NASTT

ROCKY MOUNTAIN CHAPTER

Trenchless Elevated Journal

2024

Trenchless Elevated 2024
14th Annual Regional Conference

Thursday, November 14
SLCC Miller Conference Center Sandy, UT

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MESSAGE FROM THE RMNASTT CHAIR

Stephanie Nix-Thomas, RMNASTT Chair

Advancing the Use & Understanding of Trenchless Methods Across Our Region

As we wrap up another dynamic year in the trenchless technology industry, I want to take a moment to reflect on the incredible accomplishments of the Rocky Mountain Chapter of NASTT in 2024. This year has been filled with innovative and challenging projects, educational opportunities, and impactful partnerships that have advanced the use and understanding of trenchless methods across our region.

A highlight of our year is the annual Trenchless Elevated 2024 Conference, this year held in Sandy, Utah. This event brings together professionals from across the industry to discuss the latest advancements in trenchless technology, share best practices, and network with industry leaders. This event offers valuable educational sessions and municipal scholarships to support the next generation of trenchless experts.

Educational site visits were another cornerstone of our 2024 programming. The Boulder Sewer Improvement Project and the Jackson Storm Sewer Drain Project Phase 2 offered professionals and students alike a firsthand look at innovative trenchless techniques in action. These visits not only highlighted the practical applications of trenchless technology but also provided important educational content that enriched the participants' understanding of the industry.

In terms of fostering relationships across the region, our chapter partnered with the Water Environment Association of Utah (WEAU) for a Mountain Bike & Hike event, creating a fun and active networking opportunity for industry professionals. Additionally, our Utah Holiday Kick-Off Party and the Colorado New Year Happy Hour provided festive environments for members to socialize, exchange ideas, and strengthen our community ties. Our chapter also hosted a successful Happy Hour/Networking Event at Empower Field at Mile High in partnership with the National Utility Contractors Association (NUCA) of Colorado. This collaboration fostered strong industry relationships and opened new opportunities for members to connect in a relaxed and engaging environment.

In addition to our many successful events this year, we hosted the Annual Colorado Clay Shoot at Kiowa Creek in Bennett, Colorado. This event has become a favorite among our members, providing a perfect blend of competition, camaraderie, and outdoor fun. Participants had the chance to display their shooting skills while networking with colleagues from across the industry. As always, the Clay Shoot helped raise funds for our chapter's educational initiatives, ensuring that we continue to support training and professional development for both seasoned professionals and the next generation of trenchless technology experts.

As we look ahead to 2025, the trenchless technology industry continues to grow in importance. Our chapter is committed to advancing the knowledge and use of trenchless solutions, helping municipalities and contractors tackle the challenges of aging infrastructure, environmental sustainability, and cost-effective project delivery. We are proud to support professionals in the region through scholarships offered at the Trenchless Elevated events as well as scholarships for the annual No-Dig Conference, promoting the educational growth of our members.

> "Together, we are shaping the future of trenchless technology.

I am excited to announce that our Trenchless Elevated 2025 Conference will be held in a new location in Omaha, Nebraska, on February 5, 2025. This fresh venue and time promise an even bigger and better event, and I encourage you all to mark your calendars for what is sure to be an unforgettable experience. Sponsors get it touch with Christine Barnes for information to secure your booth. This is an excellent opportunity to touch trenchless professionals in the Mid West.

Thank you for your continued support of the Rocky Mountain Chapter of NASTT. Together, we are shaping the future of trenchless technology and making a lasting impact on our communities.

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

Sincerely,

Stephanie Nix-Thomas

Chair, RMNASTT
President, C. H. Nix Construction

MESSAGE FROM THE NASTT CHAIR

Matthew Wallin, PE, NASTT Chair

Hello Trenchless Champions!

Fall is here and I want to share some key updates and upcoming opportunities that are of importance to your chapter and our organization and industry.

I hope you are joining us for the annual Trenchless Elevated Conference being held on November 14 in Sandy, UT. This is an exciting event dedicated to advancing the field of trenchless technology in the region. This year's conference promises to be an exceptional gathering of industry experts, innovators, and professionals, offering a unique opportunity to explore the latest trends, technologies, and best practices in the trenchless sector. Attendees will benefit from insightful presentations and valuable networking sessions. Don't miss this chance to connect with peers, gain fresh perspectives, and contribute to the future of the industry. For more information on the conference, visit the Chapter's website: **https://rmnastt.wildapricot.org/TrenchlessElevated**

> Together, we are driving the future of trenchless technology forward.

NEW HEIGHTS. UNDER GROUND.

I'd like to offer a big thank you to everyone who participated in this year's 2024 No-Dig Show held in Providence, RI and the 2024 No-Dig North held in Niagara Falls, ON. Your engagement and contributions made these events a resounding success! The presentations were insightful, and the networking opportunities were invaluable. ***We are currently in the thick of 2025 planning and we hope you will mark your calendars for March 30-April 4 right here in your Rocky Mountain hub of Denver, CO!*** If you have any feedback or suggestions for future events, please do not hesitate to reach out to us at **info@nastt.org**.

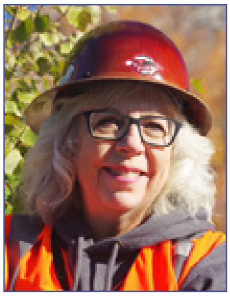
We are excited that the fifth edition of the Horizontal Directional Drilling (HDD) Good Practices Guidelines book has been released. And by popular demand, the book is now available in a digital format you can access online from any device, as well as a print-on-demand version! The fifth edition includes updated content reflecting the latest advancements and techniques in HDD. Alongside the book, we have also updated our HDD training course to align with the new edition. These courses are designed to provide both new and experienced professionals with the knowledge and skills needed to excel in their roles. Please check our website for more details on how to purchase the book and enroll in the courses.

Thank you for your continued support and dedication to your Chapter. Together, we are driving the future of trenchless technology forward. If you have any questions or need further information on any of the topics mentioned, please do not hesitate to contact me.

Matthew Wallin, PE

NASTT Board Chair

2024-2025 RMNASTT EXECUTIVE COMMITTEE



Stephanie Nix-Thomas, P.E. - *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 Regional 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.

Benny Siljenberg – *Immediate Past Chair*

Benny Siljenberg's 20+ years of progressive engineering experience with tunnel, trenchless, geotechnical and construction projects has been gained by providing responsive service to owner's, contractors, and prime engineers. This diverse teaming experience along with his business acumen allows Benny to view project risks and impacts from beginning to end and consider each individual aspect's while crafting a plan to reach the desired goals. His experience helps as he expands the reach of GEI consultants, Inc's tunnel and trenchless practice by offering services to both public and private clients. Benny's welcoming and cheerful attitude adds fun to project teams that benefit from his critically objective viewpoints.

