive to be 2,200 tons (2,000 tonnes), using an estimated average skin friction factor of 0.29 pounds per square inch (psi)(2 kPa). Therefore, W&B elected to install four intermediate jacking stations (IJS) along the pipe string. The first IJS was installed 650 ft (200m) behind the MTBM face, the second 740 ft (225 m) behind the first, a third 1,050 ft (325 m) behind the second, and finally a fourth another 1,050 ft (325 m) behind the third. Each IJS had a capacity of 1,450 tons

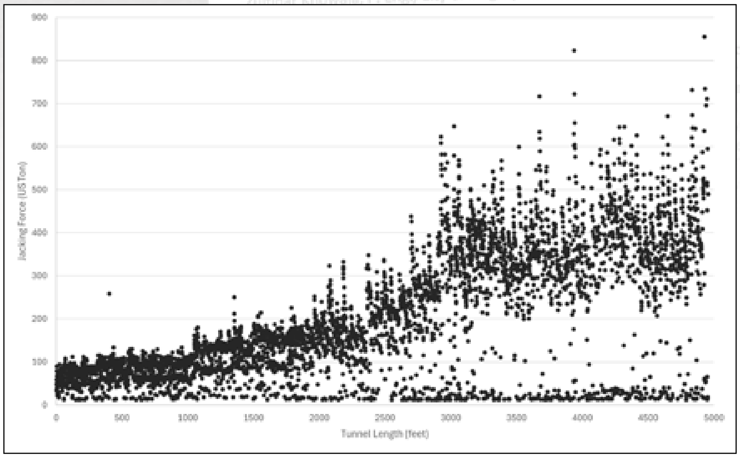


Figure 3. Jacking force versus tunnel length (Nose Creek Main Drive)

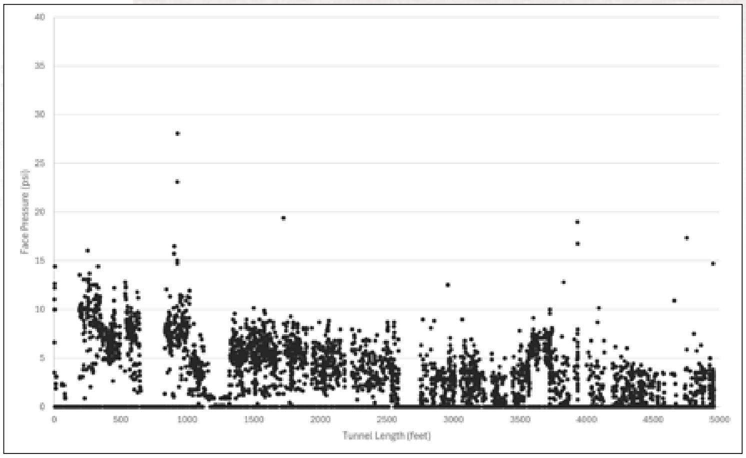


Figure 4. Face pressure versus tunnel length (Nose Creek Main Drive)

(1,318 tonnes) resulting in a full system capacity of 7,800 tons (7,070 tonnes), giving a factor of safety of 3.5 on the total expected jacking force.

W&B installed lubrication ports in the jacking pipe at 40-foot (12-m) centres (every 3rd pipe). It is W&B company standard to install 1-1/4-in (31.75-mm) diameter ports and a bentonite station at each port at a minimum of 40-foot (12-m) centres for pipe sizes of 36 in (900 mm) diameter and greater. The adequacy of this port diameter has been confirmed by the successful completion of long curved tunnels with both horizontal and vertical curves with low jacking forces. During tunnelling every 3rd pipe installed had a computer-controlled, solenoid-actuated bentonite lubrication pumping module, which delivered a pre-programmed amount of lubrication into the pipe annulus. This resulted in reducing the overall jacking forces induced onto the jacking frame. The lubrication plant used while microtunnelling was an 80 gallon per minute (gpm) (300 liter per minute)

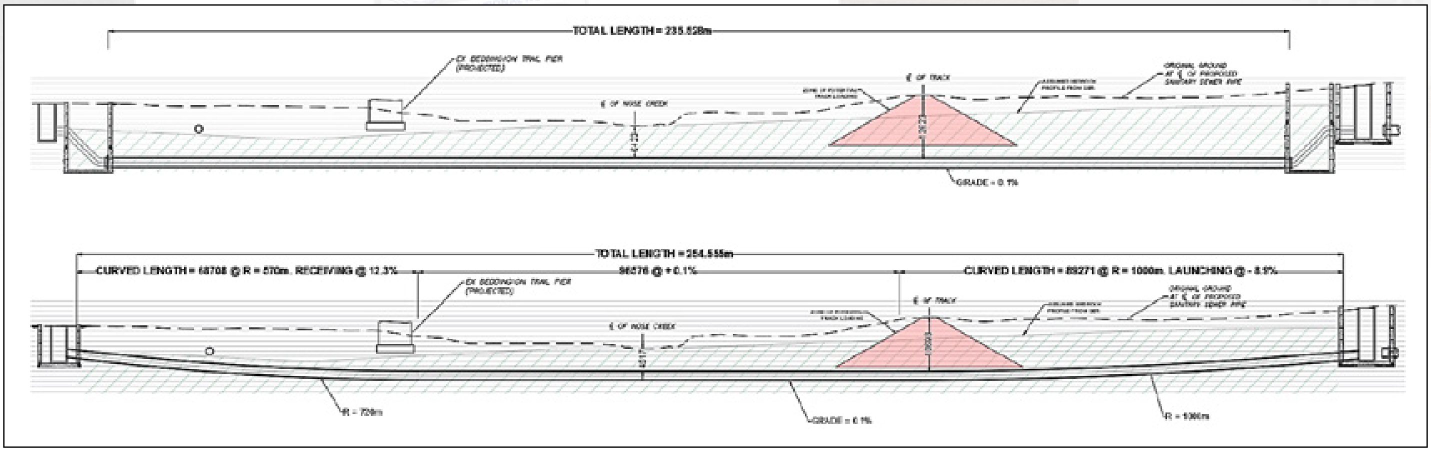


Figure 5. Siphon initial design (top) versus W&B design (bottom)

Hany system as well as a Gertec Triple Pump system and a Gertec Double Pump. This system allowed four separate 2-3/4-in (DN 70) lines to be used while tunnelling. Line 1 went directly to the MTBM itself. This line pumped bentonite around the MTBM to fill the annulus being created by the overcut discs. Line 2 pumped bentonite to the first 30 pumping modules in the tunnel to replenish and maintain the required annular lubrication. Line 3 pumped to the next 40 pumping modules, and the final line pumped to the last 56 pumping modules.

