Trenchless Elevated Journal 2026

Trenchless Elevated 2026
16th Annual Regional Conference

Thursday, February 5
Conference Center at Miller Campus Sandy, UT

HDPE PE4710 PIPE

The Best Choice For Water Systems

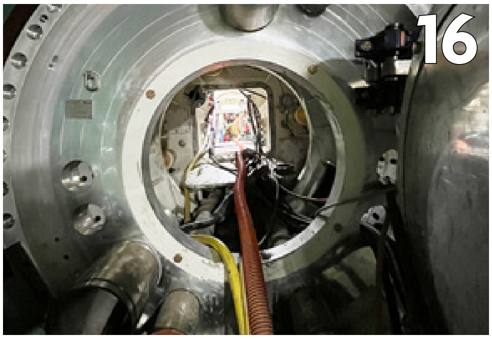
	TOP 10 Features and Benefits	HDPE	D. Iron
1	**Applications:** Potable Water (Lead Free), Raw Water, Reclaimed Water, and Wastewater	✓	✓
	References: AWWA C901, C906, C151, & NSF 61 + Health Effects of HDPE Pipes and Fittings for Potable Water Applications, NSF 2024		
2	Open Cut Construction: Design and 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	✓	X
	Ref: ASTM F585, F1962, F3508 + MAB-5, MAB-7, MAB-11		
4	**Fully Restrained Joint-Free System:** Minimize need for fittings to facilitate horizontal and vertical deflections	✓	X
	Ref: AWWA M55, M41		
5	**Longevity & Corrosion:** Pipes, Fittings, and Joints have the least potential for corrosion or tuberculation	✓	X
	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		
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	✓	X
	Refrences: AWWA M55, M41 + ASTM F2620, F3190, F3565 and MAB-1, MAB-2, MAB-8		
8	**Cost Effective:** Has the lowest initial cost, lowest life cycle cost, and lowest restoration cost for trenchless installations	✓	X
	References: Life Cycle Analysis of Water Networks, CSIRO 2008 + Annual Drinking Water Quality Report for 2014, Kittery Water District, 5/31/15		
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	✓	X
	References: Recent Earthquakes: Implications for U.S. Water Utilities, WRF 2012 + Polyethylene Pipeline Performance Against Earthquake, Kubota 2018 and MAB-9, MAB-10		
10	**Permeation/BTEX:** Pipes and elastomeric joints need to be properly engineered for contaminated conditions	X	X
	References: AWWA C901/C906 and C111/C151, Sec. 4		

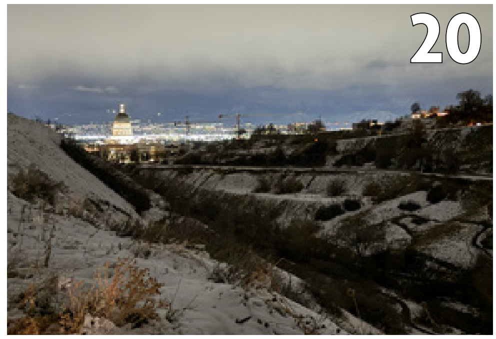
MUNICIPAL ADVISORY BOARD

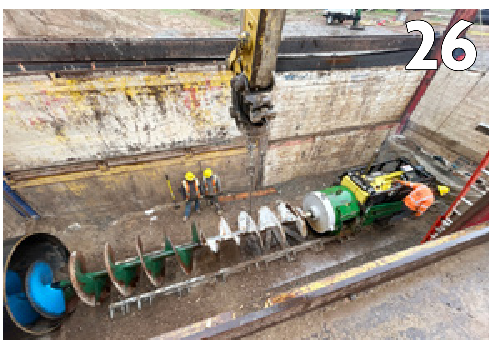
Additional information including MAB-3 Model Spec Guide can be found at www.plasticpipe.org/mabpubs

CONTENTS

Features:







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MESSAGE FROM THE RMNASTT CHAIR

Chris Knott, RMNASTT Chair

Momentum, Engagement and Growth

As I reflect on 2025, I'm incredibly proud of the momentum, engagement, and growth we've experienced as the Rocky Mountain Chapter of NASTT. This year truly showcased the strength of our community including contractors, engineers, owners, manufacturers, students and partners coming together to learn, connect, and advance trenchless technology across the region.

We kicked off the year with strong participation at our Colorado Holiday Party in January, followed closely by our Utah Holiday Party, setting an energetic tone for collaboration across state lines. In February, many of our members traveled to Trenchless Elevated 2025 in Omaha, where the Rocky Mountain Chapter was well represented and actively engaged in technical education and national dialogue around innovation in our industry.

Throughout the year, we continued to deliver meaningful, hands-on experiences. Our 7th Annual Utah Sporting Clay Shoot in April in conjunction with the WEAU conference once again brought members together for a great cause, blending networking with support for chapter initiatives. In July, we hosted The Utility Huddle: Happy Hour with a Purpose at Empower Field, an event that reinforced our commitment to building connections beyond the jobsite and fostering relationships that strengthen our industry with over 100 attendees.

> This year truly showcased the strength of our community!

The fall season was especially impactful. Our Colorado Annual Clay Shoot in October was another standout event, drawing strong attendance and continued support from our members and sponsors. This was a partnered event with our friends at NUCA, the National Utility Contractors Association. We also capped off the year with an outstanding site tour of the Lowell & 88th Water & Sanitation Realignment Project, offering a behind-the-scenes look at real-world trenchless applications and the collaborative problem-solving that defines our work with our largest group yet at over 80 spectators.

None of this would be possible without the dedication of our Board of Directors, committee volunteers, sponsors, and members who consistently step up to support the chapter. Your time, expertise, and enthusiasm are what make RMNASTT such a valuable resource in the Rocky Mountain region.

As you read this, we are excited to welcome you to Trenchless Elevated 2026 here in Utah. Hosting this conference for the 16th year is a major milestone for the Rocky Mountain Chapter and a tremendous opportunity to showcase our region on a national stage. With top-tier technical sessions, industry-leading speakers, and unmatched networking opportunities, Trenchless Elevated 2026 reflects the innovation, collaboration, and forward momentum that define both our chapter and the trenchless industry as a whole.

> Thank you for being part of this incredible community.

Looking just beyond this conference, we are also excited to see the global trenchless community come together again at the 2026 No-Dig Show, hosted by NASTT this March in Palm Springs, California. As the industry's premier international event, No-Dig provides an unparalleled platform for education, innovation, and connection across all sectors of trenchless technology. We encourage our members to continue the conversations started here in Utah and join us in Palm Springs as we collectively advance the future of underground infrastructure. **https://nastt.org/no-dig-show/**

Thank you for being part of this incredible community. I look forward to continuing our work together in 2026 as we grow and elevate trenchless technology across our region.

Additional information on the chapter and our events and meetings can be found on our website **www.rmnastt.org**

Best regards,

Chris Knott

Chair, Rocky Mountain Chapter of NASTT
2025 NASTT Chair Award for Distinguished Service Recipient

Meet Your Career Goals

Stay ahead of the curve.

- NASTT Good Practices Courses
- *Trenchless North America* & E-news
- Regional chapter magazines
- NASTT technical papers

Make valuable connections.

- NASTT Member Directory
- Speaking & training opportunities
- Conferences, training and events
- Exhibit, sponsorship and advertising opportunities

Share your knowledge.

- Leadership positions
- Student scholarships
- Authorship opportunities
- Trenchless Job Board

Gain new skills and experiences.

- Volunteer projects & committees
- Award programs
- Pipe Bursting Center of Excellence

Find new ideas and solutions.

- NASTT No-Dig Show | No-Dig North
- Regional chapter events
- NASTT Scholarship Fund Auction
- Municipal Scholarship Program

NASTT™

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NASTT membership equips and empowers you to thrive in your career.

BECOME AN EXPERT. SAVE MONEY. BOOST YOUR VISIBILITY.
STAY AHEAD OF THE CURVE. FIND SOLUTIONS. GAIN NEW SKILLS AND EXPERIENCES.
GROW YOUR NETWORK. ADVANCE YOUR CAREER.

MESSAGE FROM THE NASTT CHAIR

Greg Tippett, P.Eng

The Rocky Mountain Regional Chapter plays a vital role

On behalf of the NASTT Board of Directors, I want to extend my sincere thanks to each of you for your continued engagement, leadership, and dedication to advancing trenchless technology across the Rocky Mountain region. Your chapter exemplifies what makes NASTT strong: committed professionals who value education, collaboration, and the shared goal of improving underground infrastructure through innovative and sustainable practices.

I am especially excited to highlight the upcoming RMNASTT Trenchless Elevated Conference taking place on February 5. This event represents the very best of regional programming, offering high-quality technical education, practical insight, and meaningful opportunities to connect with peers and industry leaders. From emerging technologies to real-world project experience, Trenchless Elevated reflects the depth of expertise within your chapter and the importance of regional forums that address local challenges and opportunities. I commend the planning committee, speakers, sponsors, and volunteers who have worked tirelessly to bring this event together. Your efforts do not go unnoticed, and they make a real impact.

> Thank you for all that you do!

As we look ahead, I also encourage you to mark your calendars for the NASTT 2026 No-Dig Show, which will take place March 29 through April 2 in Palm Springs, California. This premier event brings together the global trenchless community for unparalleled education, networking, and innovation. The No-Dig Show continues to evolve, and the upcoming program will feature expanded technical sessions, a dynamic exhibit hall, and new networking experiences designed to foster connection across all sectors of our industry.

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.

Your participation, whether as attendees, presenters, exhibitors, or volunteers, helps ensure the continued success and relevance of this flagship event.

None of this would be possible without the extraordinary commitment of our chapter leaders, volunteers, sponsors, and engaged members. The time they give to planning events, mentoring others, sharing knowledge and supporting NASTT initiatives strengthens not only your region, but the entire organization. I thank them for their professionalism, passion, and willingness to contribute.

The Rocky Mountain Regional Chapter plays a vital role in shaping the future of trenchless technology, and I am grateful for their leadership and collaboration.

Thank you for all that you do in service of our industry and our association.

Sincerely,

Greg Tippett, P.Eng

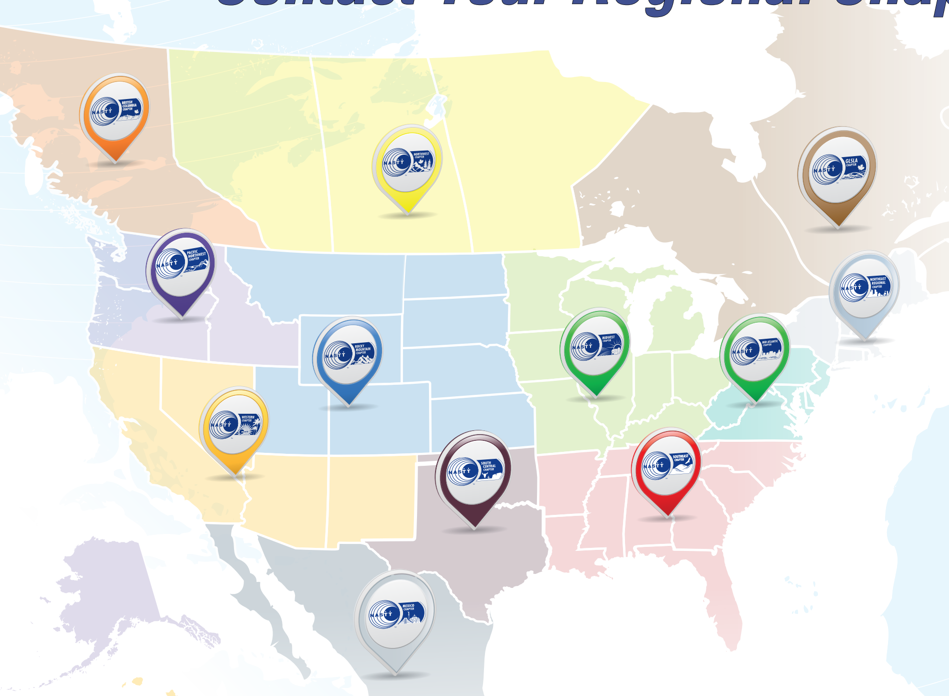
Greg Tippett, P.Eng
Chair, NASTT Board of Directors

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

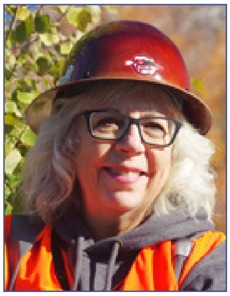
2026-2027 RMNASTT EXECUTIVE COMMITTEE

Chris Knott – *Chair*

For over 30 years, Chris Knott has shaped civil utilities construction, working his way through the ranks of laborer, auger bore crew operator, supervisor, project manager, estimator, and finally director. Chris has been with BT Construction since 2005, overseeing a diversity of trenchless methods and was pivotal in the creation of BTrenchless, Inc., the company's trenchless division. Now, as the Director of Trenchless Estimating, Chris endorses BTrenchless as the premier tunneling contractor, excelling in Pipe Ramming, Auger Boring, Pilot Tube, TBM, Microtunnels, Hand Tunneling and Slip Lining.

Chris advises engineers, owners, and contractors on optimal trenchless methods across varied soil conditions and site restrictions. He has presented at educational institutions including the Colorado School of Mines and the University of Colorado-Boulder.

Chris has also been a lacrosse coach for the last 20 years and brings his championship-level enthusiasm to work. He orchestrated the first Rocky Mountain NASTT No-Dig in 2010 and remains active on the local board. He is also involved at the national level as Director, organizing events such as the Program and Auction Committee for the National show. Chris is invested in growing the trenchless industry and NASTT memberships - channeling his expertise and energy, both in and out of the field.



Stephanie Nix-Thomas, P.E. - *Immediate Past Chair*

Stephanie Nix-Thomas joined the family business in January of 2000. In 2002, she and her brother, Jon Nix purchased the business from their parents and two years later, they completed the first pilot tube microtunneling project in the State of Utah.

In 2005, they made the decision to focus their general contracting company on trenchless methods of construction. In the same year, they won recognition from NASTT for pioneering pilot tube pipe ramming on the commuter rail project in Utah. Over the years they have gained expertise in not only pilot tube microtunneling, but also tunnel bore, auger bore, pipe ramming, pipe bursting and any combination of methods. They have made choosing the 'right horse for the course' a resource for construction projects and for assisting engineers with trenchless designs.

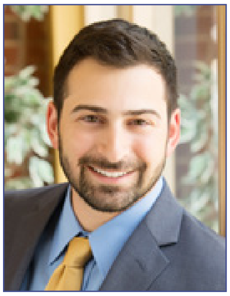
At the inception of the Rocky Mountain Chapter of NASTT, Nix Construction established Utah's first group of participants. Stephanie was involved from the beginning and organized two one-day 'Training Days' in 2015 and 2016. In the fall of 2016, she led the organization of the first regional chapter conference on the west side of the Rockies and has led or helped with conferences in Utah and Colorado since. Currently, Stephanie is the Immediate Past Chair of the Rocky Mountain Chapter and a member of the national board of NASTT.