Chris Knott – *Chair Elect*

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.

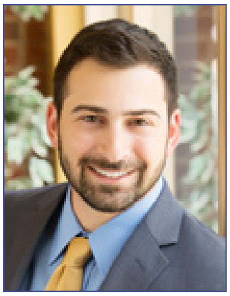
Chris advises engineers, owners, and contractors on optimal trenchless methods across varied soil conditions and site restrictions. He has presented at educational institutions including the Colorado School of Mines and the University of Colorado-Boulder.

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.

Rebecca Brock – *Treasurer*

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.

2024-2025 RMNASTT EXECUTIVE COMMITTEE



Kyle Friedman – *Secretary*

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.

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Trenchless Elevated 2024

Rocky Mountain Chapter North American Society for Trenchless Technology - RMNASTT

14th Annual Regional Conference

Thursday, November 14, 2024 | 7:30 am – 5:00 pm | SLCC Miller Conference Center 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 2024

RMNASTT 14th Annual Conference
Rocky Mountain Chapter
North American Society for Trenchless Technology

Thursday, November 14, 2024 | 7:30 am – 5:00 pm | SLCC Miller Conference Center Sandy, UT

	Conference Events Schedule		Time
	Registration and Breakfast		7:30 - 8:30 am
	Introduction and Welcome	Nick Boyer, 2024 Trenchless Elevated Chair	8:30 - 8:40 am
	Presentations	**Speakers**	
	Session 1	**Moderator: Brad Conder, PE (Azuria)**	**Time**
1.0	Platinum Sponsor Introduction	Azuria Water Solutions	8:40 - 8:45
1.1	Seeing the Light: Practical Approaches to UV Cured and Reinforced CIPP Lining Design (Rehabilitation - UV-CIPP)	Jeff Maier, P.E. (Dewberry Engineering)	8:45 - 9:15
1.2	Redundancy and Reliability of Water Supply Solved with Trenchless Approach (New Installation - HDD)	Dennis Galinato (Consor Engineering)	9:15 - 9:45
1.3	Five Trenchless Methods on one Subcontract Highlighting the Advantages of Progressive Design Build (New Installation - Tunneling)	John Beckos, P.E. (BTrenchless, Inc.)	9:45 - 10:15
	Break 10:15 - 10:35 in Exhibit Area		
	Session 2	**Moderator: Nick Boyer (Cardinal Infrastructure Services)**	**Time**
2.0	Platinum Sponsor Introduction	Cardinal Infrastructure Services, LLC	10:35 - 10:40
2.1	Life's Certainties: Death, Taxes, and $hit Flows Downhill - 1800 North SLC (New Installation - Tunneling)	Stephanie Nix, P.E. (Claude H. Nix Const) & Matthew Wallin, P.E. (Bennett Trenchless)	10:40 - 11:10
2.2	Early Steps In & Long-Term Goals for the City of Phoenix's use of AI Tech in Sewer Assessment (Pipeline Assessment)	Steve Siroky (Dibble Engineering) Patrick Womack (City of Phoenix) & Eric Sullivan (Sewer AI)	11:10 - 11:40
	Vendor Area Visit		11:40 - 12:00
	Lunch 12:00 - 1:00 - Presented by Platinum Sponsor Hobas Pipe USA Inc.		
	Session 3	**Moderator: Steven Meyer (Bowen Collins & Assoc)**	**Time**
3.0	Platinum Sponsor Introduction	Brierley Associates Corporation	1:00 - 1:05
3.1	SLCDPU - 2100 South Sewer Capacity Upgrades - Burst It or Trench It (New Installation & Pipe-Bursting)	Brandon Wyatt, P.E. (Bowen Collins & Associates)	1:05 - 1:35
3.2	South Englewood, Colorado Large Diameter Stormwater Pipeline CIPP Rehabilitation (Rehabilitation - CIPP)	Brad Conder, P.E. & Leanne Goodhue (Azuria Water Solutions)	1:35 - 2:05
3.2	Utah Utilities Installing a High Pressure Liner to Rehabilitate Difficult to Access and Deteriorating Water Mains (Rehabilitation)	David Asay (Advantage Reline) & Patrick Laidlaw (Underground Solutions)	2:05 - 2:35
	Break 2:35 - 2:55 in Exhibit Area		
	Session 4	**Moderator: John Beckos (BTrenchless)**	**Time**
4.0	Platinum Sponsor Introduction	BTrenchless, Inc.	2:55 - 3:00
4.1	Innovative Jacked Box Design Solutions & Considerations (New Installation - Tunneling)	Kyle Friedman P.E. (Brierley Associates)	3:00 - 3:30
4.2	132" Tunnel Under Taxiway West is Making DIA Great Again / Design and Construction Challenges for 2' to 13' Tunnels at Denver International Airport (New Installation - Tunneling)	Steven Alston (Hobas Pipe USA) & Ryan Marsters, P.E. (GEI Consultants)	3:30 - 4:00
4.3	RMNASTT 2024 Projects of the Year	**New Installation:** To be Announced **Rehabilitation:** To be Announced	4:00 - 4:15
4.4	Owner's Project Look Ahead	Multiple Municipal & District Representatives	4:15 - 4:35
	RM NASTT Conference Wrap Up	Stephanie Nix (RMNASTT Chairman)	4:35 - 4:50
	Social Hour in Exhibit Area and Outdoor Deck Presented by Platinum Sponsor - Claude H. Nix Construction		4:50 - 6:00

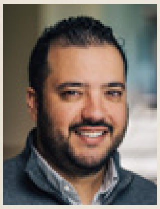
Jackson Street Storm Sewer Phase 2:

Horizontal Directional Drilling to Inject Chemical Grouting Prior to Twin Tunnel

By: Cody Telgheder, P.E., Nicholson Construction Company
Mamoun Laraki, Nicholson Construction Company
Sean Weddingfeld, BT Construction

ABOUT THE AUTHORS:

Cody Telgheder, P.E., *is the Operations Manager for the Rocky Mountain Region of Nicholson Construction Company, the US subsidiary of Paris-based Soletanche Bachy, one of the world's premier geotechnical general contractors. Cody has been involved in the construction industry since 2010 and within the geotechnical construction industry since 2014. He has worked on a wide variety of projects covering deep foundation, earth retention and ground treatment applications, with specific expertise focusing on Micropiles, Soil Nail Walls, Anchors, Permeation Grouting, and High/Low Mobility Grouting.*