Using this automated lubrication system W&B were able to complete the drive with extremely low jacking forces, as shown in Figure 3. When the MTBM reached the reception shaft the total force on the jacking frame was only at 500 tons (450 tonnes) which was less than 25- percent of the expected jacking force. This means that W&B were able to achieve an average skin friction factor of 0.073 psi (0.5 kPa). By keeping the jacking forces so low, none of the four IJSs needed to be engaged during the drive and the full tunnel was completed using the main frame in the launch shaft.

W&B launched the MTBM on May 22nd, 2024, and retrieved the machine on September 29th, 2024, completing the longest microtunnel drive in North America to date and according to MTBM manufacturer Herrenknecht it is a world-record in this diameter range. The full drive length was 5,000 ft (1,501 m) with four horizontal curves ranging from 2,300 ft (700 m) to 5,700 ft (1,750 m) in radius.

5.2 Nose Creek Crossing

The initial design of the Nose Creek siphon crossing had the tunnel invert 22 ft (6.6m) below the main drive invert at the launch shaft on the west side of the creek. Initially W&B had explored three options to install this drive. The first option involved sinking a caisson shaft 40 ft (12 m) deep, basing it, and completing the main drive. Upon completion of the main drive, they would break out the base and underpin and pour a shaft liner 21 ft (6.6 m) below the caisson to launch the siphon crossing drive.

Option 2 would have involved sinking a caisson shaft to the full 61 ft (18.6 m) depth and then backfilling 21 ft (6.6 m) and pouring a new base or installing a heavy-duty platform to complete the main drive. W&B would then break out the new base and excavate the 21 ft (6.6 m) of backfill to launch the Nose Creek siphon crossing from the lower level.

For the third option W&B considered installing two caisson shafts adjacent to each other, one for each drive. The shaft for the main drive would be sunk 40 ft (12 m) deep and the shaft for the siphon crossing would need to be sunk 61 ft (18.6 m).

All three of these options had various problems. Options 1 and 2 required an enormous shaft size to be able to fit the required pipework to raise the siphon crossing 21 ft (6.6 m) and a considerable amount of work inside the shaft once the main drive was complete. Option 3 was more desirable than options 1 and 2, however it involved the time, work, and cost of installing two full shafts.

W&B had previous experience installing vertical curves in microtunnel drives and believed this project would benefit from installing one for the siphon crossing. By introducing a vertical curve W&B were able to launch and retrieve the machine at the required inverts eliminating the need for larger or deeper caisson shafts. The use of the closed face microtunnelling method and ASTM C76 Class V Reinforced Concrete Pipe (RCP) allowed W&B to reduce the depth by 6 ft (2 m) while still maintaining the minimal track settlement values predicted by Jacobs. This raising of the pipe reduced the hydraulic head losses through the siphon in additional to the head losses eliminated due to the removal of the four 45-degree bends. With respect to the maintenance and inspection of the siphon, access is via a

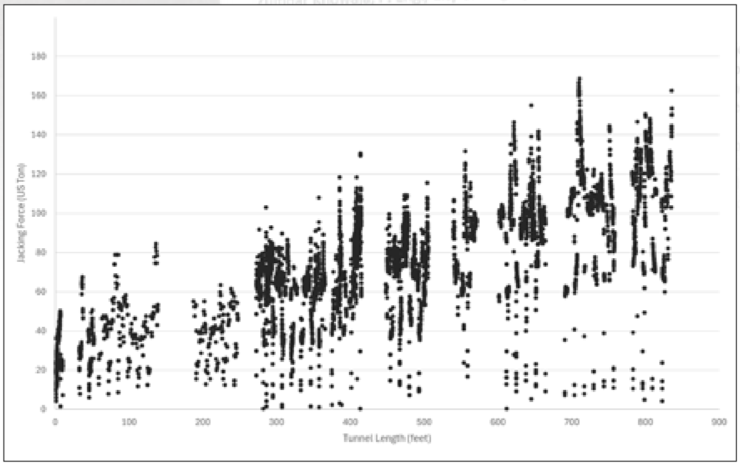


Figure 6. Jacking force versus tunnel length (Nose Creek Siphon Drive)

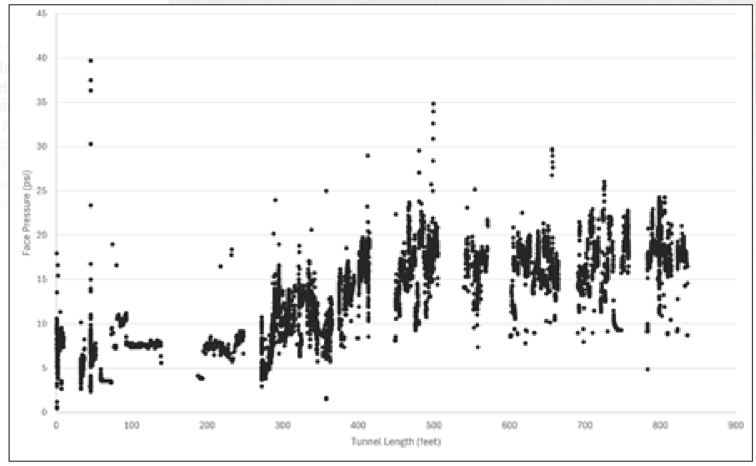


Figure 7. Face pressure versus tunnel length (Nose Creek Siphon Drive)

12-percent downward gradient in lieu of a 50-percent gradient, as shown in Figure 5.

In addition to curving the siphon alignment, W&B sought to revise the tunnel pipe material. The initial design called for 60-in (1,500-mm) fiberglass reinforced pipe installed within a steel liner plate and short section of steel casing under the CPKC ROW. W&B proposed to install an HDPE-lined reinforced concrete pipe (RCP) as the carrier pipe in a single pass installation. CPKC agreed that lined RCP was acceptable for installation as a carrier pipe in a single pass installation without the need for a permanent casing.