Stephanie earned her degree in civil and environmental engineering with a business minor from Utah State University in 1984. She worked as a consultant engineer in Salt Lake City for seven years before moving to the State Department of Environmental Quality where she worked in water quality as an environmental engineer. In 1992 she moved to the policy office of DEQ as a liaison with small businesses and Native American tribes.

Rebecca Brock – *Chair Elect*

Becky Brock is the president and owner of Brock Geo-Consulting, which she established in 2019. Becky has over 25 years of experience specializing in geo-engineering, geo-hazards, trenchless and tunneling design, and tunnel inspections. Becky has a BS in Civil Engineering and MS in Geological Engineering and is a registered Professional Engineer in Colorado and California. Her experience includes projects located within complex geological sites affected by collapsible and expansive soils, soft ground, running ground, and mixed face conditions. For trenchless and tunnel projects she provides geological evaluation and design, development of contract drawings and specifications, construction management, assistance with differing site condition claims, and litigation support. Additionally, Becky is an adjunct professor at the Colorado School of Mines in the Geological Engineering Department teaching senior and graduate-level courses. As a member of the RMNASTT Executive Board she is working to grow the Chapter's goal of promoting trenchless technology education in the Rocky Mountain region.

2026-2027 RMNASTT EXECUTIVE COMMITTEE



Kyle Friedman - *Treasurer*

Kyle Friedman is an Associate Project Engineer for Brierley Associates out of the Denver, Colorado office. Kyle has been in the trenchless industry for 8 years and has had an impactful presence within the trenchless community including one award as part of the project team for the 2021 best small project of the year by Engineering News Record for the Empire State Trail Box Tunnel and one award for the 2022 Construction Management Team Member of the year, for the Bismarck Airport. Kyle's true skills come as being a knowledgeable, hands-on field project manager working with owners and contractors.

Kyle has worked on trenchless installations around the country within a variety of ground conditions and installation methods and has witnessed over 15,000 linear feet of trenchless installations. Committed to furthering the use and teachings of trenchless technologies, Kyle has continued to be an active member of the Rocky Mountain Society for Trenchless Technology since 2019.

Matthew Olson - *Secretary*

Matthew Olson is a professional engineer with experience in all stages of the project lifecycle with a myriad of trenchless construction techniques. This experience has been gained through a diverse point of view through instrumentation, monitoring, and analysis of jacking forces as an academic, shoveling sticky clay from an auger boring spoil chute and signaling cranes as a laborer, and back-to-back MS Teams meetings as an engineering consultant. A past partner of Lithos Engineer, Mr. Olson now leads the HDD practice at GEI Consultants, Inc. He is the Secretary for the RMNASTT and leads development of the ***Trenchless Elevated Journal***.

He is the past recipient of two Outstanding Paper awards from the No Dig Show and the 2022 Ralston Young Trenchless Achievement Award. He has volunteered for several NASTT committees since 2012, including student chapter, technical program, and young professional committees.

2026-2027 RMNASTT BOARD OF DIRECTORS

Chair Elect – Chris Knott
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chris.knott@btrenchless.com

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Trenchless Elevated 2026

Rocky Mountain Chapter North American Society for Trenchless Technology - RMNASTT

16th Annual Regional Conference

Thursday, February 5, 2026 | 7:30 am - 6:00 pm | Conference Center at Miller Campus Sandy, UT

Welcome to scenic Utah to learn about the latest in trenchless technology from experts in the field. Registration for the conference includes an informative one-day technical program and industry exhibits. All of the benefits of a national conference in a smaller environment!

Conference Information

Who should attend?

Owners, utilities, municipalities, as well as engineers, contractors, manufacturers, suppliers, and students involved in the repair and replacement of underground infrastructure.

Why should I attend?

- NETWORK with underground construction professionals in the Rocky Mountain region
- LEARN about the practical and cost-saving benefits of trenchless technology
- EXPLORE trenchless exhibits showcasing new construction and rehabilitation products/services

About RMNASTT:

RMNASTT is a non-profit organization formed in 2009 to serve as a regional chapter of NASTT (North American Society for Trenchless Technology). The Rocky Mountain Chapter promotes education and implementation of trenchless technology throughout Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah and Wyoming. The Chapter's goal is to increase education and awareness of trenchless technologies for pipeline rehabilitation and new construction applications. The RMNASTT annual conference is a valuable educational and networking event for public officials, engineers, utility company personnel, designers, consultants and contractors who are involved or interested in the construction, rehabilitation, and management of underground utilities.

Trenchless Elevated 2026

RMNASTT 16th Annual Conference
Rocky Mountain Chapter
North American Society for Trenchless Technology

NASTT Rocky Mountain Chapter

Thursday, February 5, 2026 | 7:30 am – 6:00 pm | Conference Center at Miller Campus Sandy, UT

Time / Tracks	Conference Events Schedule	
7:30 - 8:30	**Registration and Breakfast**	
8:30 - 8:40	**Introduction and Welcome - Brad Conder & Steven Meyer, 2026 Trenchless Elevated Committee**	
Time/Tracks	**New Install Track - Room A** ***Moderator: Steven Meyer, PE (Bowen Collins)***	**Rehabilitation Track - Room B** ***Moderator: Brad Conder, PE (Azuria)***
8:40 - 9:45	Platinum Sponsor Introduction - Azuria Water Solutions	
8:45 - 9:15	Guided Auger Bore Crossings - Proposed Sewer Lines Under Bangerter Highway at 4700 S, Taylorsville, UT **Andrew Bowman, PE | Igor Gartenflyus - UIT**	Large Diameter Pipe Lining Options for Seismic Resiliency: Steel and HDPE Case Study **Brittany Sorenson, PE - Brown & Caldwell**
9:15 - 9:45	Alternate Tunneling Technologies to Address Conventional Ranney Well Construction Challenges **Jim Kriss, PE - Carrollo Engineers**	Structural Rehabilitation of 12 ft CMP and Protecting Fish Passage by Spray Applied Pipe Lining with Geopolymer Mortar **Kurt Chirbas - GeoTree Solutions**
9:45 - 10:15	Visualizing the Fundamentals of Sound HDD Design **Drew Sparks, PE - Laney Directional Drilling**	Close Tolerance Pipe Slurrification (CTPS) Case Study **Brian Goad, PE - Insituform Technologies**
10:15 - 10:35	**Vendor Area Visit**	
Time/Tracks	**New Install Track - Room A** ***Moderator: Chris Knott (BT Construction)***	**Rehabilitation Track - Room B** ***Moderator: Nick Boyer (Cardinal Coatings)***
10:35 - 10:40	Platinum Sponsor Introduction - BT Construction	
10:40 - 11:10	Lowell & 8th Ave Sanitary Realignment Trenchless Installation **James Carroll - BT Construction**	How Casper Is Leveraging a Large Trenchless Toolbox to Restore the NPSSI: A Real Success Story **Mark Wade, PE - Blue Water Solutions Group**
11:10 - 11:40	Guided Pipe Ram Through Saturated Granular Soils with Groundwater Dewatering **Ryan O'Connell, PE | Isabel Garlock, EIT - Kilduff Underground**	Structural Manhole Rehabilitation - When it is Needed and How to Make it Happen **Jeff Maier, PE - Dewberry Engineers**
11:40 - 12:00	**Vendor Area Visit**	
12:00 - 1:00	Lunch - Presented by Platinum Sponsor Hobas Pipe USA	
Time/Tracks	***Moderator: Colby Willis (GEI Consultants)***	
1:00 - 1:05	Platinum Sponsor Introduction - Cardinal Infrastructure Services	
1:05 - 1:20	RMNASTT 2026 Projects of the Year **New Installation**: To be Announced | **Rehabilitation**: To be Announced	
1:20 - 1:50	Subaqueous Recovery and Rock Excavation: Technical Achievements of the Deer Creek Microtunnel (New Install - MTBM) **Glen Wheeler - James W. Fowler Co.**	
1:50 - 2:20	Salt Lake City's High Pressure Waterline Rehab (Rehab - Flexible Fabric Reinforced Pipe) **Tyler Roberts, PE | David Asay - JUB Engineers & Advantage Reline**	
2:20 - 2:50	Making the Ground Behave: Utah's Largest Diameter Pipe Ram Under Rails (New Installation - Pipe Ram) **Chris Hackworth - Claude H. Nix Construction**	
2:50 - 3:10	**Vendor Area Visit**	
Time/Tracks	***Moderator: Joey Willardson (Kimley-Horn)***	
3:10 - 3:15	Platinum Sponsor Introduction	
3:15 - 3:45	South Academy Blvd TBM Storm Sewer Installation (New Installation - Tunnel Boring Machine) **Irene Truitt, EIT | Ryan O'Connell, PE - Kilduff Underground Engineering**	
3:45 - 4:15	Tunnel Crossings in the 11800 South Sewer & Water Project **Brent Packer, PE | Ryan Marsters, PE - Bowen Collins & GEI**	
4:15 - 4:35	**Owner's Project Look Ahead**	
4:35 - 4:50	RMNASTT Conference Wrap Up - **Stephanie Nix (RMNASTT Chairman)**	
4:50 - 6:00	**Social Hour in Exhibit Area and Outdoor Deck Presented by Platinum Sponsor - Nix Construction**	

Trenchless Elevated Networking, Education & Fun!

RMNASTT Chapter hosts a range of entertaining social and educational events across the Rocky Mountains/Great Plains region

OUR MISSION:

To advance the science and practice of Trenchless Technology for the public benefit by promoting education, training, research, development, information; and to disseminate, through public forums, the improvements and status of Trenchless Technology. Founded in 2008, The Rocky Mountain Chapter of NASTT (RMNASTT) promotes the NASTT mission within our region of Colorado, Kansas, Montana, Nebraska, North Dakota, South Dakota, Utah and Wyoming.

HERE'S WHAT WE DO!

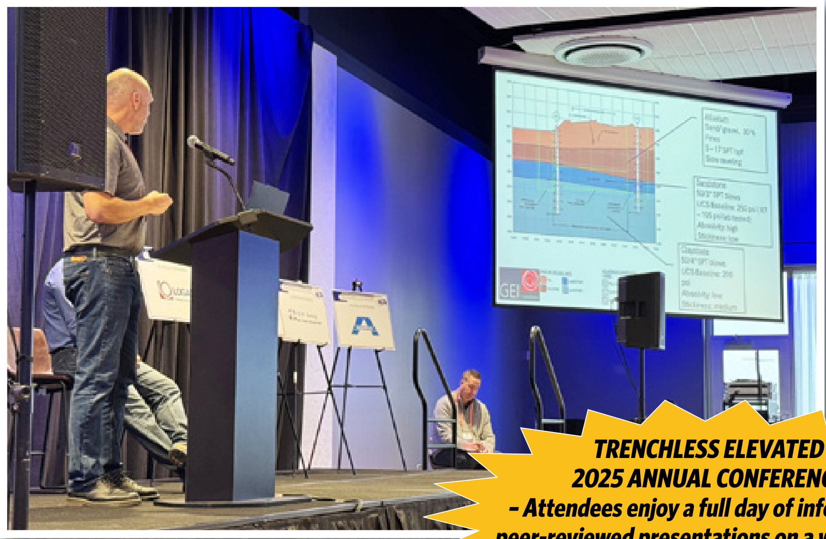
2025 Events:

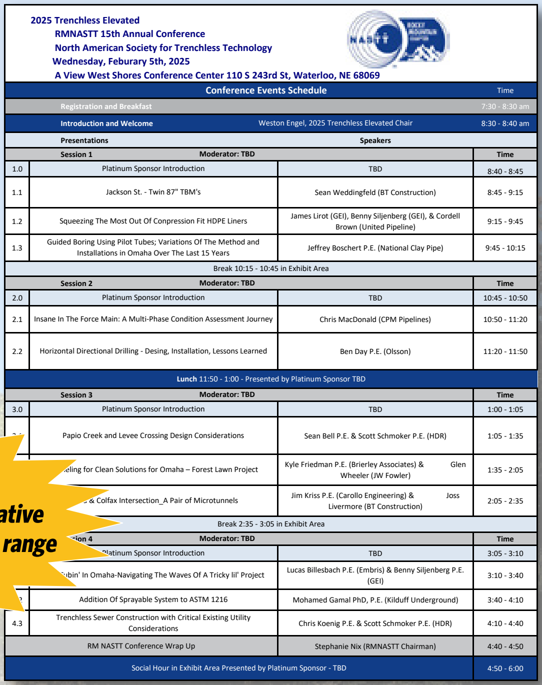
17 Oct 2025	Site Tour: Lowell & 88th Water & Sanitation Realignment Project
3 Oct 2025	RMNASTT Colorado Annual Clay Shoot
16 Jul 2025	The Utility Huddle: Happy Hour with a Purpose at Empower Field
23-25 Apr 2025	WEAU Annual Conference
22 Apr 2025	7th Annual Utah Sporting Clay Shoot
5 Feb 2025	Trenchless Elevated 2025 - Omaha, NE
29 Jan 2025	Colorado Holiday Party 2025!
22 Jan 2025	Utah Holiday Party 2025

HAPPY HOUR SOCIALIZING – Networking and Fun

Trenchless Events 2025

The RMNASTT Chapter Board of Directors thanks everyone for their participation!