Mamoun Laraki *is a Project Manager for the Rocky Mountain Region of Nicholson Construction Company, the US subsidiary of Paris-based Soletanche Bachy, one of the world's premier geotechnical general contractors. Mamoun has been involved in the geotechnical construction industry since 2016. He has overseen a wide variety of projects covering earth retention, deep foundations, ground treatment, micropiles, soil nail walls, and soil stabilization. Additionally, he has extensive experience managing multiple construction projects in nuclear sites.*

Sean Weddingfeld *is a Project Manager with BT Construction in Henderson CO. After graduating from Colorado State University, Sean gained experience in commercial, soil stabilization, heavy highway, and bridges as both Project Manager and Estimator. Since joining BT, he has been the PM on a variety of projects. From traditional bid/build projects with HDD, auger bores, and TBM, to a CMGC with a bore under 5 railroad lines and 3 different owners, and for the Xcel Energy Steam Line Distribution system in downtown Denver.*

Nicholson Construction Company (Nicholson) and BT Construction (BTC) are pleased to be awarded the Rocky Mountain NASTT Project of the Year Award – New Installations for the Jackson Street Storm Sewer Phase 2 Project (Jackson Storm). This project solution included chemical grouting prior to tunneling activities for the installation of storm drain pipes under a high traffic volume boulevard. This project was successful from beginning to end due to:

- Clear communication of anticipated risks during the bid phase.
- Preplanning with the general contractor, Iron Woman Construction (IWC), and the City and County of Denver (CCD) during preconstruction.
- Safe, quality execution of horizontal direction drilling to inject chemical grout for installing twin 84 inch diameter, 140-foot-long reinforced concrete pipe tunnels under Colorado Boulevard in the City of Denver (Figure 1).

Nicholson has used horizontal drilling techniques on several grouting projects over the last decade to safely drill under sensitive structures, such as historical buildings, airport runways, and even nuclear facilities. Jackson Storm is the second project that Nicholson and BTC have conducted together for CCD. The first project was the 27th Street Storm Interceptor Phase 2 Project where the team showcased the advantages of chemical grouting solutions. On that project, we used an acrylamide chemical

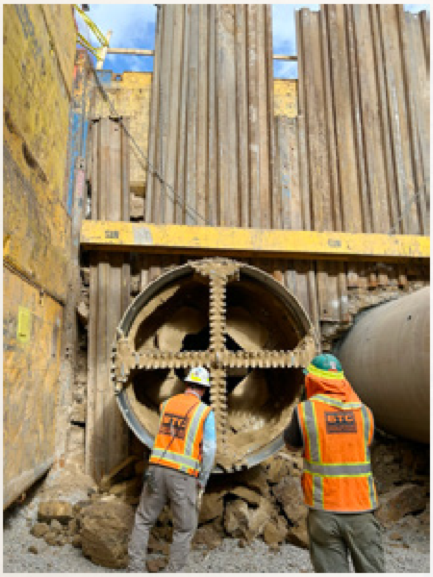


Figure 1: Permeation grouting treatment zone overlay (left); south tunnel within receiving pit (right)

product, supplied by Prime Resins, to permeate grout through soils with high fines content (15 to 30 percent+) in advance of BTC tunneling under a live RTD track. Building on the success of 27th Street, Nicholson and BTC held routine discussions with CCD and their Engineer to grow the acceptance and use of permeation grouting technology. Nicholson quickly recognized during the bid phase for Jackson Storm that acrylamide chemical grouting was the most effective solution for constructing the tunnels in similar high fines content soils (up to 31 percent).

The cross section in Figure 2 depicts the elevations of fill, silty-sand alluvium, and underlying sandstone rock at the site in relation to the tunnel alignments. The tunnels were designed to be constructed under Colorado Blvd on top of the sandstone layer. From Boring B-1 and B-2, the alluvium layer consisted of 27 to 31 percent fines. Permeation grouting was proposed to create a treatment zone that would mitigate the risk of unraveling of the alluvium that could propagate up to Colorado Blvd and create road closures or safety incidents from sinkholes. The treatment zone was planned in the alluvium layer on top of the sandstone (13 to 18 feet depth from the ground surface). The zone extended 3 feet above the planned crown of the twin tunnels and 24 feet across the cross section of the tunnels along the 140-foot tunnel alignment.