W&B launched the MTBM on November 6th, 2024 and retrieved the machine on December 7th, 2024 completing the 836-ft (255-m) curved microtunnel drive. The drive included two vertical curves ranging from 2,300 ft (700 m) to 3,300 ft (1,000 m) in radius.

6.0 CONCLUSIONS

The Nose Creek Phase B (Contract 4) project is on track for completion before the forecasted sanitary sewer trunk capacity is needed and within the estimated construction budget. Primary design challenges were associated with the deep installation necessitated by the gravity nature of the flow, the potential to destabilize the adjacent hillsides, and the permitting process for a highly skewed crossing of the CPKC tracks. Construction challenges were successfully addressed by a highly skilled contractor selected using a two-stage procurement process that emphasized experience and teamwork.

The innovation brought to the construction by W&B resulted in a reduced construction footprint and enhanced hydraulics and future access for maintenance. Submittals and proposed design modifications were well documented and thorough, which sped review and acceptance. The microtunnelling was completed without any frac outs, and observed settlement was within the baseline limits. The resulting main tunnel is the longest single-drive pipe jack in North America and a world-wide record for pipe jacking in this diameter range according to the MTBM manufacturer Herrenknecht.

7.0 REFERENCES

Goodman, R., D. Moye, A. Schalkwyk, and I. Javendel. 1965. Ground water inflow during tunnel driving, Engineering Geology 2:39.

Heuer, R.E. 1995. Estimating Rock Tunnel Water Inflow, Rapid Excavation and Tunneling Conference Proceedings.

Heuer, R.E., 2005. Estimated Rock Tunnel Water Inflow – II, Rapid Excavation and Tunneling Conference Proceedings.

MicroFEM. 2008. MLU for Windows, version 1.51, Aquifer Test Analysis for Unsteady State Flow in Multiple Aquifer Systems. http://www.microfem.com/products/mlu.html. Accessed October 1, 2009.

MicroFEM. 2013. MicroFEM for Windows, version 4.10.55, Aquifer Test Analysis for Unsteady State Flow in Multiple Aquifer Systems. http://www.microfem.com.

Thurber Engineering Ltd. (Thurber). 2009. Preliminary Geotechnical Assessment, Nose Creek Sanitary Sewer Trunk Upgrades, 32 Avenue to 144 Avenue N.E. Calgary, Alberta, Canada. May.

Thurber Engineering Ltd. (Thurber). 2011. Geotechnical Investigation, Nose Creek Sanitary Trunk Upgrade, Beddington Trail to 32 Avenue NE. Calgary, Alberta, Canada. January.

Thurber Engineering Ltd. (Thurber). 2014a. Slope Stability Assessment, Nose Creek Sanitary Trunk From 64 Avenue NE Beddington Trail. Calgary, Alberta, Canada. October.

Thurber Engineering Ltd. (Thurber). 2014b. Supplementary Geophysics and Pump Testing Program (Draft), Nose Creek Sanitary Trunk Upgrade Project, Proposed Tunnel Crossing at Beddington Trail. Calgary, Alberta, Canada. February.


2025 October 27-29 | Vancouver, BC
NO-DIG NORTH
& ISTT International No-Dig

North American Society for Trenchless Technology (NASTT)
2025 No-Dig North
Vancouver, British Columbia
October 27-29, 2025

TM-T5-02

99 Avenue Sanitary Trunk Rehabilitation - Stage 2

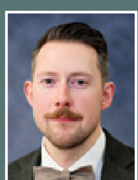
Sam Saunders, P.Eng., Associated Engineering, Edmonton, Alberta
Chris Lamont, P.Eng., Associated Engineering, Edmonton, Alberta
Peiqian (Jan) Zheng, Shanghai Construction Group (Canada) Corporation, Edmonton, Alberta
Gary Fei, P.Eng., EPCOR Water Services, Edmonton, Alberta

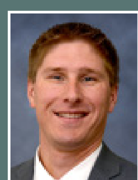
1.0 ABSTRACT

The 99 Avenue Sanitary Trunk Rehabilitation project is a two-stage project to rehabilitate approximately 1.1 km of monolithic concrete arch-shaped sanitary trunk sewer located about 30 m below ground in Edmonton, Alberta. Stage 1 involved the construction of a ~1.6 km bypass sewer to divert flow, facilitating the Stage 2 trunk rehabilitation, which was completed in 2023 (NASTT 2023 No-Dig North Paper MM-T4-03). Stage 2 was awarded to Shanghai Construction Group (Canada) Corporation (SCG) as a design-build contract. SCG's rehabilitation approach involved sliplining discrete segments of 950 mm span by 1400 mm rise

99 AVENUE SANITARY TRUNK REHABILITATION - STAGE 2

AUTHORS


Sam Saunders, P.Eng.
Associated Engineering,
Edmonton, Alberta


Chris Lamont, P.Eng.
Associated Engineering,
Edmonton, Alberta


Peiqian (Jan) Zheng
Shanghai Construction Group (Canada) Corporation,
Edmonton, Alberta


Gary Fei, P.Eng.
EPCOR Water Services,
Edmonton, Alberta

1.0 ABSTRACT

The 99 Avenue Sanitary Trunk Rehabilitation project is a two-stage project to rehabilitate approximately 1.1 km of monolithic concrete arch-shaped sanitary trunk sewer located about 30 m below ground in Edmonton, Alberta. Stage 1 involved the construction of a ~1.6 km bypass sewer to divert flow, facilitating the Stage 2 trunk rehabilitation, which was completed in 2023 (NASTT 2023 No-Dig North Paper MM-T4-03). Stage 2 was awarded to Shanghai Construction Group (Canada) Corporation (SCG) as a design-build contract. SCG's rehabilitation approach involved sliplining discrete segments of 950 mm span by 1400 mm rise non-circular fiberglass liner into the existing host tunnel (approximately 1200 mm span by 2000 mm rise) via worker-entry.

Key challenges of the project included restricted access, which required the construction of deep working shafts; a complex upstream sewer network with high flow volumes that had to be diverted for isolation; difficulties in cleaning and inspecting the trunk; uncertain short-term structural conditions for safe worker-entry; variable deflections in the host tunnel alignment; poor invert conditions affecting liner insertion; and significant groundwater infiltration that required careful management during the annular space backfill grouting.

This paper will examine the project's constraints and challenges, the rehabilitation planning and execution, the design-build team's innovations, and the lessons learned, along with recommendations for future projects.