2025 Trenchless Elevated
RMNASTT 15th Annual Conference
North American Society for Trenchless Technology
Wednesday, Feburary 5th, 2025
A View West Shores Conference Center 110 S 243rd St, Waterloo, NE 68069

Conference Events Schedule			Time
Registration and Breakfast			7:30 - 8:30 am
Introduction and Welcome		Weston Engel, 2025 Trenchless Elevated Chair	8:30 - 8:40 am
Presentations		Speakers	
Session 1	Moderator: TBD		Time
1.0	Platinum Sponsor Introduction	TBD	8:40 - 8:45
1.1	Jackson St. - Twin 87" TBM's	Sean Weddingfeld (BT Construction)	8:45 - 9:15
1.2	Squeezing The Most Out Of Conpression Fit HDPE Liners	James Lirot (GEI), Benny Siljenberg (GEI), & Cordell Brown (United Pipeline)	9:15 - 9:45
1.3	Guided Boring Using Pilot Tubes; Variations Of The Method and Installations in Omaha Over The Last 15 Years	Jeffrey Boschert P.E. (National Clay Pipe)	9:45 - 10:15
Break 10:15 - 10:45 in Exhibit Area			
Session 2	Moderator: TBD		Time
2.0	Platinum Sponsor Introduction	TBD	10:45 - 10:50
2.1	Insane In The Force Main: A Multi-Phase Condition Assessment Journey	Chris MacDonald (CPM Pipelines)	10:50 - 11:20
2.2	Horizontal Directional Drilling - Desing, Installation, Lessons Learned	Ben Day P.E. (Olsson)	11:20 - 11:50
Lunch 11:50 - 1:00 - Presented by Platinum Sponsor TBD			
Session 3	Moderator: TBD		Time
3.0	Platinum Sponsor Introduction	TBD	1:00 - 1:05
[illegible]	Papio Creek and Levee Crossing Design Considerations	Sean Bell P.E. & Scott Schmoker P.E. (HDR)	1:05 - 1:35
[illegible]	[illegible]eling for Clean Solutions for Omaha – Forest Lawn Project	Kyle Friedman P.E. (Brierley Associates) & Glen Wheeler (JW Fowler)	1:35 - 2:05
[illegible]	[illegible] & Colfax Intersection_A Pair of Microtunnels	Jim Kriss P.E. (Carollo Engineering) & Joss Livermore (BT Construction)	2:05 - 2:35
Break 2:35 - 3:05 in Exhibit Area			
[illegible]ion 4	Moderator: TBD		Time
[illegible]	[illegible]latinum Sponsor Introduction	TBD	3:05 - 3:10
[illegible]	[illegible]ubin' In Omaha-Navigating The Waves Of A Tricky lil' Project	Lucas Billesbach P.E. (Embris) & Benny Siljenberg P.E. (GEI)	3:10 - 3:40
[illegible]	Addition Of Sprayable System to ASTM 1216	Mohamed Gamal PhD, P.E. (Kilduff Underground)	3:40 - 4:10
4.3	Trenchless Sewer Construction with Critical Existing Utility Considerations	Chris Koenig P.E. & Scott Schmoker P.E. (HDR)	4:10 - 4:40
RM NASTT Conference Wrap Up		Stephanie Nix (RMNASTT Chairman)	4:40 - 4:50
Social Hour in Exhibit Area Presented by Platinum Sponsor - TBD			4:50 - 6:00

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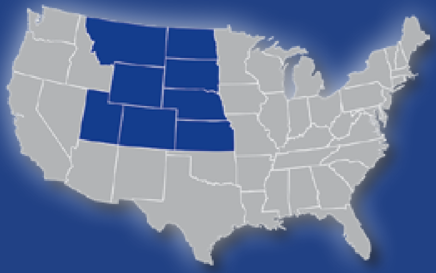

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Subaqueous Recovery and Rock Excavation:

Technical Achievements of the Deer Creek Microtunnel

By: Glen Wheeler, J.W. Fowler Tunneling LLC

INTRODUCTION

The Deer Creek Intake Project (DCIP) was designed and constructed to upgrade the water supply infrastructure at Deer Creek Reservoir in Utah, a critical component of the Provo River Water Users Association system. The existing intake facilities, originally constructed in the late 1930s as part of the dam's initial development, were constrained by aging infrastructure, limited redundancy, and restricted operational flexibility. The primary objective of the project was to construct a new submerged intake and intake tunnel that would improve long-term reliability while minimizing operational risk to the dam and reservoir, while also providing the operational flexibility necessary to perform future maintenance on the existing intake gates without interrupting water supply.

The close proximity of existing dam structures, penstocks, and an active highway corridor required minimizing surface disturbance and tightly controlling risk to the operating reservoir (See Figure 1). These constraints directed the selection of a trenchless solution, consisting of a rock microtunnel installed beneath the reservoir to connect a new intake structure to a downstream vault portal. The alignment passed entirely through bedrock and beneath the full hydrostatic head of the reservoir, leaving little opportunity for intervention once tunneling had progressed past the dam's grout curtain.

The project was delivered using a Construction Manager/General Contractor (CM/GC) contract model, allowing early contractor involvement during design development and constructability reviews. This delivery approach proved particularly beneficial for managing trenchless risk in variable rock conditions. A Geotechnical Baseline Report was incorporated into the contract documents to define anticipated ground behavior and establish baseline rock strength, abrasivity, groundwater conditions, and construction tolerances for differing site condition evaluation.

ABOUT THE AUTHOR:

Glen Wheeler *is the Chief Tunnel Engineer for JW Fowler Tunneling, LLC, based in Dallas, Oregon. He leads technical development of JWF's most challenging trenchless projects with a focus on new tunnel installations including microtunneling, hard rock tunneling, pipe ramming, earth pressure balance tunneling, and deep shaft construction. He is the Immediate Past Chair Pacific Northwest NASTT Regional Chapter.*

Figure 1: Project location and overall site layout

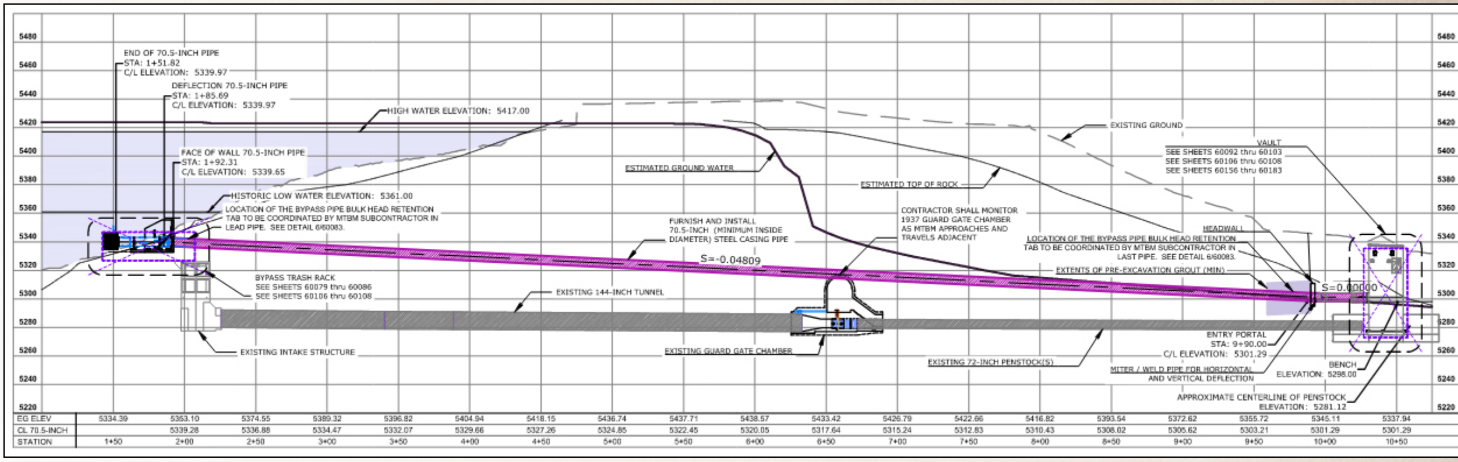


Figure 2: Profile of microtunnel alignment

> The project was delivered using a Construction Manager/ General Contractor (CM/GC) contract model.

GEOLOGIC SETTING

The microtunnel alignment passed through limestone of the Pennsylvanian Oquirrh Formation, Bridal Veil Falls Member, characterized by thin- to medium-bedded limestone with localized sandy limestone, breccia, and sandstone.

Rock quality was highly variable, with Rock Quality Designation values ranging from 0- to 100-percent and averaging approximately 40- to 50-percent along the alignment. Unconfined compressive strengths typically ranged from about 4,000 to 16,000 psi, with localized values exceeding 20,000 psi near the portals.

Figure 3: Hard rock cutting wheel

Cerchar Abrasivity Index testing yielded values between 1.7 and 2.9, classifying the limestone as abrasive to very abrasive, largely due to quartz-rich intervals. Groundwater conditions were strongly influenced by reservoir elevation, with rock mass permeability ranging from approximately 10^{-5} to 10^{-3} cm/s and piezometric levels generally following bedding orientation.

The microtunnel consisted of approximately 800 feet of rock excavation to install a 70.5-inch internal diameter steel casing, with an excavated diameter of approximately 74.6 inches including overcut (See Figure 2). Limited annular clearance heightened sensitivity to overbreak and rock block convergence.

The launch portal was constructed within a benched excavation adjacent to the dam abutment. Overburden materials consisted of fill and colluvium overlying fractured limestone, requiring pre-excavation grouting to reduce inflows and stabilize poor-quality rock. A reinforced concrete vault shaft served as the jacking pit, thrust reaction structure, and interface with existing penstock tunnels.

MTBM CONFIGURATION

The Microtunnel Boring Machine (MTBM) was set up to excavate rock with a hard rock cutting wheel, annulus flushing circuits, and a telescopic

Figure 4: MTBM launch portal

Figure 5: Bulkhead

> Limited annular clearance heightened sensitivity to overbreak and rock block convergence.

can with rock grippers (See Figure 3). The cutterhead was designed to accommodate abrasive limestone and mixed-face conditions and included provisions for back-loading cutters. There was one planned atmospheric intervention that took place before the MTBM progressed through the dam's water stop grout curtain.

MANAGING CONSTRUCTION RISKS

Several specialized systems were incorporated to manage construction risks associated with the tunnel drive. A telescopic machine can section was installed immediately behind the MTBM to provide the capability to isolate face pressure thrust from the pipe string, while also allowing a measure to prevent excessive machine roll if encountered. At the launch headwall, a launch seal equipped with an emergency seal was installed to prevent lake or groundwater pressures from releasing into the downstream portal (See Figure 4). To prevent reverse movement of the MTBM or pipe string resulting from face pressure

Figure 6: Wet recovery of MTBM

> A launch seal equipped with an emergency seal was installed.

due to excessive groundwater pressure, a pipe brake was installed and anchored through the thrust block into the greater rock mass.

TUNNEL CONSTRUCTION

Groundwater inflows during tunneling varied significantly and were closely correlated with rock quality and fracture intensity. Localized zones of higher permeability required careful slurry pressure management to maintain face stability and limit over-excavation. Pump testing at the face during planned stoppages provided useful insight into inflow behavior in anticipation of required tool change intervention.

To facilitate the removal of the MTBM within the lake, a custom-designed and fabricated bulkhead system was installed in the first section of microtunnel casing and remained in place during the duration of the drive (See Figure 5). This system would allow controlled reception of the MTBM after breakthrough while maintaining isolation of the tunnel from reservoir inflows.

Reception of the MTBM occurred under approximately 80 feet of water at the intake structure using a purpose-built subsea recovery module (See Figure 6). After recovery, the bulkhead system remained in place to facilitate downstream piping installation and subsequent construction activities without risk of dam failure.

CONCLUSION

The Deer Creek Intake Project demonstrates the value of comprehensive geotechnical characterization, early contractor involvement integral to the CM/GC delivery method, and purpose-designed construction systems when microtunneling through abrasive, geologically variable rock beneath an active reservoir.

Tunnel construction activities confirmed the variability anticipated in the GBR, with frequent transitions between competent limestone and fractured or brecciated zones, and required careful adjustment of advance rates, cutterhead thrust, and slurry balance. Abrasive rock conditions resulted in measurable cutter wear, particularly on gauge cutters where reduced overcut clearance increased the risk of sidewall contact and elevated jacking forces. Conservative operational controls and continuous monitoring of jacking loads and torque were essential to maintaining steady advancement.

The successful application of trenchless technology on this project highlights how careful planning, conservative operational strategies, and adaptive construction techniques can mitigate risk and deliver critical infrastructure upgrades in demanding geologic and hydraulic conditions.

Steep Grades, High Stakes, Smart Solution for Pressure Pipe Rehabilitation

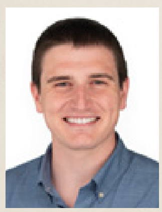
By: Tyler Roberts, P.E. (UT), J-U-B Engineers, Inc., and David Asay, Advantage Reline

A century-old culinary water pipeline serving Salt Lake City receives new life through innovative trenchless rehabilitation

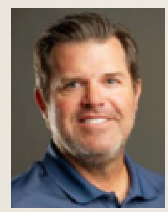
INTRODUCTION

Established in 1876, the Salt Lake City Department of Public Utilities (SLCDPU) has spent nearly 150 years supplying high-quality drinking water to more than 365,000 residents, businesses, and state institutions across its 100-square-mile service area, making it one of the region's most

ABOUT THE AUTHORS:



Tyler Roberts P.E. *is a project engineer for J-U-B Engineers with experience in water system and sewer system design projects. Tyler has utilized both traditional open-cut and trenchless methods to provide constructable and cost saving designs specific to the project needs.*



David Asay *is the President of Advantage Reline, an Arizona-based company that travels the country specializing in the rehabilitation of the aging infrastructure of water, sewer and storm system pipelines for both public and private agencies and utilities across the United States.*

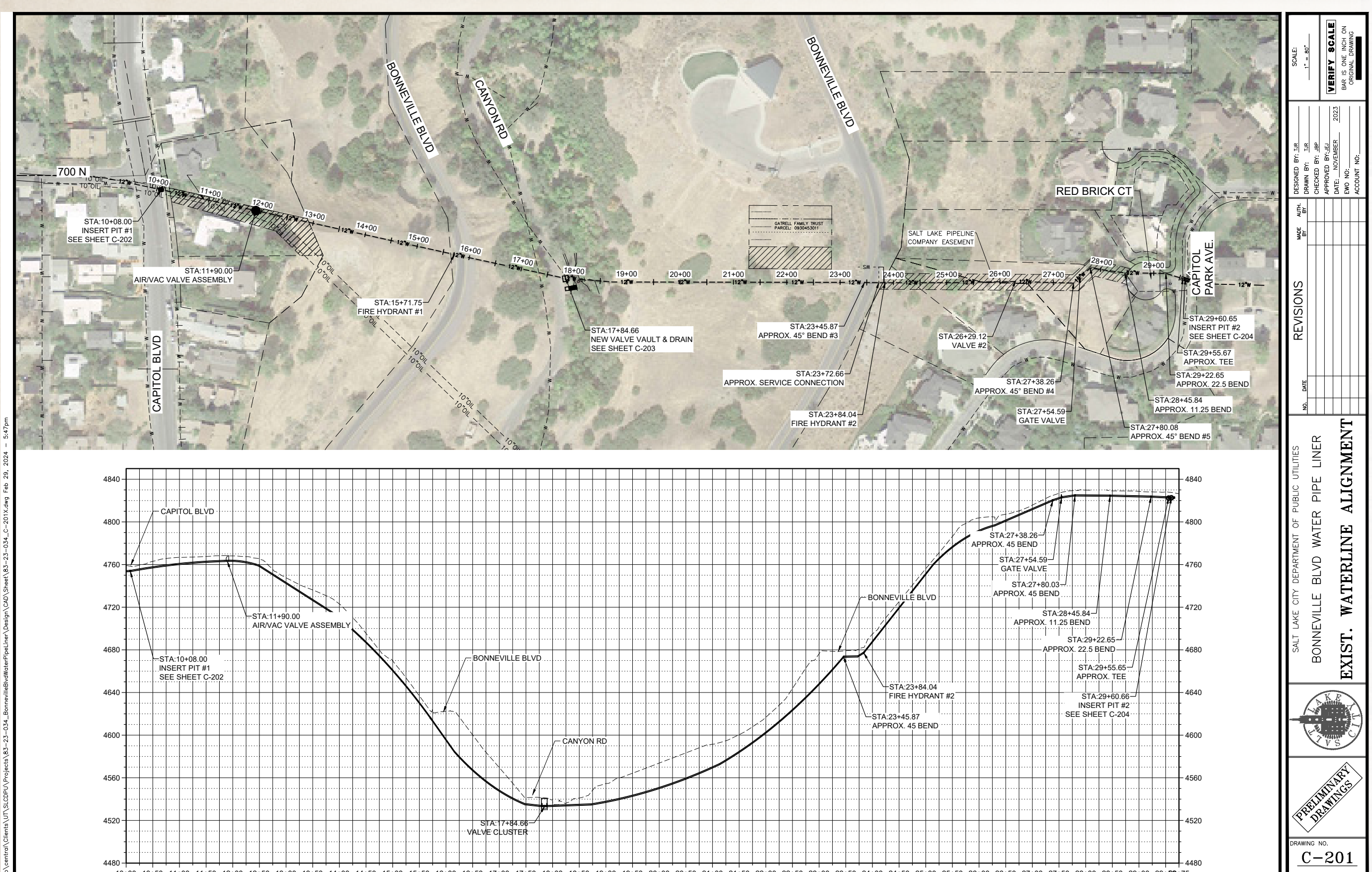


Figure 1: Plan, Profile, and Aerial of Bonneville Boulevard Waterline

Figure 2: View from the top of the valley on Bonneville Boulevard

vital infrastructure providers. As one of the oldest continuously operating water utilities west of the Mississippi River, SLCDPU manages a complex system with nearly 600 miles of water mains. Many of these pipelines are approaching or have exceeded their expected service life, with some dating back nearly a century to the utility's earliest infrastructure investments. With growing service demands and continuing pipeline failures, replacing or rehabilitating these aging assets has become essential. Among the most challenging of these assets was the Bonneville Boulevard waterline, a 2,000-foot cast-iron pipeline that runs through one of Salt Lake City's historic and topographically constrained corridors. (Figure 1).