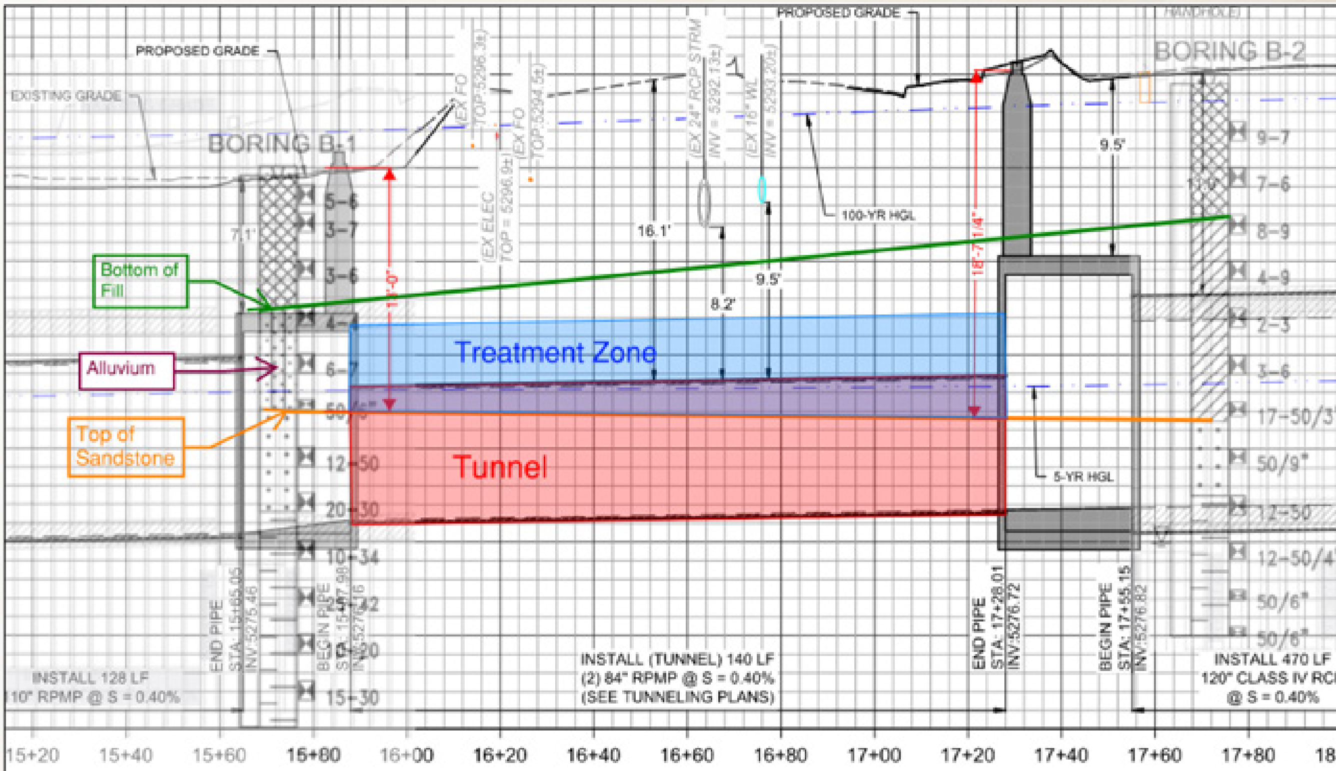


Figure 2: Cross section of geology and treatment zone/tunnel

Figure 3: Multi port sleeve pipe (upper left); directional drilling rig (bottom left); connecting MPSP (top right); horizontal hole layout (bottom right)

This project was not originally expected to require horizontal drilling; it was assumed that traffic lanes would be shut down on Colorado Boulevard to allow injection holes to be drilled vertically or at an angle from the ground surface. However, about a week prior to the bid date, CCD unexpectedly did not approve roadway lane closures during peak hours. So, nighttime operations would have been required during winter months. Nicholson proposed a horizontal drilling solution that would allow the road to remain open during the day; a solution that eliminated night shifts during winter months, provided a safer way to complete the scope, and allowed the project to be executed in a shorter timeframe with reduced overall costs.

The horizontal drill holes were initiated from existing grade on the east side of Colorado Blvd. (foreground of Figure 1) and angled to depths of 13 to 16 feet below grade. The holes then extended 140 feet along the tunnel alignment under the road, and then angled back up to daylight on the west side. Drill hole locations and trajectories were designed by Nicholson with 17 horizontal drill locations (9 primary, 8 secondary) that were between 380 to 420 lineal feet long. Nicholson and subcontractor, EEL Drilling, completed the drill holes and installed multi-port sleeve pipes (MPSP) for grout injection (Figure 3). MPSPs are specially fabricated grouting pipes with regularly spaced ports that allow targeted volumes of grout to be injected at specific locations. Drill holes were required to be installed within a tolerance of a 6-inch target radius from design, and grout volume and pressure criteria were agreed by project team.

After MPSPs were installed, drilling operations demobilized, and chemical grouting equipment was brought onsite. Over the last decade, Nicholson has strived to provide this technology with the highest quality injection and monitoring equipment available. The grout delivery system includes automated batching and pumps. Figure 4 shows our four-header grout trailer and the Grout Header Operator observing and managing the pressures and flows during injection.

High quality injection operations require consistent communication throughout the shifts among the Superintendent, Project Engineer, and Grout Header Operator. One slight mistake in the process can cause a cascading effect that could threaten the viability of an injection hole. Remediation of a lost hole would require either doubling the grout volume in the surrounding ports or, in the worst case, redrilling a new hole. Figure 1 shows a rendering of grout injected at ports along the tunnel trajectory. The size of the bulbs shown around the tunnel centerline are proportional to the volume of grout injected at that location. Not every port along each hole required the same amount of chemical grout. This can be attributed either to variations in density and fines content in the alluvium around that port or the impact of grout from adjacent ports. The presence of chemical grout in the alluvium layer behind the sheet piles at the tunnel facing (Figure 7) proves that the grout was placed and functioned as expected.

Figure 4: Chemical grout trailer (left); grouting operations (right)

The design called for 110-inch Hobas pipe to be installed along the storm route transitioning in a cast-in-place vault to twin 84-inch inner diameter Hobas pipes under Colorado Boulevard, near Colfax Avenue. A unique challenge of the project was the tunnel installation. The invert of these would be 24 feet below existing grade with a 3.5-foot separation between them. A slide rail system was installed by IWC for the launch and receiving pits. Most of the soil the tunnels were to be placed in was described as Sandstone (250 psi) and some Claystone on the bottom (200 psi). After visual inspection of the material being removed for the launch pit, BTC decided to switch from a closed to an open face TBM. The material was harder than indicated in the GBR. After testing it was revealed to be 264 psi to 513 psi.

BTC installed the 84 inch Hobas pipes with an Akkerman 5200 Series Pump Unit mounted on the 5000 series skid. This equipment setup is paired with a thrust yoke appropriate for the diameter of the pipe being installed. The thrust yoke then transfers the thrust from the hydraulic cylinders inside the 5200-pump unit while providing a service bay to accommodate for the spoil removal. Despite the difficulties from the harder material, our crews were able to complete the tunneling portion within the designated schedule.

Another positive impact this project had on the community was for Denver Fire Department (DFD) and their rescue

Figure 5: Insite Tunneling Operations (left); Soil Cuttings Bucket (right); Chemical Grouted Silty-Sand (center-top)

Figure 6: Jacking Pit with thrust yoke (left); Lowering Next Section of Pipe (right)

training. DFD rarely gets the opportunity to train on an excavation of this depth, which makes it difficult to operate at maximum efficiency when the need arises. It was arranged to have DFD do this training while we switched from the South tunnel to the North tunnel. DFD was very appreciative of this opportunity as it helps to maintain their top-level skill set.

The project started in December of 2023, and since completion of the tunneling in April 2024, no settlement has been observed along the alignment over Colorado Boulevard. No technical issues occurred during the permeation grouting or tunneling. Projects that run smoothly can be mistakenly perceived as easy. In this case, a great deal of effort went into making this project look easy.

We understand Jackson Storm is the first project to use horizontal direction drilling to install MPSP for permeation grouting in Colorado, maybe even across the Rocky Mountain region. Nicholson and BTC stand by the fact that when the right, experienced team is assembled, the right solution can be brought to address project needs and risks. Knowledge and experience help us ensure outcomes that are constructable and cost-effective. When Contractors work closely with Owners and Engineers, we can define and evaluate risks throughout a project's lifecycle. As we are more aware of these risks and collaborate as one team, we can often consider permeation grouting as an effective option to mitigate risks. This project required a strong, nimble, experienced team to think out of the box and quickly pivot to the horizontal drilling technique that provided the solution that met CCD's needs – safely and cost-effectively.