This paper was selected as Outstanding Project of the Year – Rehabilitation from all the presentations at NASTT 2025 No-Dig North in Vancouver BC. NASTT No-Dig Papers are available for download, free to members, at www.nastt.org

2.0 INTRODUCTION

The 99 Avenue Sanitary Trunk (the Trunk) is a critical conveyance link for sanitary flow from Edmonton's west end neighbourhoods, receiving flow from several major trunks and servicing over 100,000 residents with growth projections predicting the service population to exceed 200,000. The Trunk was constructed between 1965 and 1966 by hand tunnelling at a depth of approximately 30 m below ground using steel arch ribs and timber lagging for primary support and collapsible slipforms to cast an approximately 1200 mm span by 1800 mm to 2000 mm rise arch-shaped permanent concrete liner. After more than 50 years of service, the Trunk exhibited significant deterioration and loss of section due to hydrogen sulfide (H2S) induced corrosion and high flow rates (up to 4.5 m3/s during wet weather). Rehabilitation of the Trunk was deemed necessary by EPCOR Water Services (EPCOR) prompting a two-stage approach to first divert the existing upstream flow via a new microtunnelled bypass sewer and second isolate and rehabilitate the Trunk. Stage 1 was completed by SCG in 2023, and the project is described by Chinnathambi, V., et al. (2023). Stage 2, the rehabilitation of the Trunk, was awarded to SCG as a design-build contract in 2024 following the completion of Stage 1 and is the focus of this paper. Figure 1 depicts the project location and alignment of the trunk.

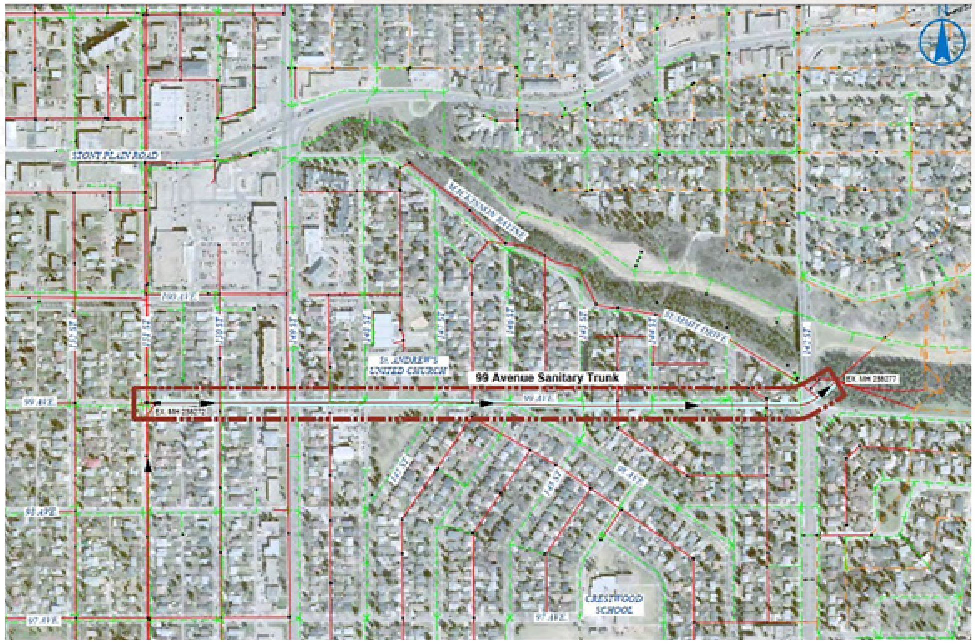


Figure 1. Project Location and Alignment of Existing Trunk (2017 Condition Assessment Report, Stantec Consulting)

3.0 EXISTING CONDITIONS

The Trunk is primarily located beneath 99 Avenue NW within the mature west Edmonton neighbourhoods of West Jasper Place and Crestwood. Access is limited to two locations separated by approximately 1 km of uninterrupted trunk sewer: an upstream maintenance hole (MH) located near 151 Street NW in West Jasper Place and a pair of adjacent MHs located near 142 Street NW within the MacKinnon Ravine, a protected area under Edmonton's North Saskatchewan River Valley Area Redevelopment Plan Bylaw No. 7188.

Records for the Trunk are limited to plan and profile drawings, which state the Trunk to be '60" Oval Monolithic Tunnel' but otherwise do not include cross-section details or references to other record drawings containing cross-section details. A City of Edmonton arch rib detail from 1984 is inferred to be the 'best match' to the Trunk geometry that has been observed during inspection. The historic cross-section is presented in Figure 2; the internal dimensions detailed are 1219 mm span by 1778 mm rise and the minimum concrete thickness above and below the springline detailed is 200 mm and 150 mm, respectively.

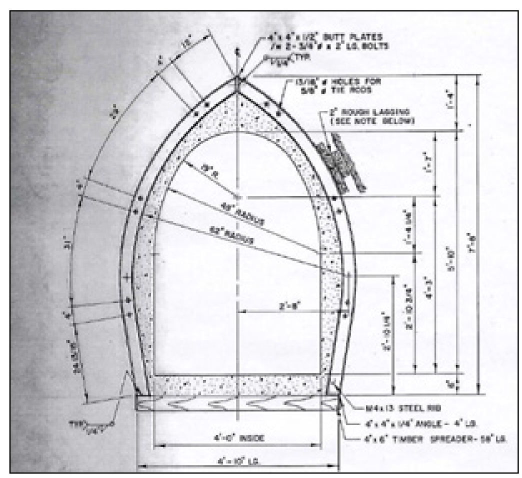


Figure 2. 1984 Arch Rib Detail

An inspection program for the Trunk was completed in 2014 and 2015 prior to the commencement of the Stage 1 project, and a subsequent inspection was completed in 2021 while Stage 1 construction was underway. Both inspections revealed loss of concrete section, accumulation of debris/sediment, infiltration and encrustation, and several holes in the obvert of the concrete liner with external voids and visible soil.

4.0 DESIGN-BUILD REQUEST FOR PROPOSAL

A request for proposal (RFP) including all design and construction services for the rehabilitation of the Trunk was issued by EPCOR in September 2022. The scope included temporary flow control, three temporary working shafts (Shaft 2, Shaft 3, and Shaft 4) to be furnished with access maintenance holes post-rehabilitation, modification of the upstream access MH

Figure 3. Working Shaft Locations

(referred to as Shaft 1) for the purpose of the rehabilitation, and approximately 1025 m of rehabilitation.