The Bonneville Boulevard waterline was installed in the 1930s, long before the area was developed with the residential homes, public park, and recreation paths that exist today. The pipeline stands as a testament to the engineering capabilities and foresight of SLCDPU's founders, who constructed it with the emerging construction equipment and technology available during that era, overcoming significant terrain challenges that would be daunting even by today's standards. The Bonneville Blvd waterline is a critical major transmission pipeline that conveys water from sources and reservoirs across City Creek Canyon, and to heavily populated service areas. Over time, the cast iron pipe's joints have shifted, causing recurring leaks and emergency shutdowns for repair. When shutdowns occurred for repairs, the system had redundancy concerns in this service area, elevating the need for a durable, long-term solution. These challenges prompted SLCDPU to pursue a long-term rehabilitation solution that could restore reliability without damaging the steep and rocky hillside or disrupting daily life for the surrounding community. (Figure 2)

THE CHALLENGE

Rehabilitating the Bonneville Boulevard pipeline required addressing a unique combination of physical, technical, and environmental constraints. The steep terrain created significant access challenges and resulted in high operating pressures at the lowest points of the system. Construction equipment, material staging, and crew movement were limited by the narrow corridor between the two boulevards. Excavation along the full alignment would have been time consuming, costly, and potentially hazardous due to the steep grades.

The alignment also shares its corridor with several sensitive utilities, including a petroleum pipeline and buried electrical lines. Any ground disturbance posed risks to both environmental safety and system reliability. Excavating near the oil line or electrical network could cause contamination, service outages, or hazardous conditions for both the community and construction crews. Avoiding these impacts was essential for the safety of the community and the integrity of critical infrastructure.

The corridor also crossed through driveways and backyards, adding residential access constraints to the technical challenges. Homeowners required consistent access to their properties, and restoration of any impacted areas needed to be completed quickly. In addition, the entire area carries historic significance due to its proximity and usage of City Creek Canyon. Any visible disruption to the landscape, erosion of hillside features, or long-term scars would be unacceptable to residents, city staff, and preservation officials. Traditional open-cut replacement was immediately dismissed because it would have required excavating nearly 2,000 feet of steep, historic terrain and would have caused widespread disruption.

Recognizing these constraints, SLCDPU and its consultant, J-U-B Engineers, evaluated multiple trenchless alternatives. The solution needed to meet the following criteria:

- Manage up to 300psi of water pressure at the lower elevations
- Allow for minimal access points spaced up to 700 feet apart
- Navigate safely around the petroleum pipeline and electrical lines
- Minimize surface disruption through historic areas and impact on residents
- Installed during a short time frame to minimize shutdown and demand on the system

Four capable trenchless pressure rehabilitations methods were evaluated for the Bonneville Blvd waterline rehabilitation project. Cured-in-place pipe (CIPP) was considered but determined unsuitable due to possible migration of the resin within the liner, difficulties curing the liner evenly on steep slopes, and the pressure requirements of the line. Loose-fit and tight-fit sliplining with an HDPE pipe was eliminated due to hydraulic concerns downsizing the inner diameter of the pipe from 12-inches to 8-inches, and lack of construction and staging areas along the alignment to install the HDPE pipe. Pipe bursting was also evaluated but found to carry unacceptable risks given the proximity of the petroleum pipeline and other utilities, and time and cost needed to fracture the cast iron pipe. The only technology capable of meeting the pressure capacity, geometric constraints, utility conflicts, limited access, and installation timeframe was Primus Line®, Flexible Fabric Reinforced Pipe (FFRP) rehab system.

THE SOLUTION

Primus Line offered a unique combination of flexibility, strength, and installation efficiency that made it ideal for the Bonneville Boulevard Waterline Rehabilitation project. Developed in Germany more than 25 years ago specifically for demanding oil and gas industry applications, Primus Line has been extensively proven and refined in high-pressure pipeline rehabilitation projects across many countries worldwide, establishing a record of reliability and performance. The system has demonstrated success in installations involving thousands of feet in continuous runs and has become a trusted solution for pressure pipeline rehabilitation.

Primus Line uses a three-layer composite system, and for high-pressure applications the aramid fabric core is manufactured

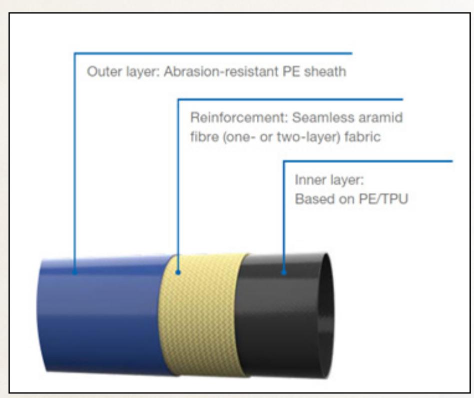


Figure 3: Cross-section of Primus Line FFRP material

with a double layer of Kevlar reinforcement. This dual reinforcement provides exceptional tensile strength, allowing the liner to withstand heavy internal pressures while navigating bends, elevation changes, and long distances between access points. The reinforced liner is independently pressure rated and does not rely on the host pipe for structural support. (Figure 3)

A key advantage of Primus Line is its ability to be installed in long continuous sections. This capability was essential for Bonneville Boulevard, where steep slopes and limited access prevented the frequent excavation of pits. The technology also maintains stability under pressures exceeding 300psi, which aligned with the high-pressure conditions resulting from the significant elevation drop in the system. The absence of internal joints in each installed segment eliminated the weak points that had contributed to failures in the original cast iron pipe.

J-U-B Engineers incorporated these capabilities into the final design by specifying 1,140 feet of 12-inch medium pressure Primus Line, and 860 feet of 12-inch high-pressure Primus Line with a double-layer Kevlar fabric core and pressure-rated end fittings. This configuration allowed the liner to accommodate multiple 45-degree bends, navigate the steep hillside, and provide the required performance for the pipeline's pressure conditions. The ability to install the liner in long sections also minimized excavation, protected sensitive utilities, and reduced impacts to the surrounding historic and residential landscape.

THE INSTALLATION

The bid documents were completed in May 2024, with the construction contract awarded to Cliff Johnson Excavating for civil and mechanical work, and to Advantage Reline for the Primus Line installation. Because the pipeline serves a heavily populated service area, shutdown of the Bonneville Blvd waterline was scheduled for 4 weeks to avoid major demand on SLCDPU water system and prior to landscape irrigation use increasing demand on the water system. Construction was scheduled for February 2025.

Extensive preparation was required before installation could begin. J-U-B Engineers determined access pit locations, secured permits, and coordinated plans that accounted for rocky terrain, limited easements, and residential property constraints. The alignment passed through driveways, backyards, and narrow utility corridors, requiring consistent communication with homeowners and coordination with gas and electric utilities. The team needed to avoid service interruptions and maintain safety near the petroleum pipeline and buried electrical systems.

Six access points were strategically established along the pipeline. These included two pits at the east and west extents of the project, a pit at the high point of City Creek Canyon, two access locations at fire hydrants midway down the hillside, and one in a cast-in-place stone vault that housed an important

Figure 4: City Creek and existing valve vault at the bottom of the valley

cross connection at the bottom of the canyon. The alignment also passed under City Creek near the bottom of the slope, adding another geometric challenge to be navigated during installation. (Figure 4)

A thorough CCTV inspection documented the condition of the host pipe and revealed heavy tuberculation and significant sharp buildup from decades of joint repairs. Before the liner could be installed, these deposits needed to be removed to create a smooth interior surface. Advantage Reline crews used high-pressure water jetting, metal scrapers, foam pigs, and a robotic cutting tool to remove deposits and ensure that the interior was ready for liner insertion. Additional cleaning passes were required in areas where conditions were worse than initially assessed. (Figure 5)

Once cleaning was completed, the Primus liner was carefully pulled through the host pipe using a 10-ton capacity TT Technologies pulling winch, requiring 6 tons of force to navigate the steep elevation changes and multiple bends (Figure 6). After successfully navigating multiple bends, steep slopes, and the City Creek crossing, the liner was fully positioned and expanded using air pressure to ensure the liner was completed expanded and ready for water transmission.

Advantage Reline installed ANSI Class 150# and 300# flanged connections to terminate the liner to the existing system, and Cliff Johnson Excavation installed ductile iron closure spools to reinstate service at the access pits. Unique connection designs were required at the high point for a combo air/vacuum relief valve, existing hydrant connections, and redesigned valve vault to ensure proper operations of the waterline at these locations. The cast iron pipe now functioned as a protective outer shell, while the new liner provided a modern, pressure-rated interior capable of meeting present and future system demands.

Quality control was maintained throughout the installation. Crews monitored pull forces, documented installation parameters, performed a full video inspection of the expanded liner, and conducted pressure testing to verify performance. Post-installation monitoring confirmed the liner's ability to accommodate typical ground movement and meet the required pressure capacity.

THE RESULTS

The rehabilitation exceeded expectations and delivered significant

Figure 5: Metal scrapers and rubber discs used to remove tuberculation from host pipe

Figure 6: Pulling liner into pipe using 10-ton pulling winch

operational, environmental, and community benefits. The project was completed within the required 4-week construction time window. The new Primus Line installation successfully manages the full 300psi operating pressure required in the lower portions of the system, and pressure tests confirmed long-term reliability.

By selecting a trenchless method, the project avoided large-scale excavation. Sensitive utilities, such as petroleum pipelines, electrical systems, and residential infrastructure, remained protected throughout construction, and driveways, landscaping, and pavement experienced minimal disruption, significantly reducing restoration costs.

Homeowners expressed satisfaction with the project team's careful coordination and quick restoration of access to their properties. The historic characteristics of the City Creek Canyon hillside were preserved, with no visible long-term impacts to the landscape. The successful completion of this complex rehabilitation improved public confidence in SLCDPU's ability to modernize critical infrastructure while respecting community and environmental constraints.

The project also reinforced important principles for similar rehabilitation efforts. Careful evaluation and selection of appropriate technology was essential to meet the hydraulic and constructability needs to rehabilitate the Bonneville Blvd waterline. Open and productive communication early in the design phase between SLCDPU, J-U-B, and Advantage Reline helped produce clear and constructable plans to limit the number of changes during construction. Thorough site characterization, and CCTV inspection, allowed the team to anticipate pipeline conditions and plan effective cleaning and installation strategies. And early communication with stakeholders supported smooth scheduling and minimized disruptions, while flexible execution allowed crews to address emerging challenges efficiently.

THE CONCLUSION

The Bonneville Boulevard waterline rehabilitation demonstrates how innovative engineering and trenchless technology can solve infrastructure challenges that traditional methods cannot. The 2,000-foot pipeline with a 600-foot elevation drop, the proximity to a petroleum pipeline and buried electrical lines, the limited access through residential properties, and the historic preservation requirements created a scenario where open-cut replacement was simply not viable. Primus Line provided a reliable, long-term solution that restored the integrity of a century-old pipeline while maintaining the character of the City Creek Canyon.

For SLCDPU, approaching its 150th anniversary, this project represents a bridge between the foresight of those who built the original system and modern innovation, ensuring continued reliable service for the next generation. For utilities throughout North America facing aging pipeline challenges in difficult terrain, this project provides a clear example of how modern engineering, detailed planning, and thoughtful execution can deliver successful outcomes even under the most complex conditions.

Making the Ground Behave:

Utah’s Largest Diameter Pipe Ram

By: Chris Hackworth, Claude H. Nix Construction

Project Overview

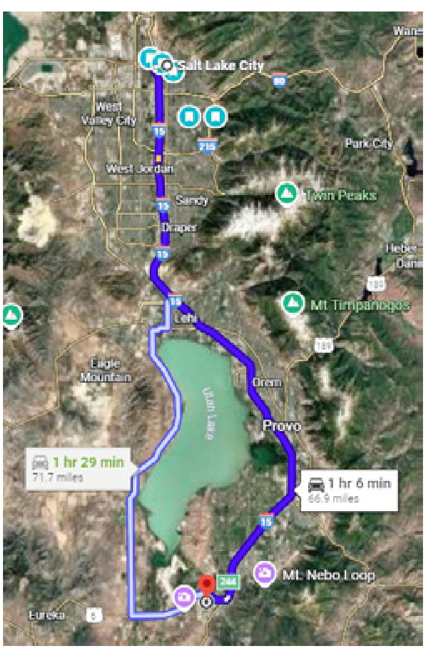
The Santaquin Reach project is a project for Central Utah Water Conservancy District (CUWCD) that includes 23,048 feet of waterline through Santaquin City and southern Utah County. Designed to deliver water for municipal and industrial use, this project involves multiple trenchless crossings: one of which is a 120-foot crossing to be installed under a UPRR rail line.

Nix was brought in to bid the job because ground conditions were significantly more unstable than initially expected- the first bore attempt was made with an open-face Tunnel Bore Machine. The changed soil conditions shut the attempt down because the material ran into the machine “like granulated sugar or dune sand” (Jacobs Engineering, December 2024). Nix Construction completed the crossing using Unguided Pipe Ramming. As the foreman on the project, my crew worked through a series of challenges to safely execute the crossing.

> “Crew worked through a series of challenges to safely execute the crossing.