Figure 7: Completion of tunneling within receiving pit

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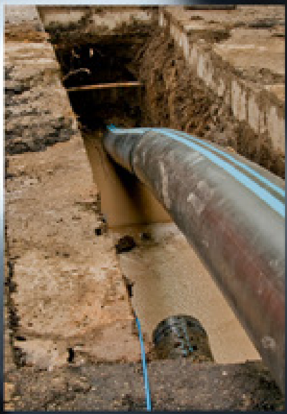

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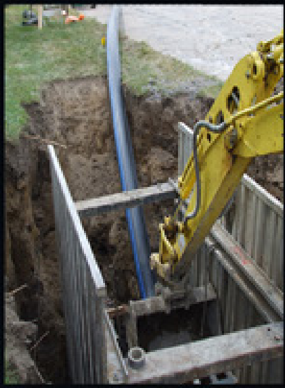

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South Englewood Large Diameter Stormwater Pipeline CIPP Rehabilitation

By: Brad Conder, P.E. & Leanne Goodhue, Insituform Technologies, LLC

INTRODUCTION

In response to the catastrophic flood of 1965 in the South Denver metro area, the Oxford Street Storm alignment was built (see Figure 1). The Oxford Alignment was designed in the early 1970s with original construction completed by 1975. Vertical alignment of the pipeline near Santa Fe Drive was adjusted in the early 1990s to allow construction of a new railroad bridge, and an extension to the pipeline was constructed in 2017 at the outfall to the South Platte River to accommodate a new pedestrian path. Fifty years after its initial construction, four major sinkhole events occurred in 2015, 2018 and 2019, requiring emergency repairs to the 92-inch and 78-inch corrugated metal stormwater pipelines which had reached the end of their design life and could not withstand the increasingly regular flooding events.

ABOUT THE AUTHORS:

__Brad Conder, PE,__ is the Commercial Manager for Insituform (an Azuria Company) for the states of Utah, Idaho, Nevada and Arizona. His diverse background includes experience in consulting, municipal and contracting organizations over the past 25+ years. Brad has a B.S. and M.S. in Civil Engineering from Utah State University.

__Leanne Goodhue__ is the Business Development Manager for Insituform for the states of Colorado, New Mexico, Wyoming and Montana. She began her trenchless career with Insituform in 2013 as a Field Engineer in their Littleton office and moved into Business Development in 2017.

PROJECT BACKGROUND

With both pipeline structural integrity and future hydraulic capacity being major concerns to the City of Englewood, various pipeline condition assessments were conducted over the years. GEI Consultants (formerly Lithos Engineering), working as a subconsultant to HDR, completed the latest pipeline assessment in 2021, followed shortly by a rehabilitation alternatives analysis which recommended Cured-In-Place Pipe (CIPP) as the preferred rehabilitation solution for the approximately 2,190-foot-long stormwater pipeline. GEI Consultants then moved immediately into design and reached out to Insituform Technologies to discuss CIPP methodology and high level budget pricing, where it was determined an over-the-hole wet-out process would be the most efficient and cost-effective means to construct this project.

Figure 1: Aftermath of 1965 flood (Courtesy of https://www.westword.com/news/the-1965-flood-how-denvers-greatest-disaster-changed-the-city-6668119)

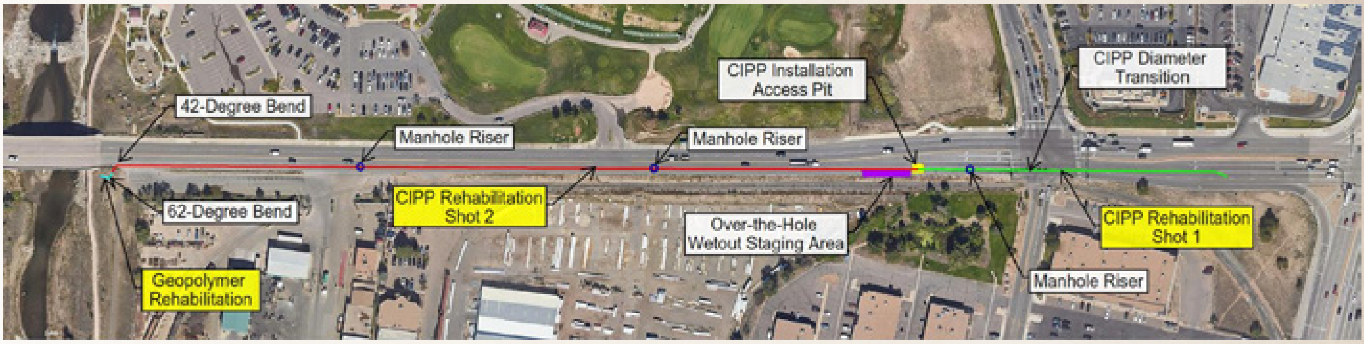


Figure 2: Project layout

By the Spring of 2023, before design was completed, another large sinkhole occurred requiring an emergency excavated repair. With concerns of more failures, the City of Englewood decided to fast-track the project, and the "South Englewood Flood Reduction Site A" project was put out for bid in early August of 2023. Following a competitive low bid process, Insituform Technologies, LLC was selected as the contractor to complete the project (see Figures 2 and Figure 3).

PROJECT CHALLENGES

There were several unique project challenges that were faced during design and installation of the CIPP liner, including: CIPP liner structural design, access points for installation, over-the-hole wet-out process, a pipeline diameter transition, mitered pipe bends near the downstream terminus of the pipeline, and cure water testing and discharge requirements. Each of these challenges, including how they were overcome by Insituform Technologies during construction, are discussed below.

CIPP Liner Structural Design

There were several unique structural design considerations for the gravity storm sewer outfall. First, the maximum CIPP liner thickness, per project specifications, was allowed to be 2.5 inches or 64 mm to maintain flow capacity requirements. Second, the design needed to account for AASHTO H-20 live loads under a heavily trafficked roadway where depth of cover over the top of the pipe ranged from around 10 feet to less than 2 feet. Third, although the outfall is a gravity pipeline, the structural design needed to account for an internal pressure of 10 psi. A balanced design was utilized that took into consideration both the design requirements and constructability of the CIPP liner. To reduce both the thickness and weight of the CIPP liner, Insituform Technologies incorporated fiberglass layers into the liner construction. The final design thickness of the 72-inch liner was reduced from 30.70 mm to 22.50 mm, and the 92-inch liner was reduced from 34.60 mm to 26.55 mm, which met project specifications. The thinner, lighter, fiberglass-reinforced liner also helped ease installation difficulties as compared to using a thicker, un-reinforced felt liner.