The project was conditionally awarded to SCG in November 2022, supported by an engineering team composed of Associated Engineering (Associated) for the rehabilitation design, SMA Consulting for project and risk management support, and SolidEarth Geotechnical for geotechnical instrumentation monitoring.

SCG proposed to rehabilitate the Trunk by sliplining using 950 mm span by 1400 mm rise non- circular (NC) fiberglass reinforced polymer mortar (FRPM) pipe manufactured by HOBAS Pipe USA (HOBAS). Pipe jacking was envisioned as the primary insertion method, supplemented by worker-entry insertion method for the known horizontal curve in the Trunk's alignment near 142 Street NW where pipe jacking would not be feasible.

Following the conditional award, Shafts 2 and 3 were deleted from the scope and replaced with Shaft 2A located at the approximate mid-point of the Trunk as a value-engineering cost-saving opportunity. The RFP design working shaft locations are presented in Figure 3.

5.0 REHABILITATION DESIGN AND EXECUTION

5.1 Initial Cleaning and Inspection

Cleaning during live flow was conducted to facilitate a 3D MSI for the purpose of verifying the condition, cross-sectional geometry, alignment, and profile of the Trunk, which was completed in August 2023. Neither the cleaning nor MSI equipment could traverse the full length of the Trunk due to equipment limitations, and as a result, the Trunk was partially cleaned and inspected from both terminal access locations. The resultant inspection data was 'stitched' to create a continuous model of the Trunk georeferenced to the insertion MHs.

Review of the point cloud generated from the MSI raised concerns over the feasibility of insertion by pipe jacking due to unexpected alignment and profile changes that could result in the angular deflection limits of the proposed FRPM pipe being exceeded or in the pipe becoming stuck during jacking. As a result, SCG revised their planned insertion methodology to be solely worker-entry pending an engineered assessment of the Trunk for short-term rehabilitation access and a conventional tunnel survey post-isolation.

Additionally, while the point cloud model aligned to the expected alignment of the Trunk near the insertion MHs, there was increasing horizontal variance and uncertainty near the 'stitching' point. This uncertainty raised concerns that Shaft 2A could potentially be excavated off-line of the Trunk. To mitigate this risk, the Trunk was physically located by drilling an array of boreholes at the design Shaft 2A location perpendicular to the expected alignment.

Mud rotary drilling was used for the locating effort due to the method's vertical accuracy and comparable faster drilling production. The actual location of the Trunk at Shaft 2A was confirmed via increased torque at depth near the expected elevation of the crown of the Trunk, as well as the identification of timber in the cuttings.

The Trunk was encountered at the design Shaft 2A location but not encountered at its expected location based on the point cloud generated from the MSI, which further introduced uncertainty on the accuracy of the 'stitched' model.

5.2 Shaft Excavation

The anticipated ground conditions for the project consisted of lacustrine clay overlying glacial clay till with the potential for intra-till sand and rafted bedrock. The predominant stratum for the shaft excavations was the glacial clay till. Based on the anticipated ground conditions, SCG opted to excavate the shafts by a combination of hand and machine excavation using liner plates and steel ribs for the support. Excavation of Shaft 4 occurred from September to November 2023 and was followed by the excavation of Shaft 2A from March to May 2024. The excavation of Shaft 4 proceeded the excavation of Shaft 2A due to greater certainty in the location of the Trunk due to proximity to the existing downstream access MHs. Figure 4 depicts the Trunk as exposed during Shaft 2A excavation.

Figure 4. Shaft 2A Excavation

5.3 Trunk Isolation

Isolation of the Trunk was accomplished by installing cast-in-place concrete bulkheads immediately upstream an downstream of the rehabilitation scope. To facilitate a semi-dry working space to install the bulkhead, SCG installed a temporary plywood and sandbag weir system in the Trunk during overnight

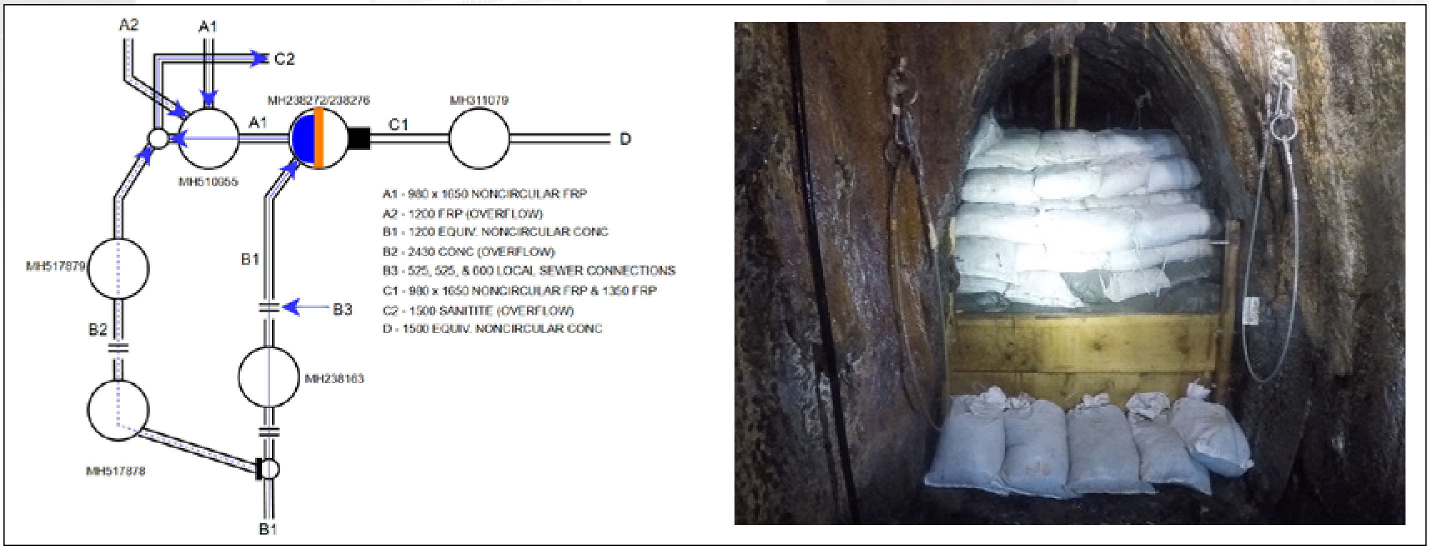


Figure 5. Upstream System Schematic and Temporary Weir System

periods of lower flow. Once in place, the upstream flow passively diverted to the Stage 1 bypass trunk sewer.