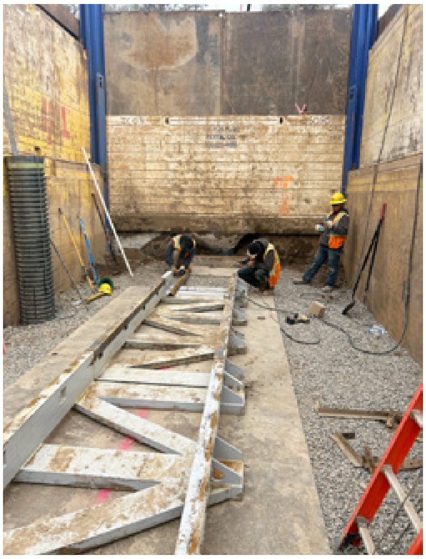
Equipment Overview

Unguided Pipe Ramming was selected as the new method of installation because it leaves the material inside the casing until the crossing is completed- eliminating the concerns of instability under the railroad. The Geotechnical Memorandum dated December 2024 from Jacobs Engineering was critical to the selection of new means and methods. Nix opted to use a TT Technologies Taurus 24-inch Grundoram Pneumatic Hammer powered by two 1800 CFM compressors in tandem to supply enough power to complete the drive. Nix also supplied a 20-foot piece of 79-inch, 1.125 X52 rated steel casing and attached a custom-made cutter head to the lead edge to overcome the abrasive nature of the expected material. We cleaned the casing out using 54-inch augers and a Barbco Auger Bore Machine (ABM) with a custom fitted lift kit to accommodate the increased pipe size.



Central Utah Water Conservancy District (CUWCD) encompasses Utah Lake

24-Inch Taurus Hammer



Project Setup: ABM track reinforced with angle iron

Sandbag Plug in the lead casing

79-Inch Casing

Preparation

Before arriving on site, CUWCD requested that we use the 79-inch mechanical joint casing that was already purchased and on site to minimize change order cost. This casing was designed and manufactured to be jacked into the ground, so in an effort to minimize risk, Nix opted to cut off the machined ends and perform full-penetration butt welds to ensure full contact at each casing joint, accounting for the substantial forces applied during ramming operations.

Construction

Nix Construction arrived on site in early April to begin initial setup. Working inside the existing launch shaft supplied by VanCon, Inc. (the general contractor), we reset grade in the pit floor and poured a supplemental thrust block. We also constructed a carrier saddle tight against the pit face to retain line and grade upon launching the casing and to leave adequate space for the bell hole at the rear of each section. We reinforced the ABM track surfaces with angle iron to protect them from the weight and friction from the 16,000+ pound pieces of 79-inch casing.

After a 3-week delay due to coordination with the railroad, we buried the lead casing on April 23, 2025. The progression rate goal was to drive one 20-foot piece of casing each day, and weld through the night, as each joint was expected to take 8-10 hours to complete. Part of the launch procedure was to construct a sandbag plug to retain soil stability at the leading edge of the casing. This plug functioned as a temporary measure, and it was to be removed as the casing advances through the ground. We installed the first casing completely without removing any of the plug. On later pipe sets the soil settlement inside the casing forced the plug back against the hammer face, so we had to remove the plug over time to maintain forward progress.

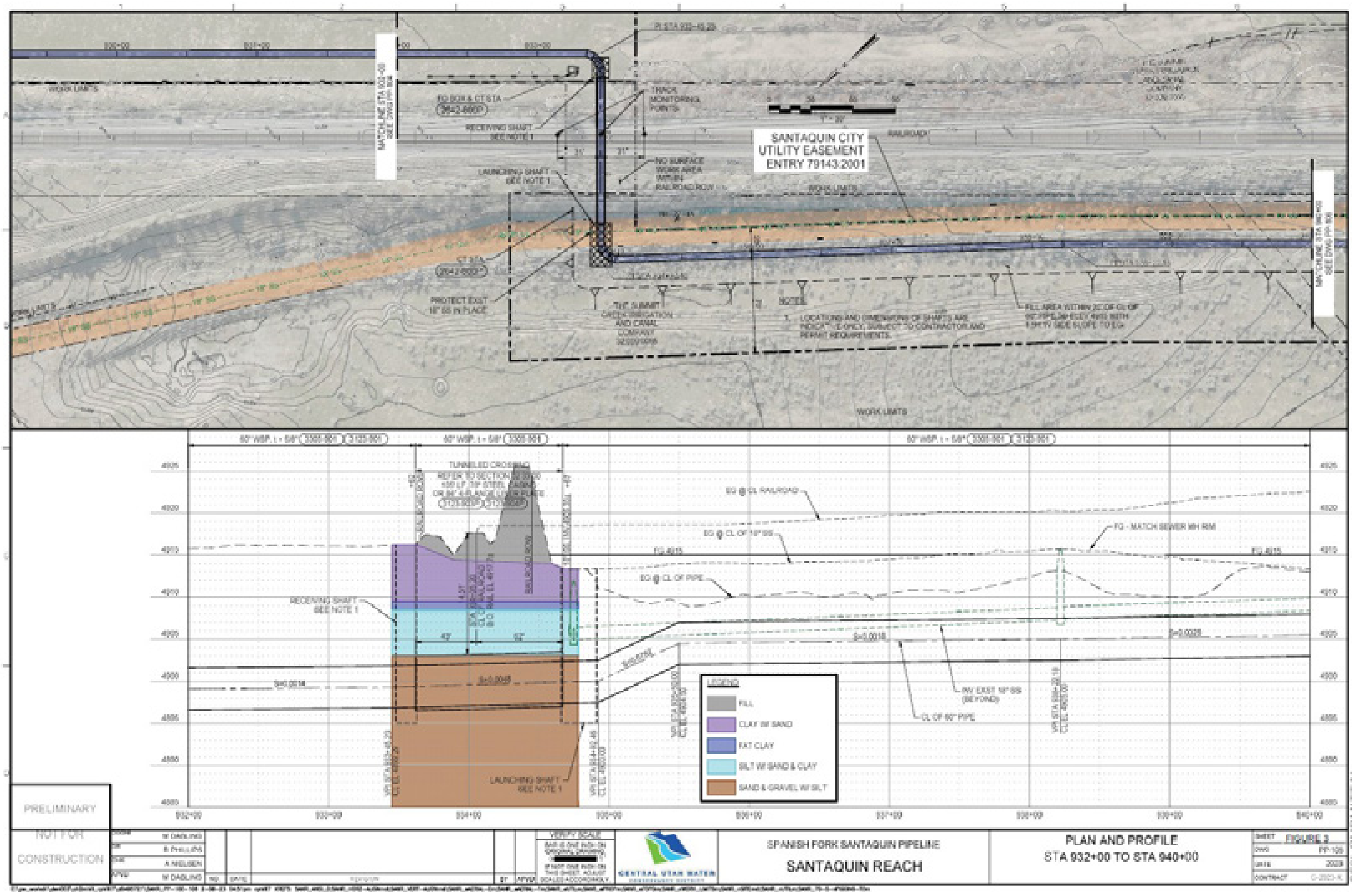
While the tunneling crew had to remove material between each pipe set, forward progress was initially maintained at one 20-foot piece of casing per day, as planned. On April 28, with 82 linear feet of casing buried in the ground, we encountered soil expansion that was inconsistent with what we had seen to date on the drive. The material in the pipe expanded 12 feet backwards and halted the hammer. Suspecting a change in soil conditions, we continued the drive after changing to a polymer-based lubricant that increased the advancement rate by over 2 minutes per foot. We finished the remainder of this casing without lubricant and were delayed a day and a half while we applied for a lube variance from the UPRR contractor. After 10

Jacking in the product pipe

Cleaning out the casing

days of (mostly) uninterrupted round-the-clock effort from tunneling and welding crews, Nix completed the drive on May 2, 2025. The casing deviated from line and grade 1 foot off line to the north, and dove 8 inches during the crossing. This deviation is within reasonable expectation for unguided pipe ramming, especially with large diameter casing and challenging geological conditions.

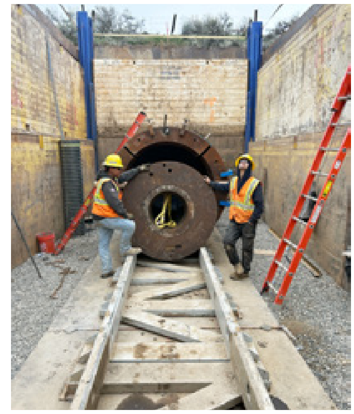
After cleaning out the casing, VanCon worked quickly and efficiently on the weld joints and coatings of the 60-inch carrier pipe, while Nix installed casing spacers and jacked the pipe into place using the ABM.



Geological Plan and Profile for the UPRR Crossing

Material settlement packed against the hammer face

The casing had to be split in order to extract the hammer



The hammer gear for casing this size weighs over 10,000 pounds total

Nix completed the job with construction of bulkheads and installation of 150 PSI Low Density Cellular Concrete (LDCC) annular grout to backfill the casing.

Geotechnical Challenges

There's a lesson we've learned after years of working underground in the mountains. You never know what mother nature has in store for you after you bury the casing. The original geotechnical baseline report indicated that the material through the pipe zone was sand & gravel with silt. Nix designed a lubrication mix that used primarily bentonite with polymer ingredients to ensure borehole stability, and to create a slick, evenly coated annulus behind the cutter head. Bentonite being the primary ingredient allows for a "shell" to be left behind around the casing that holds adequate moisture to keep the casing easy to move after an overnight welding process.

After overcoming the raveling soils for the first 82 linear feet of casing installation, the lead edge of the casing encountered a change in soil conditions. As hammer operations began for the day on April 28, the material expanded 12 feet against

> You never know what mother nature has in store for you after you bury the casing.

the hammer after only 8 feet of forward progress. I suspected that the change in soil conditions was reacting negatively with our original lube mixture- a bentonite-heavy mix that would create expansion and increased friction if it interacted with clays. We altered the lube mix to accommodate the suspected change in ground conditions, and our increased advancement rate was a sign that we were on the right track.

Material Challenges and Welding Procedure

For this crossing, the materials and installation procedures had some unique challenges due to the size and weight of the casing and tooling necessary for this pipe size. 79 Inch x 1.100 wall pipe weighs over 16,000 lbs. per 20-foot stick- and during an operation where pipe fitment and keeping the barrel perfectly straight is critical, this made for a challenging welding process.

Weld Joint fitments were difficult for the entire drive

Working closely with our subcontractor, National Welding, Nix's tunneling crew worked diligently during the day to be prepared for the overnight welding shift.

Beveling the pipe in the field led to inconsistent welding surfaces on some of the joints- creating a challenging fitment process for welding crews. With such a large diameter casing, any imperfections from one side of the pipe to the other created gaps and surface inconsistencies that had to be fixed during each weld. National was able to overcome these challenges and provide full penetration welds each night to ensure progress would continue on schedule. Each joint took up to 11 hours and over 50 pounds of wire. As the string of pipe continued through the ground, the leading edge of the casing was diving slightly and turning to the north of our alignment. As a result, each pipe fitment was slightly different, and required a new combination of shims, jacks, and tack welds to keep our alignment true.

Accomplished the largest diameter pipe ram in the state of Utah

Mechanical joint casing is manufactured out of softer material than what we would typically use for a pipe ram. We almost always use higher yield strength casing because of its resiliency to the kinetic energy that gets applied to the casing. Using mechanical joint casing as a cost savings effort allowed the hammer gear to get overstuffed in the casing, making it very difficult to remove efficiently.

TT Technologies supplied the hammer gear to fit this size casing: ram cone, casing adapter, and casing segments. Part of the challenge with casing this size is handling the equipment associated with driving it, with each of the 4 casing segments weighing nearly 1200 pounds. The casing adapter and the ram cone, after being installed on the hammer, add over 6000 pounds to the weight of the hammer. All these factors contribute to a challenging and sometimes tedious setup and teardown process for each casing section, and sometimes we had to get creative to stay on schedule.

Conclusion

Big pipe leads to big challenges. This project pushed our crew and equipment in ways that we couldn't have predicted at the start, and we're very proud of our team for having the grit and creativity to overcome all the challenges that we encountered along the way. Thanks to a well-coordinated effort from CUWCD, Jacobs Engineering, VanCon Inc., National Welding, TT Technologies and our team at Claude H. Nix Construction, we were able to accomplish the largest diameter pipe ram in the state of Utah.

ABOUT THE AUTHOR:

***Chris Hackworth** is a Jr. Estimator for Claude H. Nix Construction. Drawing on his decade of underground experience, and his prior roles with Nix as an Operator and Foreman, he brings a practical, field-driven perspective to trenchless construction methods. Chris was the foreman on the Santaquin Reach 79 Inch pipe ram installation.*

811 COLORADO ONE CALL LEGISLATIVE CHANGES

Case Study: Balanced Enforcement & Third-Party Enforcement Board in Colorado Helps to Minimize Damages to Utility Assets

By: Jay Rendos, Continuum Capital

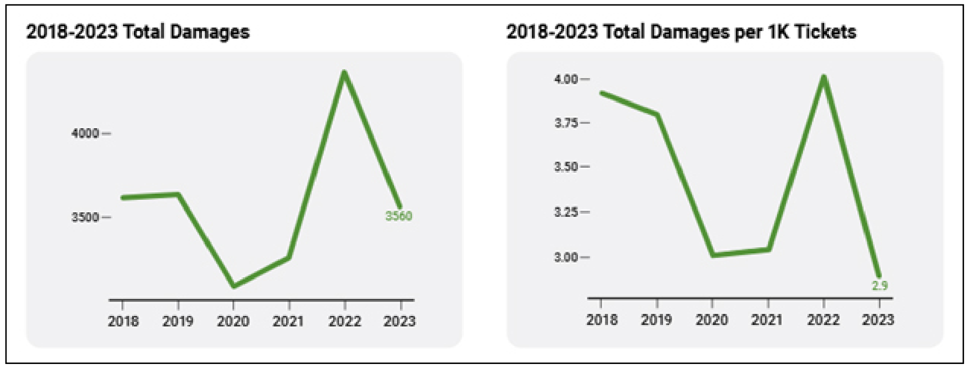
Introduction

Colorado's dig law, established under Title 9-1.5 of state statute, was created to prevent injury and damage to underground infrastructure by requiring excavators to notify Colorado 811 before digging. In 2018, Senate Bill 18-167 initiated major improvements by requiring universal participation in the statewide notification system, establishing mandatory positive response, standardizing locating expectations, and creating the Underground Damage Prevention Safety Commission to oversee enforcement and review violations. Further statutory refinement occurred in 2022, clarifying roles, improving response requirements, and strengthening alignment between notification, locating, and enforcement expectations.

CHALLENGE: Inadequate Damage Prevention Law

Prior to the 2018 legislative changes, there was no Third Party enforcement authority in Colorado. The 811 process was a two-tiered system. This tiered system meant that Colorado did not have a true one-call system before 2018. In this system, Tier 1

> "The Colorado Contractors Association decided to lead the effort.



2018 – 2023 Total Damages, Colorado

members (such as large facility owners) were contacted via the one call system, but Tier 2 members required the excavator to call them directly using a provided phone number.