Access Points for Installation

The project plans indicated that three existing manhole risers and one additional excavated pit could serve as access points for the CIPP installation. By selecting an over-the-hole wetout process, only the single excavated pit was required, as the CIPP liner could be installed in two long shots both upstream and downstream from the pit. Shot 1, which included both 72-inch and 92-inch pipe as well as the diameter transition described below, was approximately 600 feet long. Shot 2, which included 92-inch pipe as well as the 42-degree bend described below, was approximately 1,500 feet long. The manhole riser sections, which had temporary blocking installed to prevent migration of the CIPP liner into the riser during installation, were cut open and returned to service once the CIPP was cured (see Figure 2).

Figure 3: Vertical deformation and point patch repair in pipe crown at joint (left) and typical surface corrosion in pipe invert (right) (Courtesy of Oxford Avenue Storm Sewer Outfall Condition Assessment Report, prepared by Lithos Engineering)

Figure 4: Over-the-hole wetout site layout (upper left), on-site wetout facility (upper right), dry CIPP liner prior to wetout (lower left), finished CIPP liner (lower right)

Over-the Hole Wet-Out Process

Due to the diameter and length of the CIPP liners required for this project, it was determined that a fully wet-out CIPP liner would: 1) physically be too large to fit into a refrigerated box truck; and 2) exceed acceptable DOT weight limits for shipment. Therefore, an over-the-hole wet-out process was selected by Insituform Technologies. An over-the-hole wet-out differs slightly from a typical wetout process in that all equipment, dry liner, resin and catalyst are temporarily located at the access point for CIPP installation. The dry liner, which is both physically smaller and weighs less than a wet-out liner, is shipped from the manufacturing facility directly to the project site. The dry liner is then wet-out in the temporary on-site facility and inverted directly into the manhole or access point (See Figure 2 and Figure 4).

By utilizing an over-the-hole wet-out process, Insituform Technologies was able to complete the liner installation in two blind shots of approximate lengths of 700 feet (Shot 1) and 1500 feet (Shot 2). Once wet out, the CIPP liner was installed using a water inversion and curing method. The water inversion method allowed for better control of the CIPP liner during placement inside of the host pipe, as well as helping to maintain consistent internal pressure to ensure the liner stayed tight against the interior of the host pipe during curing. The water cure method allowed for more consistent circulation of the heated cure water to help prevent colder areas where curing was delayed or excessively hot areas where damage to the CIPP liner could occur.

Pipeline Diameter Transition (Shot 1)

Near the intersection of W. Oxford Avenue and S. Natches Court, the pipe transitioned from a 92-inch diameter thin polymer lined corrugated metal pipe (CMP) to a 72-inch unlined reinforced concrete pipe (RCP). The diameter transition was located mid-pipe between two manholes. To complete the installation of the CIPP liner, careful measurements were taken of the existing pipeline to identify the distance to the point of diameter transition from the invert location. A 92-inch to 78-inch transition was sewn into the CIPP liner during manufacturing at the measured distance, and the liner was carefully inverted to install the transition as closely as possible to the location of the diameter change. The transition sewn into the CIPP liner had two purposes: first, to minimize wrinkling of the 92-inch liner where the diameter reduced to 72 inches; and second, to minimize over-stretching and thinning of the 72-inch liner where the diameter increased to 92 inches.

Following installation and curing of the CIPP liner, project specifications required that the remaining annular space between the CIPP liner and host pipe be backfilled with grout. Cardinal Coatings, a subcontractor to Insituform Technologies, completed the work. The annular space volume was approximately 195 cubic feet, and 51 gallons of Polyurethane grout was used. Cardinal Coatings drilled multiple ports in a grid pattern in the CIPP liner to ensure the grout moved completely through the annular space. They pumped slowly and observed each port to ensure complete backfilling of the annular space (See Figure 5).

Mitered Pipe Bends Near Downstream Terminus of Pipeline

The western reach of the Oxford Avenue pipeline terminated at the South Platte River. Near the outfall at the river, there was a 62-degree and a 42-degree bend that were fashioned in the 92-inch pipe using single miters in the CMP. The project plans required that the CIPP liner be installed through both bends. Due to a high-level of risk from lining through both mitered bends, including twisting and wrinkling of the liner, or worse, failure of the liner to fully invert, Insituform Technologies worked with the design engineers following award of contract to propose a change in construction. First, the CIPP liner was installed with a blind shot through the 42-degree bend. Next, Cardinal Coatings installed a geopolymer spray-applied liner beginning at the terminus of the CIPP liner and extending through the

Figure 5: Grout installation ports at diameter transition (left), injection of grout (right) (Courtesy of Cardinal Coatings)

62-degree bend to complete the pipeline rehabilitation. The geopolymer was installed in the pipe corrugation to an average depth of 1.25 inches to create a smooth pipe interior, and then an additional 1.5 inches was installed for a total average thickness of 2.75 inches (See Figure 6).

Cure Water Testing and Discharge Requirements

In accordance with project specifications, there were very stringent requirements on discharge of the water used to cure the CIPP liner. Cure water was not allowed to be discharged to the adjacent South Platte River or any other surface drainage. Furthermore, all cure water was required to be discharged to South Platte Renew (SPR) for treatment per their regulations and requirements.

SPR is a wastewater treatment entity

Figure 6: Geopolymer installation in CMP pipeline corrugations (left), completed geopolymer installation through 62-degree bend (right) (Courtesy of Cardinal Coatings)

located in Englewood, Colorado that serves 19 connecting communities in the Denver area. They are the third largest water renewal facility in Colorado, and they clean nearly 20 million gallons of wastewater a day from 300,000 customers. SPR was concerned about chemical constituents in the cure water discharge that could negatively affect the biological treatment plant processes and put them at risk of violating their National Pollutant Discharge Elimination System (NPDES) discharge permit. A special discharge permit was required by SPR for the project to detail acceptable cure water discharge flow rates, concentration limits of styrene and other constituent chemicals, and required sampling and testing.