Detailed engineering review of the upstream trunk sewer system configuration and hydraulics was completed in support of SCG's isolation plan to verify the concept prior to implementation. While the concept was deemed feasible, the installation was extremely challenging as flow depths overnight were on average 600 to 700 mm, with the potential for the Trunk to surcharge during wet weather events. Figure 5 schematically illustrates the upstream system and isolation concept (temporary weir illustrated in orange and bulkhead illustrated in black) and depicts the temporary weir system installed.

5.4 Engineered Trunk Assessment For Construction Occupancy

Following the successful isolation of the Trunk, a secondary cleaning was completed from Shaft 2A for the purpose of the rehabilitation works. Following the cleaning, Associated conducted a detailed assessment of the Trunk to evaluate temporary short-term worker occupancy to facilitate the rehabilitation. The assessment included a desktop review of the pre- isolation MSI and the previous inspections, as well as a field review of the Trunk's exterior at the excavated working shafts and interior between the working shafts.

At the working shafts, the assessment included core sampling and rebound hammer testing for the purpose of developing a correlation between rebound values and measured compressive strength. Within the Trunk, the assessment included visual observation, concrete sounding, rebound hammer testing, and 'spike testing' – an informal test used to measure the thickness of deteriorated gypsum layers on the interior surface of the Trunk's section by driving survey nails into the concrete until refusal.

Following the field reviews, the estimated remaining capacity of the Trunk's concrete liner was estimated and compared against the estimated moment and thrust demands. In general, the Trunk was determined to have sufficient remaining capacity to resist the estimated demands, however, the field review identified several localized defects of concern (e.g. small voids in the structure's obvert where workers could be potentially exposed to raveling soil). Administrative controls were recommended to monitor localized defects of concern during the course of the rehabilitation works and to backfill grout the inserted FRPM pipe as soon as practical after insertion.

5.5 Post-Isolation Sliplining Planning

Once assessed as safe for short-term worker occupancy, SCG completed a conventional tunnel survey traversing through the Trunk to verify its actual alignment and profile. The post-isolation survey indicated locations of alignment and profile changes that could indeed impact pipe jacking but that did not align with the point cloud model generated from the pre-isolation 3D MSI. Based on the observed and measured variability of the Trunk's alignment and profile, SCG confirmed that the FRPM pipe would be inserted solely by worker-entry as pipe jacking was deemed too risky considering the conditions. Figure 6 depicts SCG's survey specialist traversing through the Trunk.

Post-isolation, the design-build team also identified that the condition of the Trunk's invert would likely have an impact on SCG's pipe insertion productivity and overall project schedule. Several hundred metres of the Trunk's invert was uneven with

Figure 6. Conventional Tunnel Survey

Figure 7. Bonded Invert Material and Rail Installation

various deposition of what is believed to be bonded concrete material – potentially left-over excess material from the Trunk's construction placed on the invert. To facilitate smooth pipe insertion, SCG manually demolished the bonded material and designed and installed a rail system along the invert of the Trunk. Figure 7 depicts the bonded material and invert rail installation.

A lay schedule for the FRPM pipe was prepared using SCG's conventional tunnel survey data and nominal pipe lengths of 0.61 m, 1.22 m, and 2.44 m. Most of the pipes were the 2.44 m nominal length, which was preferred to reduce the number of joints and individual pipes requiring blocking. The shorter pipes were allocated to locations of varying alignment and profile as required to meet the pipe manufacturer's horizontal and vertical allowable angular deviations limits. An example of the developed lay schedule is presented in Figure 8.

5.6 Sliplining Design

The minimum wall thickness of 47 mm for the proposed FRPM pipe was verified to be suitable for the long-

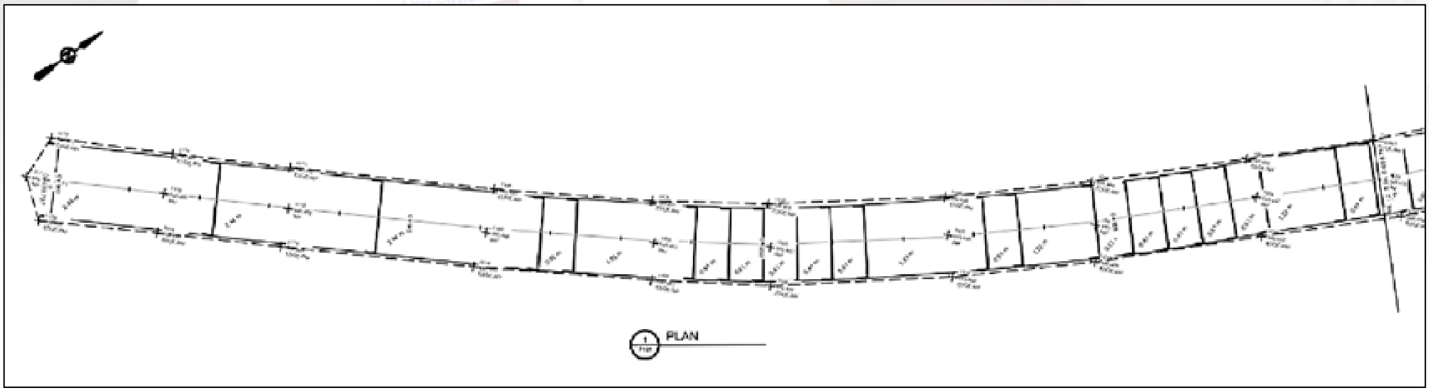


Figure 8. Portion of Lay Schedule for Horizontal Curve near 142 Street NW

term external loading conditions by HOBAS and Associated. HOBAS provided long-term calculations in accordance with WRc Type II design method, which demonstrated safe external head pressure for buckling stability. Associated provided supporting long-term calculations in accordance with ASCE MOP 145 Design State 3, which demonstrated acceptable limit state checks for long-term buckling stability, material strength, and stain corrosion cracking under the design hydrostatic loading and earth loadings. The governing limit state for the ASCE MOP 145 design checks was wall crushing under the design hydrostatic loading due to combined stresses.