Another challenge was when the Underground Damage Prevention Safety Commission was established. Challenges were identified during the legislative process and after the legislation was enacted. During the legislative process, the main challenge was managing the desire of every stakeholder to have a seat on the commission, which led to a concern about making the commission too large. After the commission was established, a recurring challenge has been maintaining full representation due to vacancies in the commission seats. A further challenge in the commission's early days was the need to promulgate rules and regulations, a process that felt like rewriting the legislative bill again to address details not covered in the original law.

The last major challenge was identified when the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) conducted an evaluation of Colorado's enforcement of its excavation damage prevention law in September 2019. Based on this evaluation, PHMSA determined that Colorado's enforcement of its excavation damage prevention law was inadequate. Colorado law allows a home rule community to establish its own excavation damage prevention enforcement program, in lieu of participating in the excavation damage prevention enforcement program administered by the Colorado Division of Oil and Public Safety (CDOPS). PHSMA determined that for Colorado to meet the requirements of 49 CFR § 198.55(a), Colorado must designate an agency or other body as the authority responsible for enforcement of the excavation damage prevention law for the entire state.

SOLUTION: 811 Colorado One Call Legislative Reform

The Colorado Contractors Association decided to lead the effort to address PHSMA's letter, determining that Colorado's enforcement of its excavation damage prevention law was inadequate. They held stakeholder meetings that included facility owners, contractors, excavators, and Colorado 811, and the decision was made that a rewrite of the 811 law was needed. A previous attempt to rewrite the law approximately five years prior had failed, possibly because it did not include elements that were incorporated into the successful later bill. They secured bill sponsors and lobbied for the bill, including holding stakeholder meetings across the state to build support for the legislation changes.

In 2018, Colorado enacted Senate Bill 18-167, establishing two pivotal regulatory advancements aligned with best-practice Infrastructure Protection Coalition (IPC) standards: 3 – Balanced Enforcement and 4 – Third-Party Enforcement Board. The legislation created the Underground Damage Prevention Safety Commission, an independent 15-member enforcement body representing excavators, utility owners, local government, and Colorado 811 leadership, and empowered it to review alleged violations, develop best practices, and administer penalties.

Under this new structure, investigations now require complete documentation from all involved parties rather than relying solely on owner-submitted reports. The statute also mandated improved locating standards, clarified excavation notice requirements, eliminated Colorado's former two-tier notification system, and required all facility owners to participate directly in the statewide notification system – strengthening transparency and aligning Colorado's system with national enforcement models.

RESULTS: Reduction in Positive Response Re-Notification and Damages Per Ticket Volume

Since implementing the Underground Damage Prevention Safety Commission, Colorado has seen measurable improvements in reporting participation, enforcement consistency, and shared accountability across the excavation ecosystem. Two examples that have shown reductions include the 2024 automatic positive re-notification percentage of ticket transmissions (APRRN) and a decrease in state-reported damages.

There has been an overall reduction in the automatic positive re-notification percentage of ticket transmissions in 2024 over 2023 by 3.5 percent.

Also, there has been a decrease in state-reported damages. A total of

> Colorado's framework now functions as a leading model for modern dig law governance.

3,560 underground facility damages were reported to the Common Ground Alliance (CGA) DIRT Tool for damages in 2023 in the State of Colorado; this represents an -18 percent decrease from 2022. The overall trend shown in the two charts below, reported Colorado underground facility damages captured in the CGA DIRT Tool in 2023, decreased in both overall volume and per 1K ticket rate compared to the 2022 peak.

Conclusion

Colorado's adoption of Balanced Enforcement and a Third-Party Enforcement Board mark a substantial shift toward transparency, uniform accountability, and prevention-focused compliance. Since implementation, the Underground Damage Prevention Safety Commission has processed complaints, issued fines and training requirements, and continued refining best practices – strengthening enforcement consistency statewide. For example, in 2024, the Commission assessed fines, training, or alternative remedial actions in multiple cases, demonstrating the system's active role in influencing behavior and improving compliance outcomes.

These reforms also align closely with other key Infrastructure Protection Coalition recommendations, including #5 Standardized Minimum Notification Time, #6 Effective Penalty Structure, #9 Positive Response Requirement, and #10 Excavation Site Accurate Description. As excavation activity continues across broadband and infrastructure upgrades, Colorado's framework now functions as a leading model for modern dig law governance – one built on shared responsibility, accurate reporting, and independent oversight.

ABOUT THE AUTHOR:

Jay Rendos is a consultant with Continuum Capital, which provides management consulting, training, and investment banking services to the worldwide energy, utility, and infrastructure construction industry. Jay brings over thirty years of experience and works primarily with gas/electric utilities, power generators, pipeline companies, and energy companies to support the planning, design, construction, and operation of capital assets. He is a recognized expert in both natural gas utility construction, operations, and maintenance along with power generation facility construction and operations including very specialized experience in reduced and no carbon emission facilities powered by natural gas, nuclear, or renewable sources.

About IPC

811 EMERGENCY
$61 Billion Lost in System to Protect Underground Utilities

The Infrastructure Protection Coalition (IPC) is a coalition of industry groups who represent regular users and stakeholders in the 811 system and want to see it run safely and efficiently. Members include:

American Pipeline Contractors Association (APCA - www.americanpipeline.org) – Founded in 1971, APCA represents merit shop pipeline and station contractors operating throughout the US constructing energy infrastructure.

Distribution Contractors Association (DCA - www.dcaweb.org) – Founded in 1961, DCA represents contractors operating throughout the US constructing, replacing, or rehabilitating natural gas pipeline, electric cable, fiber optic cable, and duct systems.

National Utility Contractors Association (NUCA - www.nuca.com) – Founded in 1964, NUCA represents contractors completing utility construction and excavation throughout the US in the water, sewer, gas, electric, treatment plant, telecommunications, and excavation industries.

National Utility Locating Contractors Association (Nulca - www.nulca.org) – Founded in 1994, Nulca represents utility locating professionals operating throughout the US.

Power & Communications Contractors Association (PCCA - www.pccaweb.org) – Founded in 1945, PCCA members construct electric power facilities, including T&D lines and substations; broadband facilities, including telephone, fiber optic, and cable television systems; energy infrastructure, including renewable power generation facilities and gas and oil pipelines; and water/sewer infrastructure of all types.

Infrastructure Protection Coalition • www.ipcweb.org

Noise Impact Management for HDD Operations

By: Matt Cott & Amanda Gilliam, Environmental Noise Control

The rise in HDD projects heightened the awareness of equipment noise in sensitive areas, leading to more federal, state, local, and contractual sound requirements. Following regulations and minimizing the noise impact is especially important near residences and sensitive wildlife areas. In areas without formal guidelines, project owners increasingly adopt best practices to set limits and align expectations with regulators and neighboring communities.

Noise Management Plans (NMPs) are a common submittal requirement to acquire construction or operating permits. However, the development of an accurate bid/tender includes careful consideration of requirements, regulations and goals related to noise management early in the process.

When reviewing a potential project, clients and design engineers should consider including an NMP in the specifications. Clear NMP requirements help manage stakeholder expectations. Consulting a noise engineer early can confirm the feasibility of these requirements.

An NMP analyzes HDD projects from start to finish, aiming to reduce noise and vibration impacts while ensuring regulatory compliance. Challenges arise from variations in local and federal codes, as well as project-specific factors like equipment, operating times, and compliance needs.

Contractors should review NMP requirements before pricing to assess compliance feasibility. This may affect equipment selection, site layout, or necessitate design changes to increase distance from sensitive areas. If engineered noise controls – such as barriers, perimeter walls, enclosures, or absorbers – are required, they must be factored into both pricing and layout.

Upon receiving plans, contractors should confirm whether a noise survey was completed, understand noise limits, and determine responsibility for mitigation, as these directly impact costs. When required, HDD contractors may engage an acoustic engineer to assess compliance based on local ordinances, project-specific requirements, or general guidelines.

A contractor may be able to use GIS software (such as Google Earth) to overlay the proposed trenchless route and establish a baseline for horizontal distances in populated areas to determine the potential effect equipment may have on residents. GIS software may also help to outline access routes that may be affected by trucks and equipment traveling during construction. Any natural barriers that have the potential to help reduce the

Freestanding panels provide noise mitigation for HDD project near a usually quiet neighborhood

> Stricter regulations make early noise management essential.

nose levels, such as vegetation or change in elevation, can also be identified.

The contractor and the acoustic engineer may be best to work together to establish an approach and mitigation measures to give the project a high probability of complying the specifications. This may include the need for additional surveys or more information to clarify questions that come up during the review process.

There may be a need to ask additional questions if the bid/tender is unclear rather than make assumptions that could lead to inadequate control measures or increased pricing should a contingency measure be needed. For a bid/tender to be accurately prepared, specifications should clearly define the requirements of sound mitigation measures such as dBA levels, equipment considerations and allowable mitigation tools (i.e. barriers, mufflers, etc.).

Broad perimeter-based sound mitigation plans often lack clarity, leading to misinterpretation, non-compliance, and excess material costs. Conducting a detailed front-end analysis or providing specific contractor guidelines offers a clearer, more efficient approach, reducing the likelihood of affecting nearby communities or sensitive areas.

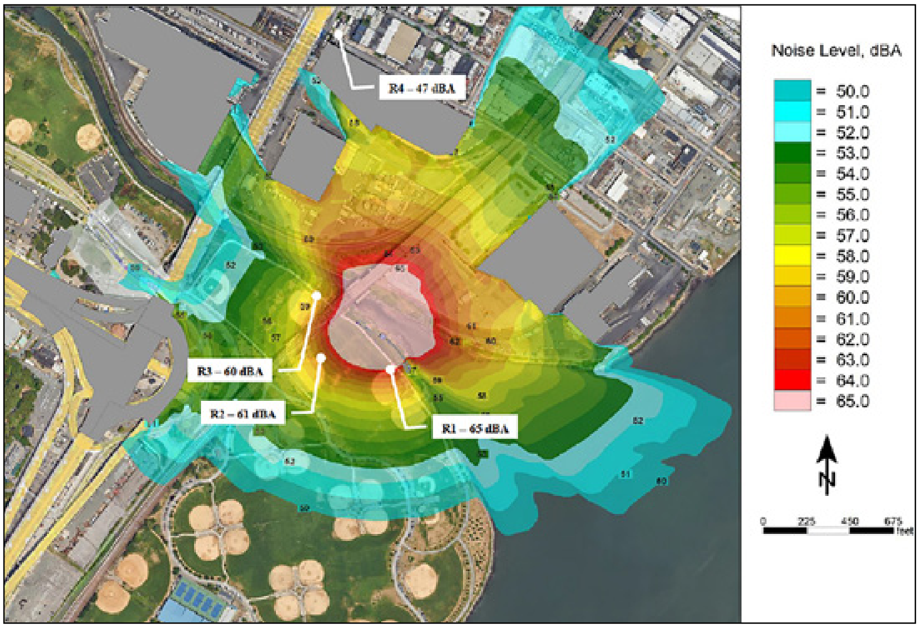
Pre-construction noise modeling, combined with ambient sound measurements, provides a reliable method for estimating impacts and selecting mitigation measures. This engineered approach supports compliance, fulfills approval requirements, and helps justify mitigation expenses.

Another benefit to computer modeling is the potential to identify whether localized mitigation is necessary on or near a single residence rather than surrounding the entire site. Having this knowledge up front may save the client both financially and in the schedule as less mitigation panels may need to be erected.

If sound mitigation is necessary to reduce impact on a neighboring residence or sensitive area, the workspace may be set up to accommodate the mitigation measures and its securement. Due to the size of the HDD equipment and setup, various types of sound control may be needed, including source panels typically up to 16' feet tall, acoustic blankets and perimeter sound walls up to 40' tall.

Contractors may also have other methods to reduce impact of the construction noise rather than erecting sound panels, including enclosures around engines (ether premanufactured or built onsite), and noise reducing mufflers for the exhaust systems.

Equipment layout can be optimized to reduce the impact or disruption of the neighboring communities. Although space may be limited, identifying the areas that may be impacted the most by construction noise can assist with determining the size and layout of the equipment used for the project. Placement of auxiliary equipment, such as mud systems, generators, pumps, and planning



Unmitigated noise model of HDD Entry Site

truck traffic routes, are major components to consider when building a Noise Management Plan.

Ambient sound level surveys establish the background noise levels of an area or job site before any operations begin. The documented background sound levels are sometimes used as the basis for noise codes when determining the maximum allowable additional impacts for proposed operations and are essential prior to construction to understand the current conditions. If the allowable noise levels are currently exceeded prior to any job site activities taking place, it provides the operators valuable data to request a change or variance to the allowable noise levels for the duration of the project.

Pre-construction ambient sound levels surveys are generally completed at compliance points and / or off-site receptors to document existing sound levels prior to construction activities. Ambient sound level surveys are completed in accordance with code requirements and can vary on duration, placement of data collection systems, requirements for inclusion of weather data collection, and data presentation format.

Typical surveys last between 24 and 72 hours with occasional requirements for longer term data collection. Although data is generally collected continuously from deployment to collection of systems, code requirements may only look at existing sound level averages used during certain periods of time (ex: daytime or nighttime hours).

Site-specific noise impact modeling considers the site's noise generation, equipment positioning, topography, adjacent surface land cover, and adjacent structures to develop a map showing anticipated noise levels at distance from the job site. For accurate noise propagation modeling, measured operational sound levels, including frequency spectra data of the proposed equipment and operations, are recommended for use as data inputs.

Additional analysis can be completed during the noise modeling phase including both noise and vibration impacts during site construction as well as vehicle traffic impacts in and out of the location.

Noise impact modeling can account for fixed "do not exceed" dBA levels, other filters, intermittent noise, tonal impacts, and other specific requirements. Outputs typically include noise maps showing how unmitigated HDD site noise propagates, along with data tables of predicted impacts at nearby receptors. These predictions are compared to code limits to determine if additional controls are required for compliance.

When sound reduction is required, computer modeling can be used to design mitigation plans and predict noise reductions at compliance points or agreed limits. Noise is typically controlled at the source, the receptor, or along the path. In HDD projects with limited space, path treatments – such as engineered sound walls, equipment enclosures, acoustical blankets, and absorber materials – are most common. When possible, free-standing panels and other systems can also be applied at the source for added protection.

Once completed, a mitigated noise model may provide the operator with a cost-effective noise barrier solution to meet the design criteria, without resorting to guesswork or on-site testing while the job is operational. The mitigated model may be able to demonstrate to concerned neighbors and government officials the expected noise levels during operations. This information may also be used for any permitting approvals or license application requirements that may exist.

Compliance monitoring can be conducted using Type 1 sound level meters configured to continuously log readings at set locations during site work. Meters can store data locally or transmit it to a secure web platform, often powered by solar panels with cellular connectivity.

Web-based systems stream live dBA readings, other filters, full-frequency measurements, and weather data from a cell connection. Project owners can access this information 24/7 and set alerts that trigger notifications when sound exceeds a set threshold. When triggered, the system automatically records audio for event review.

Reports can be generated daily, weekly, or monthly as needed to meet submittal requirements or address complaints.