To meet the project and discharge permit requirements, Insituform Technologies undertook four steps following curing of the CIPP liners to protect SPR's downstream treatment facility. First, the cure water was pumped out of the liner and into several on-site storage tanks rather than being directly discharged to the sewer system. Prior to pumping into the tanks, the temperature of the cure water was cooled to at least 104 degrees Fahrenheit utilizing chiller units to expedite the cool-down process. Second, while being pumped into the tanks, the cure water was processed through a carbon filtration system to reduce the concentration of styrene and other chemical constituents. To ensure maximum efficacy, the carbon filters were completely replaced between CIPP installations. Third, after circulating in the tanks for several days, samples of the filtered cure water were collected by both Insituform Technologies and SPR for testing by two separate third-party laboratories. The test results from the two laboratories proved to be nearly identical and indicated that the treated cure water met the chemical concentration requirements as detailed in the permit to allow discharge to the sewer system. Fourth, discharge of the cure water from the tanks to the sewer system was limited to 100 gallons per minute. This rate of discharge allowed the cure water to sufficiently mix and dilute with the effluent flow in the sewer system before reaching the wastewater treatment facility. Ultimately, the permitting and construction process was successful as the treatment operations at the SPR facility were not negatively impacted by the discharge of the CIPP cure water.

CONCLUSION

The project was awarded to Insituform Technologies in September 2023. The original as-bid design was complicated and risky, but following award, Insituform worked in collaboration with the engineers and project stakeholders throughout the submittal and approval process to develop trust in the construction team and to create positive solutions to project risks. In January 2024, when construction and installation of the CIPP liner began, the numerous project challenges as described above in this paper had been mitigated which led to the successful completion of the project. The project reached Substantial Completion in just 90 days by March 30, 2024, despite several snow events which delayed construction. Contract revisions were covered by a Force Account bid item and actual change orders were not needed for the project. The final price for the work was $3,445,000. Creative thinking, upfront problem solving, and lessons learned on successful complex projects like these, for all involved parties, will hopefully lead to better design solutions on future projects.

Five Trenchless Methods under One Subcontract:

The Benefits of Progressive Design-Build

By: John Beckos, P.E., BTrenchless

BTrenchless was selected as the trenchless contractor to assist Sandridge Constructors on the Utah Department of Transportation's interchange reconstruction and widening project in the cities of Roy and Riverdale, Weber County, UT at 5600 S and Interstate I-15. The project is being delivered with a progressive and collaborative design-build method.

Construction began in June 2023 with final paving anticipated during summer of 2026. Our team provided initial pricing on 10 different installations in February 2023, advanced to the final stage of subcontractor selection that summer and got under subcontract in the fall of 2023.

As of October 2024, nine utility installations have been completed out of our anticipated final scope of work, which includes eleven different utility installations utilizing five different construction methods:

- Two (2) Open-cut Casing installations (24-inch x 500LF, 48-inch x 200LF)
- One (1) Auger Bore (38LF x 48-inch)
- Three (3) GBM (guided) Auger bores (24-inch x 81LF, 24-inch x 365LF, 42-inch x 313LF)
- Three (3) OTS (On Target Steering) Auger bores (42-inch x 210LF, 48-inch x 96LF and 177LF)
- Two (2) Horizontal Directional Drill (HDD) installations (6-inch x 275LF and 24-inch x 270LF)

With the progressive design-build concept in mind, BTrenchless' early involvement in the design process allowed the team to make adjustments to make installations more constructable and more cost efficient. A few of the more interesting stories include:

1. **Roy City Water - 500LF x 24-inch open-cut**
2. **Roy City Water - 365LF x 24-inch GBM-Auger**
3. **Weber Basin - 177LF of 48-inch OTS**
4. **Clinton Ditch Irrigation - 270LF of 24-inch HDD**
5. **Weber Basin - 313LF x 42-inch GBM-Auger**

Before the different project types are discussed, a word on the soil type along this section of UDOT's Interstate 15 (I-15). As the joint venture name of Sandridge Constructors alludes, the majority of the subsurface ground was expected to include sand! More specifically, dense to medium dense sand with traces of silt and some gravels down to depths of 25 to 30 feet below grade. Most of the sand will stand up on its own during excavation. Groundwater was not present in any of the soil borings BTrenchless received at bid time and has not been present in any of the installations completed to-date. Our company has a long history of constructing trenchless installations in and around this area – it is some of the best dirt to bore through in the greater Salt Lake City valley.

Let's look at these five different case studies in the list above:

#1: Roy City Water - 500LF x 24-inch open-cut

The open-cut installation of the 500LF, 24-inch casing for Roy City Water was originally called out to be an 820LF, 24-inch jack and bore. Had the original plan been constructed, this GBM-Auger bore could have set a company-best installation distance with this method and raised the bar for the Guided Auger Bore method

Open-cut casing installation under a future pedestrian trail

within the trenchless industry. Due to the angled crossing across the highway (I-15) a minimum 500LF pilot bore would have been required with the opportunity to extend an additional 320LF. The 820LF alignment was planned to utilize a re-tooling and/or second jacking pit near that 500LF mark and would have restricted progress on the highway phasing plan. Fortunately for the project team, a reroute of the waterline was considered and an opportunity to place the 500LF casing at grade prior to construction of the new concrete trail through an existing nearby abandoned railway underpass was seized.

In early October 2023 BTrenchless revised our pricing and mobilized a crew to install the 500LF of 24-inch casing below the future pedestrian trail concrete floor. This saved the client and owner $400k, kept the project on schedule, and had fewer phasing restrictions on the roadway construction above. A huge win for the whole team.

Auger in casing ready for 365-foot bore

#2: Roy City Water - 365LF x 24-inch GBM-Auger

The second case study, Roy City Water required installation of 365LF of 24-inch steel casing across interstate I-15 and the Davis Weber County Canal (DWCC). Originally designed as a 285LF bore, there was an extremely challenging open-cut portion required to dig underneath the DWCC. The team decided that extending the bore past the canal should be considered and could reduce risk on that portion of the work. This required lowering the bore alignment and flattening out the grade. A GBM-Auger installation method was chosen due to the length of the bore and tight clearance tolerances past the existing utility network.

During construction, our pilot rods got stuck at 230LF and were unable to advance without losing line and grade. Fortunately, this location was on the east side of I-15 and could be excavated down to investigate the obstruction. A concrete kick block for an abandoned waterline was the culprit. Viewed by the team as a Differing Site Condition (DSC), it was an easy decision to move forward with a simple rescue pit above the stuck GBM. We removed the obstruction, continued the GBM, and came back following completion of the bore to backfill the excavation with CLSM (i.e. flowable fill) material.