Fabrication of the mandrel/mould was authorized by SCG following the pre-isolation MSI as the proposed FRPM pipe cross-section was confirmed to fit within the measured internal cross-section of the Trunk. The quantity of varying length pipes was confirmed following the lay schedule developed post-isolation.

The sliplining design was based on SCG's construction methodology, which was confirmed post-isolation. The relevant design checks included assembly forces during joining and flotation and unconstrained buckling during annular backfill grouting. The sliplining design included timber blocking between the crown of each FRPM pipe and the obvert of the Trunk to restrict flotation. The blocking material and dimensions were designed based on the allowable contact pressure for the FRPM pipe provided by HOBAS, as well as longitudinal bending due to the estimated uplift forces between blocking points. The sliplining rehabilitation design details are presented in Figure 9.

The minimum design compressive strength specified for the annular backfill grout was 3 MPa at 28 days. SCG opted to use a slightly higher strength grout (8 MPa at 28 days) with proven flowability characterized by low measured efflux times (< 18 s) from flow cone tests on previous projects. Grout flowability was a priority to ensure that the grout could successfully flow through the minimal annular clearance at the sidewalls of the FRPM pipe as well as fill observed voids at the obvert of the Trunk.

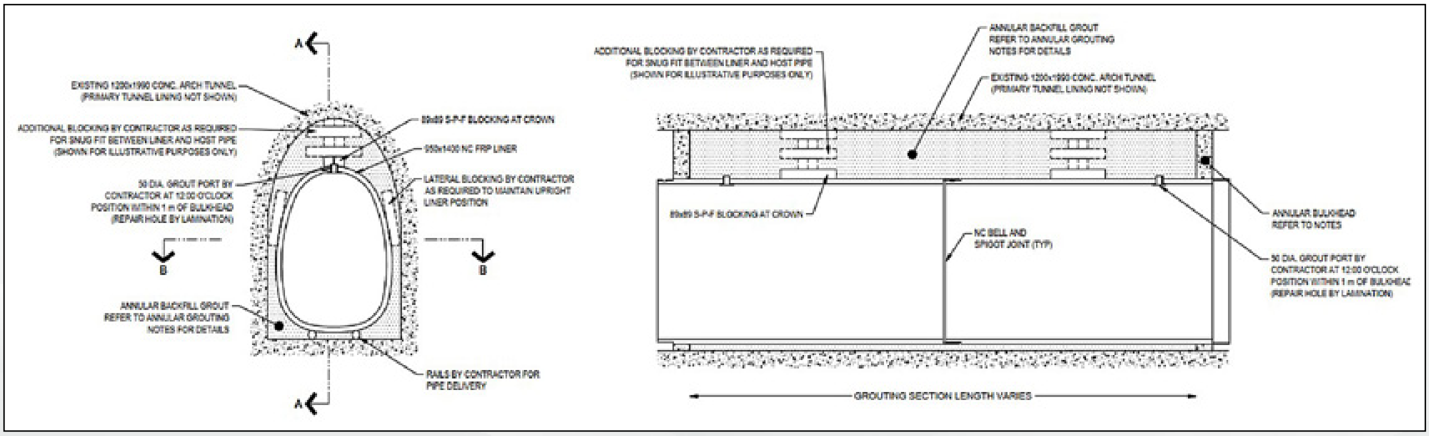


Figure 9. Sliplining Rehabilitation Design Details

Figure 10. Timber Blocking

Figure 11. Infiltration during Sliplining and Annular Dewatering into Inserted FRPM Pipe

5.7 Sliplining Trial

The first pipes inserted into the Trunk were 2.44 m long nominal length pipes inserted in August 2024. During the initial pipe insertions and blocking the project team identified that the 2.44 m long nominal length pipes could not be blocked at their mid-point as intended in the design. Based on the annular access constraints, the centroid of the blocking could only be installed approximately 800 mm from the end of each inserted pipe.

A trail section consisting of five pipe segments was proposed by the design-build team with close monitoring of the pipe joints. Following the successful grouting of the trial section, the revised blocking configuration for the 2.44 m long pipes was deemed suitable and sliplining continued. Figure 10 depicts the timber blocking material compression fit between the FRPM pipe segments and the existing Trunk.

5.8 Sliplining Execution

SCG sliplined the Trunk between August 2024 and April 2025, inserting 443 FRPM pipe segments (a total rehabilitation length of 983 m neglecting joint openings) and partitioning the annulus between the FRPM pipe and the Trunk into 18 distinct grouting sections varying in length between 12.2 m (the trial section noted in Section 5.7) and 75.6 m; the average grouting section length was approximately 55 m.

In general, grouting was accomplished through two ports cored into the obvert of the inserted FRPM pipe: 1) an injection port located at the downstream end of the grouting section and 2) a ventilation port located at the upstream end of the grouting section. The maximum recommended allowable grouting pressure for the FRPM pipe was 55 kPa at the pipe invert. A refusal pressure of 40 kPa was adopted based on the elevation difference between the injection ports pressure gauges and the pipe invert.

A third port, cored into the invert of the inserted FRPM pipe at the downstream end of each grouting section, was introduced after the commencement of sliplining in response to observed groundwater infiltration. Sealing of the existing Trunk was not considered due to the extent of infiltration observed and the length of the rehabilitation scope. The invert ports were used to facilitate passive draining during sliplining and were further actively dewatered with submersible pumps the days preceding the scheduled grouting of a sections. Figure 11 depicts the infiltrated groundwater accumulation during sliplining and the dewatering of the annulus prior to grouting.

Verification of the grouting program was primarily accomplished based on theoretical backfill volume comparisons and a targeted refusal pressure following the discharge of grout from the upstream ventilation port and closing of the ventilation port. Hammer sounding was intended as an additional verification measure, however, proved unreliable due to the variable annular thickness outside of the FRPM pipe; the section of the annulus above the FRPM pipe was observed to falsely 'ring' hollow compared to the sidewalls and invert. Drilling into the annulus was completed to physically verify several false negatives identified by hammer sounding. Towards the latter half of the project, the design-build team experimented with thermal imaging cameras as a potential verification method to observe the heat of hydration reaction of the cementitious backfill grout the days following grouting. Figure 12 depicts an example of the post-grout thermal imaging.