Understanding conditions for a typical HDD setup and operation is critical to understanding the potential challenges operators face when assessing and recommending solutions to minimize the operations noise and vibration impact during drilling. Factors to be considered that limit mitigation design are the existence of above ground obstructions (ex: power lines, trees, etc.), underground obstructions (ex: existing pipelines, underground utilities, etc.), site and equipment access requirements, safety concerns, and exposure to potential high wind conditions. All the potential limitations common to HDD operations must be considered when designing effective noise mitigation.

Despite all the operational challenges and restrictions of some HDD sites, specialized noise mitigation solutions exist to accommodate the most restrictive sites while still complying with

Noise monitoring equipment provides data on operational noise levels

the local rules and regulations. Due to the general size and nature of noise mitigation systems, potential overhead or underground obstructions can prevent certain types of mitigation from being effectively utilized. To accommodate these obstructions, the mitigation design may call for free-standing panels without any ground penetrating support structure to avoid any underground obstructions. To avoid any overhead obstructions, the mitigation design may call for smaller, portable panels that are designed to be placed closer to the equipment to maximize the effectivity of the panel.

When designing the noise barrier systems, it is best practice for the operations and safety groups of the HDD operator to collaborate and approve the mitigation design to ensure the noise barriers maintain a safe and efficient job site. If the mitigation design negatively impacts the HDD operator's safety considerations or operational pace, the noise mitigation would be a roadblock to success instead of a mutual benefit for all stakeholders.

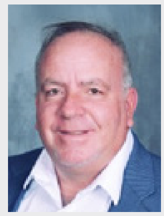
The effect of wind and weather can influence the design and construction of the noise barrier systems. Large noise barrier walls must be engineered to withstand the environmental rigors of the job site. On job sites with high wind exposure, it can be beneficial to have an engineered noise barrier system, backed with P.E. stamped drawings.

None of the challenges are insurmountable and taking the approach during the evaluation process and taking into consideration the potential pitfall down the line is an important step in planning properly from design and allowing for a successful project through completion.

Understanding the concerns of all project stakeholders and the impact of a construction project, such as an HDD set-up or other trenchless construction project, are key components of a successful project. Managing expectations surrounding construction noise must be considered. Early involvement and planning can reduce the risks associated with not having the proper mitigation measures in place.

HDD projects often occur in sensitive areas where noise is a growing concern for both permitting and construction. Stricter regulations make early noise management essential. By following the framework in this paper and engaging a sound engineer, contractors can better assess, predict, and mitigate noise impacts. Incorporating best practices early in design and construction can reduce permitting delays, minimize downtime, and foster positive relationships with nearby communities.

ABOUT THE AUTHORS:



Matt R. Cott *is Business Development Director for Environmental Noise Control, and has provided noise mitigation consultations for HDD projects throughout the United States for over a decade. He is involved in many of the local and national NASTT events, helping operators understand how to address their noise challenges effectively.*

Amanda Gilliam *is Inside Sales Manager at Environmental Noise Control, bringing two years of experience helping customers implement effective noise management solutions for HDD and construction projects nationwide.*

Seismic Design Criteria for HDPE Pipe Water Mains

Technical Document Important for Utilities in Earthquake Prone Areas

By: Steve Cooper, SCA Communications

> Experience suggests that HDPE pipe does very well in earthquakes.
>
> - Michael O'Rourke, Ph.D., P.E., F.SEI, M.ASCE Professor, Emeritus Civil Engineering, Rensselaer Polytechnic Institute

A pioneering report provides documentation for the required wall thickness of a fully fused, high-density polyethylene (HDPE) water main pipeline to withstand the lateral spread from an earthquake. Researched and authored by Michael O'Rourke, Ph.D., P.E., F.SEI, M.ASCE Professor Emeritus Civil Engineering at the Rensselaer Polytechnic Institute, the *Design of HDPE Water Mains for the Lateral Spread Seismic Hazard* (MAB-9) can be found at the website of the PPI Municipal Advisory Board: www.plasticpipe.org/MABpubs

"This critically important document provides the criteria for the proper design of an HDPE water main system," stated Camille George Rubeiz, P.E., F. ASCE, co-chair, HDPE Municipal Advisory Board, and senior director of engineering for the PPI Municipal & Industrial Division. "It is the first report of its kind that provides the rationale, data and formulas for determining the proper wall thickness for a fused, highly ductile and highly flexible HDPE water main in a seismically sensitive area, subjected to a lateral spread typically due to liquefaction of a subsurface soil layer.

"According to the latest United States Geological Survey, nearly 75 percent of the United States could experience an earthquake during the next 100 years that would cause significant damage to underground water mains. Professor O'Rourke's analysis of possible lateral spread hazards with formulas and charts provides the much needed data to help design a resilient water system."

The MAB serves as an independent, non-commercial adviser to the Municipal & Industrial Division of PPI, the major North American trade association representing the plastic pipe industry

The two primary seismic hazards to buried pipelines are wave propagation and permanent ground deformation. Because earthquakes are caused by movement at a fault, the resulting movement results in waves traveling away from the fault. These waves stretch and bend pipeline infrastructure at or near the ground surface and is referred to as the wave propagation (WP) hazard.

"The WP hazard occurs in all earthquakes and is most commonly quantified by the resulting ground strain," O'Rourke explained. "The WP hazard is also transitory in that after the shaking ends, the ground returns to its original pre-quake position. If the earthquake is large, it can also result in permanent offsets at the surface or movements of the ground (lateral spread hazard) both referred to as permanent ground deformation (PGD). The report addresses the lateral spread hazard and the pipeline strains due to PGD which are larger and hence more important than those due to WP."

O'Rourke's document contains formulas, calculations, empirical data, and illustrations plus nomenclature and definitions, all of which can be used in designing the HDPE water piping system.

"Experience suggests that high-density polyethylene pipe does very well in earthquakes," O'Rourke said, "but engineers like to have ways to calculate and substantiate their design. Listening to what somebody else says that, 'Oh yes, the pipe is great', but they still are faced with the question of 'what wall thickness do I need?' 'I have this particular diameter pipe and it's going to be buried this far underneath the ground so what wall thickness do I need for some expected seismic event?' The goal is to have HDPE pipe that will be able to withstand the expected earthquake loads on this inherently ductile material. With that in mind, MAB thought it would be useful to develop a document that provides

The ductility of HDPE pipe provides high resistance to earthquakes and is also an important factor for ease of installation

Heat fusing HDPE pipe sections provides a leak-free joint plus heightened security and protection from seismic events

designers with some relationships, tables, formulas, et cetera, that they can use to figure out how thick the wall would need to be for an expected lateral spread. And that's the purpose of the MAB-9. A similar new report, MAB-10, which is now available, addresses the fault offset seismic harzard.

"HDPE is known as a continuous pipe, which means the pipe segments, which are 40 feet to 50 feet long, are fused together," he continued. "The ductile iron or cast iron pipe has joints every 15 or 20 feet, and the damage from a seismic event frequently occurs at those joints. Continuous pipe, whether it's welded steel or high-density polyethylene, usually does better than segmented pipe in earthquakes. HDPE has the added advantage over steel (and all other materials) in that it is highly ductile, flexible and corrosion resistant and so it can move with the earth as opposed to trying to resist the deformations that the earth is imposing on it."

Rubeiz elaborated, "MAB-9 is essential for many reasons. Proper wall thickness is very important, especially with earthquakes, and ground movement. Plus, there continues to be a dire need to replace the aging infrastructure, especially pipes across North America that are leaking, brittle, and are in seismic regions where they may crack due to earthquakes. HDPE pipe can help both regions, while in seismic regions the information contained in MAB-9 will help in those replacement programs to provide a proper and resilient water main system.

"Being intrinsically able to withstand seismic shifts along with corrosion resistance, leak-proof fused joints creating a monolithic HDPE piping system, having a high degree of flexibility, and high ductility, are among the many reasons HDPE pipe is recognized to be the best product used for seismic installations and, of course, trenchless and open cut installations," Rubeiz stated.

"We would also like to thank the other MAB members and supporting engineers who provided their time and expertise to the project - Robert Diamond, P.E., City of Palo Alto, CA; Casey Haynes, P.E., City Utilities, Springfield, MO; Bill Heubach, P.E., M. ASCE, Seattle Public Utilities, WA; Harvey Svetlik, P.E., GPPC, TX; and Gerry Groen, P.Eng., Infra Pipe Solutions, ON."

Additional information can be found at www.plasticpipe.org/mabpubs or www.plasticpipe.org/municipalindustrial

RIDGECREST, Calif. - A formerly straight section of pipe broken by shifting earth during a 7.1 earthquake that shook Southern California in July 2019, cracking buildings, breaking roads and causing power outages. The quake, centered 11 miles from the Ridgecrest area, is the largest quake to hit Southern California in at least 20 years. It was followed by a series of large and small aftershocks, including a handful above magnitude 5.0. (Credit: Gene Blevins/ZUMA Wire/Alamy Live News)

ABOUT PPI:

PPI Plastics Pipe Institute MUNICIPAL & INDUSTRIAL

The Plastics Pipe Institute, Inc. (PPI) *is the major North American trade association representing the plastic pipe industry and is dedicated to promoting plastic as the materials of choice for pipe and conduit applications. PPI is the premier technical, engineering and industry knowledge resource publishing data for use in the development and design of plastic pipe and conduit systems. Additionally, PPI collaborates with industry organizations that set standards for manufacturing practices and installation methods.*

Uplands Roads Reconfiguration and Federal Boulevard Project

Enhancing the Community by Upgrading Essential Utilities

By: James Carroll, BT Construction

Project Background and Overview

The Uplands is a new mixed-use community being built in the City of Westminster (Westminster). The project will include residential housing, water-wise parks with connecting pathways, and a village center for local businesses to flourish. When Uplands is complete, it will be a thriving community of 2,350 homes situated in pocket neighborhoods that are connected by wide sidewalks, multi-purpose paths, parks, and tree corridors.

Westminster hosts a population of roughly 115,000 residents spanning both Adams County and Jefferson County. Westminster is a part of the Denver Metropolitan Area and the Front Range Urban Corridor. The Westminster Municipal Center is located 9 miles northwest of the Colorado State Capitol in Denver.

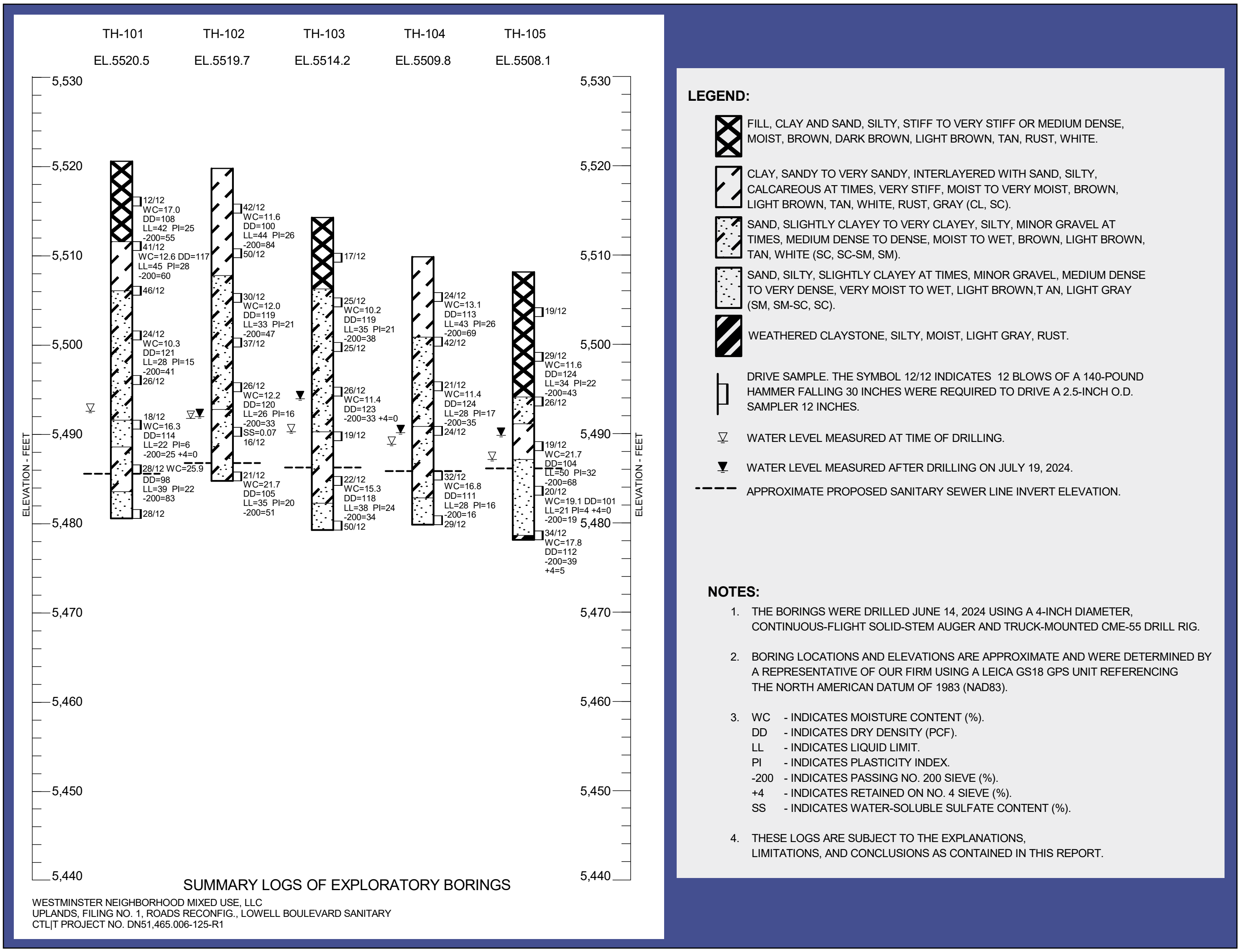
GroundWorks shoring system prior to installation within Shaft 100

Westminster's Economic Development Division (EDD) supports affordable housing development with the city. They believe that affordable housing is essential for creating stable, healthy communities. One of their goals is for residents to spend less on housing, improving financial well-being and access to education, healthcare, and job opportunities. These efforts will help reduce homelessness, foster diverse neighborhoods, and support long-term community growth, which helps everyone thrive. With the Uplands project the EDD has worked with the project construction manager, Contour Services (Contour), to provide the Maiker Housing Authority Project. This combined effort will provide Westminster with 70 affordable units, with 10 specifically designed to support adults with intellectual and developmental disabilities.

Along with the EDD, Westminster's Public Works and Utilities Divisions support the project with funding to repair and replace existing water and sewer infrastructure in the project area. Westminster is committed to providing the community with high-quality and reliable water services now and into the future. Westminster is responsible for treating up to 59 million gallons of water each day through two water treatment facilities and distributing water through approximately 554 miles of pipes to homes and places of business. Additionally, Westminster oversees wastewater system treating over 7 MGD of wastewater from 400 miles of pipe each year at the Big Dry Creek Wastewater Treatment Facility.

Project Builders

Contour is the construction management firm for the Uplands project. They are assisting with bidding services for the master infrastructure and perimeter roadway improvements to support the overall neighborhood needs. The first of several bid packages are complete and civil improvements and much of this scope is



Geotechnical borings completed for tunnel work from Shaft 300 to Shaft 200

under construction. The work discussed within this paper focuses on the civil infrastructure needs to support the project.

Contour brought in JHL Constructors (JHL) to complete the Uplands Roads Reconfiguration and Federal Boulevard Project, spanning from 88th to 82nd, which aims to enhance the surrounding community by upgrading essential utilities and road features. The project encompasses the installation of new water, sanitary sewer, and storm water systems to support the area's development needs. Additionally, it includes widening of local roadways, construction of new curbs and gutters, pedestrian and bike ramps, sidewalks and trails, the replacement of medians, and the modernization of traffic signals and signage.

BT Construction, Inc (BT) was brought on to the project to support JHL with the installation of a portion of deep sanitary sewer, exceeding 35 feet in depth. Initially BT was asked to provide a 42-inch hand tunnel for the connection of the new sanitary infrastructure to the existing upstream sanitary manhole. This work was complicated by a an 8-inch gas man that could not be relocated to allow for open cut installation of the sewer line. Additionally, it was decided that an additional 790 feet of deep sanitary sewer could be better installed by tunneling methods instead of the planned open cut excavations.

Ground Conditions

Limited geotechnical information was available at the start of the project. While a host of geotechnical borings were completed across the project boundary, most borings were being used to support the roadway and housing buildings. For the deep sewer installation CTL Thompson (CTL) was brought in to explore the geology associated with the deep sewer installation.

The geologic strata found in the borings consisted of about 14 feet of existing fill, underlain by interlayered clay and sand with minor amounts of gravel, with one boring having weathered claystone bedrock at 29.5 feet. Soils in the excavation

Shaft 200 slide rail installation with ground water present in shaft bottom

Shaft 200 Slide rail with ground water present after generator cables were stolen over the weekend shutting off the dewatering system on site

Shaft 200 loss of ground due to surface water flows over the weekend

zones were expected to be consisted of stiff to very stiff sandy clays and medium dense to dense silty to clayey sands. The soils near invert elevations became less clayey and siltier in some test holes.

Groundwater was measured at approximately 18.5 to 28 feet below existing grades. CTL estimated the invert of the planned deep sewer alignment would be about four to seven feet below measured groundwater levels. De-watering and stabilization would be necessary for successful installation.

It was the opinion of CTL that the presence of groundwater and relatively low-cohesion sandy soils in the deeper portions of the excavation would complicate the sanitary sewer installation. CTL stated that the contractor should be prepared for the risk of caving and unstable soil conditions, that precautions would be necessary to protect workers and equipment, and that construction dewatering would be needed. This acknowledgement by CTL further led the Contour and JHL team to believe that a tunnel installation of the full 700+ feet of deeper sanitary installation would be best installation method.

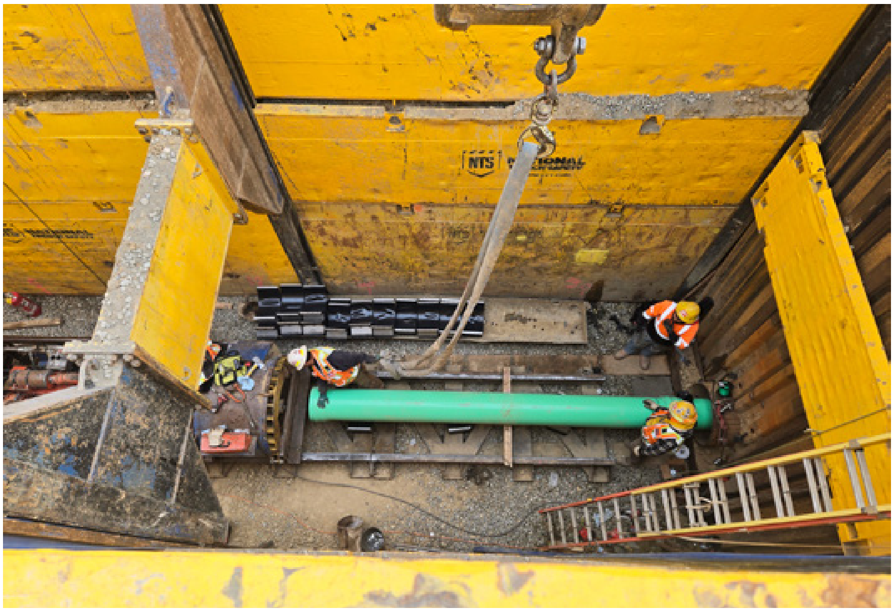
Tunnel Alignment

The new sanitary sewer alignment on the project runs along Lowell Blvd from 88th Ave. on the north side of the project to 87th Ave. on the south side. With this project, Westminster is able to relocate the sewer out of the roadway for easier maintenance access in the future. At the intersection of 88th Ave. and Lowell Blvd, the new sewer was connected to the existing manhole, already outside of the intersection. The existing manhole has a depth of approximately 36 feet to its invert.

BT worked with JHL, Contour, and their engineers to plan out the 790 feet of tunneled sewer. It was decided that the project would be completed in three (3) reaches. The first two reaches included 380 feet of 24-inch steel casing pipe installed by guided auger boring methods. The last reach of the sewer would be 30 feet of 42-inch steel casing pipe installed by hand tunneling methods. All tunneled sections included 15-inch restrained joint PVC Sanitary Sewer. With the full alignment broken into the three reaches, three separate shafts (100, 200, 300) of varying depth were required. At the completion of the tunnel work, JHL will construct a new manhole within each tunnel shaft prior to completing the backfill.

Shaft 100 was the southernmost shaft located east of Lowell Blvd at 87th Ave. This shaft was the shallowest excavation on the project, at a depth of just 16 feet. Groundwater at the shaft was anticipated to be below the sewer invert yet still within the shaft excavation. Four (4) dewatering wells were drilled near the shaft by JHL prior to BT's arrival on site.

BT utilized a GroundWorks trench shoring system to support the ground while tunneling from Shaft 100 to Shaft 200. Use of the GroundWorks box simplifies trench box construction on site, as the box is lifted into place as one piece keeping workers clear of moving loads and eliminating pinch points. The GroundWorks system used included four (4) separate trench boxes to provide a 40 feet long by 16 feet wide work area for the tunnel installation. The boxes were double stacked with a forward bay at 24 feet in length and the back bay at 16 feet in length. Both lower boxes for the front and the back bays were high arch boxes with a


Shaft 200, Installing carrier pipe from shaft 200 towards shaft 100

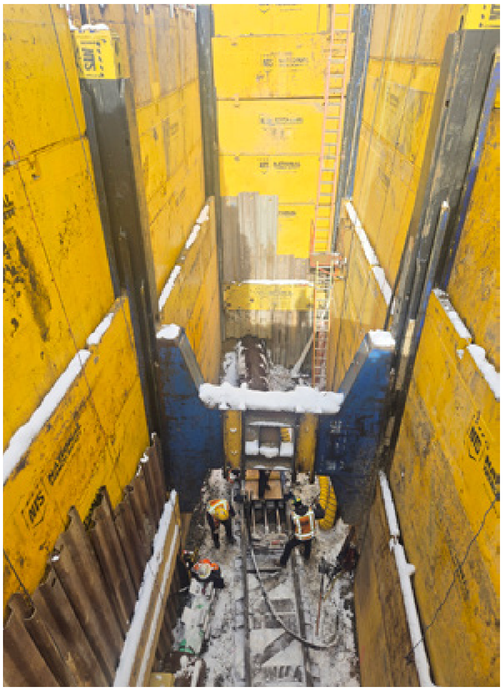
width of 16 feet wide by 10 feet tall. These boxes were topped with a second row of standard 16 feet wide by 8 feet tall boxes. The advantage of using high arch boxes is that the higher arch design allows for increased headroom on the shaft bottom, providing enough space for the auger bore machine to move under the raised header.

Shaft 200 was constructed utilizing slide rail shoring systems from National Trench Safety (NTS). Shaft 200 was constructed to a depth of 26 feet. The slide rail system consisted of a forward and back bay at 20 feet and 16 feet long.

Four (4) stacked rows of panels were used with each bay, providing for an overall height of 32 feet from the invert of the shaft. Groundwater was present at Shaft 200 and was relieved during construction with the placement of four (4) dewatering wells around the shaft.

The 380 feet of tunnel advance from Shaft 100 to Shaft 200 was completed by Guide Auger Boring Methods. Under this method, BT utilized an Akkerman pilot tube system to steer the pilot tube from the launch to the reception shaft. At approximately 80 feet from the launch shaft, BT hit a change in geologic material and was not able to advance the pilot tube further due to increased jacking pressures. The pilot tube and steer head were removed back to Shaft 100 to investigate the issue. BT found that the mostly sandy material had changed to a mostly clay material which increased the friction on the pilot tube string and caused the high jacking pressures. BT brought out a clay cutting lubricant and modified the steering head to spray the lubricant to the front of the steering


Shaft 100, Carrier pipe installed and preparing shaft for installation of manhole


Shaft 300, Preparing shaft for the start of hand mine tunneling operations


Shaft 300, Manhole has been installed the crew is working to remove the slide rail system and backfill the shaft under tight tolerances

head. With this change BT was able to advance the pilot tube to Shaft 200 the following day.

Once the pilot tube was at Shaft 200, BT added a wagon wheel adaptor to the pilot tube in Shaft 100. With the wagon wheel in place on the pilot tube, the first of nineteen (19) 20 feet long 24-inch casing pipes were welded on. It was at this time that BT opted to add a lubrication line consisting of ¾-inch black steel pipe. The steel lubrication pipe was positioned on the top and outside of the casing pipe; ending at transition from the pilot tube to the 1st casing pipe in the string. The same clay modifier used with the pilot tube was then used to lubricate the 24-inch casing throughout its installation. BT was able to install all nineteen segments of the casing pipe in approximately 5 days. Once the casing pipe was fulling installed and confirmed to be within specification line and grade, the 15-inch restrained PVC carrier pipe was pushed in placed. All carrier pipes were placed with pipe spacers, lifting the carrier pipe to the center of the tunneled casing.

Shaft 300 proved to be the most difficult excavation on the project. The shaft was constructed with a second NTS slide rail system, in a similar two bay arrangement to Shaft 200. However, Shaft 300 was excavated to a depth of 38 feet.

Groundwater and flowing sand caused extended delays with Shaft 300 construction. BT had estimated that the shaft construction would take approximately five (5) days to complete. However, due to ground water inflow through the bottom of the shaft excavation BT spent approximately 5 weeks working on the shaft excavation. Four (4) dewatering wells had initially been placed around the shaft.

Once forward bay excavation reached approximately 26 feet in depth, the ground conditions changed from a clayey sand to clean sand. With the loss of the fines in this material, groundwater inflow increased and the material started exhibiting flowing conditions. Sand boils were also documented in the shaft invert during the morning hours when the water in pit was clear enough to see the bottom.

BT worked by moving around a 4-inch sump pump placed on a small rock pile at the bottom of the shaft. This proved to be difficult to sequence with the excavator at this depth. At this time, the well drilling subcontractor was brought out to help assess the groundwater situation.

It was the opinion of those on-site, that the clay material atop the sand material was causing a confinement of the aquifer within the sand layer and the best option would be to place additional wells at a greater depth than the original wells. The four original wells were placed at a depth of 34 feet. The well casing was originally drilled to 55 – 60 feet deep, and the wells were placed higher at the depth of 34 feet. Upon noticing this inconsistency, the pumps were lowered to the full depth within the casings. Three (3) additional wells were added, two (2) east of the shaft in the only clear utility zone available, and one halfway between the shaft and the existing manhole along the hand mine tunnel alignment. The third well along the hand mine tunnel excavation was added by JHL at the request of BT, as without groundwater control, the hand mine tunnel operation would be at high risk of failure with the documented flowing sands. The JHL team agreed.

Once additional groundwater wells were added and the original well pumps were dropped to their full depth, shaft

GroundWorks system demonstration for RMNASTT and NUCA field trip to the site in October 2025

excavation rates picked up. This shaft still proved to be difficult with surface subsidence extending approximately 8 inches at a distance of 15 feet from the west side of the shaft. This subsidence can be an issue in some areas. The project team was lucky, in that the road was planned to be removed and replaced at the completion of the water line and sewer. No additional remedies or cost were observed as a result of the subsidence.

With Shaft 300 at its final depth, tunnel excavation from Shaft 200 to Shaft 300 was completed by guided auger boring. The crew continued to utilize the clay cutting lubricant with both the pilot tube installation and the casing pipe installation. The tunneling, including pilot tube operations, from Shaft 200 to Shaft 300, took approximately 7 days. Work could now begin on the hand tunnel operation from Shaft 300 to the existing manhole at the intersection of 88th Ave. and Lowell Blvd.

The hand tunnel was planned at just 30 feet in length from Shaft 300 to existing manhole. As part of this tunneling work, portions of the existing 10-inch sanitary line would be partially removed through the tunnel. BT coordinated with JHL on placement and timing of a sanitary bypass operation. BT had hoped that bypass pumping would be completed before the start of hand mining but ultimately was able to reach the existing sanitary line before the bypass pumping was operational. Once pumping had started, BT advanced through and along the existing sanitary line, reaching the existing manhole in five (5) days. At this point BT worked with JHL's concrete crew to cut a hole in the manhole invert to accept the new 15-inch sewer line. BT's and JHL's expectation were that the existing manhole had a 6- to 8-inch-thick wall, however after the saw cutting crew learned the manhole was cast in place, without a rear form, and the manhole wall was closer to 32 – 36 inches thick. Following this extended effort, the final 15-inch PVC carrier pipe was installed.

One final issue remained for BT's crews. In discussing project closeout internally, BTs superintendent recommended that the existing 10-inch sanitary line should be filled and abandoned. His concern was that once the dewatering wells were shut off, the sands would revert to a flowing condition running down the abandoned sewer line and causing a sink hole at the surface. This concern was brought to the attention of JHL and Westminster, who both agreed on BT's plan of action to fill and abandon the line. BT accomplished the work by potholing down 36 feet to expose the top of the old sewer line. BT used a steel rod to penetrate the top of the line, built a bulkhead at the downstream manhole outlet, and pumped a fly ash grout through the pothole until grout was approximately 4 feet deep within the now abandoned downstream manhole.

ABOUT THE AUTHOR:

***James Carroll**, is a Senior Project Manager for BT Construction (BTC). James joined BTC after working for over 20 years as a Tunnelling Engineer. At BTC James has been involved with a wide range of trenchless underground projects including: Auger Bores, Pipe Rams, Hand Tunnels, Horizontal Directional Bores, Microtunneling and TBMS projects.*

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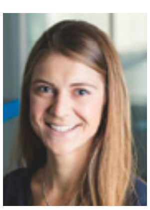

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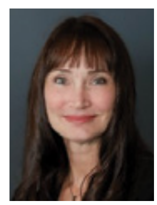

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