The recorded total volume of the annular backfill grout was 821.5 m^3, approximately 106 percent of the theoretical volume for the annulus between the FRPM pipe and the existing Trunk, considering the timber blocking and annular bulkhead that also occupied the annular space.
Based on the volume balance, measured refusal pressures at the injection ports, physical verification by drilling, and the post-grout thermal imaging the annulus was determined to be successfully filled, meeting the project requirements.

Following completion of annular grouting, the grout ports as well as any joints exceeding the maximum allowable joint gap of 25 mm recommended by HOBAS were laminated in accordance with HOBAS' recommended field lay-up procedures. Only 35 joint laminations were required for the 443 pipes installed.

Figure 12. Post-Grout Thermal Image

6.0 LESSONS LEARNED

In the opinion of the authors, lessons learned from the 99 Avenue Sanitary Trunk Rehabilitation - Stage 2 project that can be considered on future sliplining rehabilitation projects are related to host pipe geometry confirmation, groundwater management, and annular backfill grout verifications.

6.1 Host Pipe Geometry

Host pipe geometry including cross-section certainty, as well as alignment and profile certainty can impact a planned rehabilitation method. In the case of the subject project, SCG revised their planned insertion method from pipe jacking to worker-entry to provide greater control over the pipe placement and joining. Thorough pre-rehabilitation geometric investigation is recommended to inform design and construction planning accurately.

Additionally, it is important to understand the accuracy, uncertainty, and potential limitations and errors when employing MSI for the purpose of host pipe confirmation. Supplemental means of confirmation/verification such as conventional survey or other unconventional methods should be considered to provide confidence in the data.

6.2 Groundwater Management

The magnitude of groundwater infiltration into a trunk sewer is difficult to quantify during live flow. Infiltration is observable above the normal flow depth during inspections but could also be occurring below the normal flow depth depending on the external hydrostatic pressure. In the case of the subject project, the Trunk experienced significant groundwater infiltration through construction joints located approximately 300 mm above invert. Groundwater infiltration should be expected in aging sewer infrastructure below the groundwater table, and contingency plans for groundwater management should be in place at the start of project execution. Accumulated annular groundwater could potentially dilute backfill grout and if unrelieved prior to backfill grouting could even result in unconstrained hydrostatic buckling depending on the magnitude and duration. SCG managed annular groundwater by allowing the passive drainage into the inserted FRPM pipe where it was conveyed to the downstream end of the rehabilitation scope and discharged through ports installed in the downstream isolation bulkhead. Without these ports, the accumulated groundwater would have needed to have been lifted 30 m above ground to be discharged into the system.

6.3 Grout Verification

Verification of annular backfill volume is a challenging process, especially for the sliplining rehabilitation of existing infrastructure that could have cross-sectional variation due to tolerances of the original installation methods or loss of section due to corrosion or erosion. Volume comparison is often the simplest approach but can be subject to inherent uncertainty. In the case of the subject project, the internal dimensions of the Trunk were observed to vary along the alignment: the span varied between approximately 1050 mm and 1400 mm and the rise varied between approximately 1800 mm and 2000 mm. The design-build team conservatively adopted a cross-section of 1200 mm span by 2000 mm rise for the purpose of the volume comparison. As noted in Section 5.8 the design-build team explored thermal imaging to qualitatively confirm the presence of annular backfill grout due to the heat of hydration reaction. Additional verification and sensitivity analysis using this approach is required as the heat of hydration generated would depend on the size/thickness of the annular space, the grout mix design, and the thermal conductivity/resistivity of the sliplining pipe materials.

7.0 CONCLUSIONS

The 99 Avenue Sanitary Trunk Rehabilitation - Stage 2 project demonstrates some of the complexities that can be encountered during the sliplining rehabilitation of deep large diameter trunk sewers. Through detailed investigations, flexible design adaptations, and a comprehensive and adaptable rehabilitation plan, the project was completed delivering a structurally sound and functional trunk sewer.

8.0 REFERENCES

Chinnathambi, V., et al. (2023). 99 Avenue Sanitary Trunk Bypass: Stage 1 – Microtunnel Installation, North American Society for Trenchless Technology (NASTT), NASTT's 2023 No-Dig North Show, Edmonton Alberta.

NASTT Events Calendar

NO-DIG SHOW

Since its inception in 1991, the NASTT 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.

The NASTT No-Dig Show is the ideal event for municipalities, contractors and engineers.

Upcoming Conferences, Courses & Events

February 12
Northwest Technical Luncheon
Edmonton, Alberta, Canada

February 17
Introduction to Trenchless Technology – New Installations
Virtual

February 25 - 26
HDD Good Practices Course
Virtual

March 29 - April 2, 2026
NASTT 2026 No-Dig Show
Palm Springs, California, USA

March 29
Introduction to Trenchless Technology – New Installations
Palm Springs, California, USA

March 29
Introduction to Trenchless Technology – Rehabilitation
Palm Springs, California, USA

March 29
Sewer Laterals Good Practices Course
Palm Springs, California, USA

April 1 - 2
CIPP Good Practices Course
Palm Springs, California, USA

April 1 - 2
HDD Good Practices Course
Palm Springs, California, USA

April 1 - 2
New Installation Methods Good Practices Course
Palm Springs, California, USA

April 1 - 2
Pipe Bursting Good Practices Course
Palm Springs, California, USA

April 1 - 2
Direct Steerable Pipe Thrusting Good Practices Course
Palm Springs, California, USA

November 2 - 4, 2026
NASTT 2026 No-Dig North
Calgary, Alberta, Canada

November 9-10
10th Annual Northeast Trenchless Conference
Saratoga Springs, New York, USA

March 21 – March 25, 2027
NASTT 2027 No-Dig Show
Raleigh, North Carolina, USA

For more information and the latest course offerings, visit nastt.org/training/events.

March 29 - April 2, 2026

Palm Springs Convention Center
Palm Springs, California

March 21 – March 25, 2027

Raleigh Convention Center
Raleigh, North Carolina

SPONSORSHIPS:

For more information and the latest course offerings, visit nastt.org/training/events.

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

- Opening Breakfast Table Sponsorships
- Mobile App Sponsorships
- Premium Conference Sponsorships
- And more!

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

888-388-2554

Index to Advertisers