#3: Weber Basin - 177LF of 48-inch OTS

The third case study was part of the overall relocation and upgrade to the Weber Basin Water Conservancy District (WBWCD) waterline on the east side of I-15. The 177LF crossing of 5600 S would wind up being one of the more challenging bores on the project. Our team used a 48-inch McLaughlin/OTS machine, which is a steerable head welded to the lead piece of the steel casing. The OTS allows for steering adjustments to be made from the safety of the bore pit and completes bores in a single pass as compared to the multiple step process of the GBM-Auger method. While boring our third stick of casing at roughly 60LF, our crew hit a full face of concrete, an obstruction large enough and hard enough to stop our bore machine. This obstruction would later be discovered to be an abandoned bridge foundation that had been left in place underneath the active 5600 S roadway. Further historical research would teach us that the DWCC used to be an open-

On Target Steering rig in bore pit with 48-inch casing

Abandoned bridge foundation encountered as obstruction

air canal across 5600 S, not the current enclosed box culvert, and the roadway was built with a bridge across the canal.

Unfortunately, this roadway happens to be 1 of only 3 access gates into the Hill Air Force Base (HAFB); shutting it down for exploratory excavation was not a viable option. The team collaborated on potential options, did some potholing the next night and found 2 more locations with concrete and rebar debris in the proposed bore path. We considered continuing the tunnel with a hand tunnel method (too slow and expensive) or abandoning the tunnel altogether and completing the casing installation with a traditional open-cut method using shoring boxes. Due to limited night traffic closure windows combined with the requirement to keep all lanes open during the daytime for the nearby HAFB access gate, we came up with a unique solution. The reality of abandoning the bore efforts entirely and installing pipe with a traditional open-cut shored method wasn't very practical or cost-efficient. The limited working hours would make an open-cut option take too long. The hand tunnel method in a 48-inch casing through the 30-inch opening at the front of the OTS machine wasn't practical, and we knew there were multiple obstacles in our path.

The decision was made to open-cut the bore alignment and clear the path of all debris then immediately backfill it with imported fill that could easily be bored through. This effort would be completed in two shifts of night work – all of the work could be done from the top with machines, not requiring personnel access into the trench and therefore didn't require shoring. Making it a much safer and quicker operation all together. With the bore path clear, BTrenchless was able to resume operations with their 48-inch OTS machine and completed the bore on line and grade as designed. The 36-inch Weber Basin waterline would then be installed through the casing.

#4: Clinton Ditch Irrigation - 270LF of 24-inch HDD

Our fourth case study involved the 270LF Horizontal Directional Drill (HDD) installation for the grade-critical upsizing of an existing water line for the Clinton Ditch irrigation company. Site constraints on the west side of I-15 and an existing high pressure gas line on the east side didn't allow for a traditional at-grade start for the bore as is common with most HDD projects.

BTrenchless found a location for a large 25FT deep excavation at the start of the bore and built a long ramp that our Vermeer 100/140 drill rig could walk down to gain access for the bore. That bore pit utilized three different support-of-excavation (SOE) techniques: laying the material back at a 1:1.5 slope, using a trench box at the front of the bore pit, and constructing a steel pile and lagging wall at the back of the pit. The west side of the project required the team to set up our fused 24-inch pipe string in the middle of 6000 S Street and then pull the fused pipe through a 12LF wide alleyway between two existing businesses into a small receive pit. This would require a full closure of the traffic intersection at 6000 S and 1900 W during the pullback and installation of the final 24-inch irrigation pipe. Our team worked well together navigating a tight utility corridor while executing a well thought out plan getting the irrigation line upsized and replaced on line and grade ahead of the spring run-off.

#5: Weber Basin - 313LF x 42-inch GBM-Auger

The final case study is our 313LF x 42-inch casing installation across I-15 for Weber Basin Water Conservancy District; (currently under construction as this article goes to print). Site logistics and constraints on this trenchless crossing require some less typical approaches to this jack and bore. Typically jack and bores are preferred to be installed uphill as it helps with soil conveyance and

Deep bore pit with ramp for waterline HDD

handling of any ground water encountered during the bore. Limited room on the downhill side of this bore requires it to be installed downhill. Typical installation slopes are usually less than 3 percent, but with an elevation difference across I-15 of 31FT, will require a downhill installation at 8.33 percent. This can be challenging as anything above 10 percent with traditional boring equipment will cause issues with normal operation of the diesel-powered equipment installing the bore. There are also additional safety concerns when setting up a bore pit at such a steep angle including the risk of the bore machine sliding down the tracks if there were a hydraulic lock failure.

Construction will begin on with a bore pit being setup in the middle of the DWCC canal to protect two critical utilities behind the pit: an existing 30-inch WBWCD waterline and newly relocated 24-inch high pressure Enbridge gas line. Once the 42-inch casing is installed on line and grade, the challenges will continue with final product pipe installation. A new 30-inch HDPE waterline will be fused together behind the bore pit and a tail ditch will be excavated underneath these two critical utilities and pulled underneath them into the new casing. It will also need to be installed over the top of the new 8 x 7-foot box culvert that will be the new home of the DWCC. Design coordination for the relocation of the canal, the high pressure gas and the new waterline installation have been ever evolving and have had to involve the coordination of both this current UDOT expansion project as well as account for the next one near 1800 N that is only in the preliminary design phase. Quite the effort!

BTrenchless prides itself on our teamwork, our ability to think outside the box, use all the tools in our toy box, and build challenging work safely. We have enjoyed the collaboration with our partners at Sandridge Constructors, UDOT, Whitaker Construction, BHI, Bowen Collins and Associates, and Horrocks Engineers. We look forward to completing our work on this intricate project safely, on time and under budget by early 2025.

ABOUT THE AUTHOR:

***John Beckos, P.E.**, is a* Senior Project Manager and Estimator for BTrenchless. Since becoming a part of BT in 2013, he has been involved in a wide range of trenchless underground projects, encompassing various aspects of the work, including: Auger Bores, Guided Bores, Hand Tunnels, Pipe Ramming, McLaughlin Boring, Microtunneling, TBM's, Pipe Bursting, Slip Lining, and Horizontal Directional Drilling.

Trenchless Technology's Role in Addressing Infrastructure Challenges in a Growing State

By: Colby Willis, GEI Consultants

Salt Lake City and its surroundings are one of the fastest-growing municipal areas in the United States. Heavy population growth and environmental challenges such as drought and climate change require forward-thinking local and state agencies to meet water and energy demands for the future. Originally installed with capacities anticipating future needs, pipelines may soon be inadequate due to accelerated development, growing populations, and changing standards (Water Resource Plan, 2022). Utah's complex geology and focus on seismic resiliency, along with major restrictions from north-south boundaries such as Interstates, UPRR lines, UDOT highways, and environmental features, make trenchless technology an essential aspect of growth and infrastructure planning.

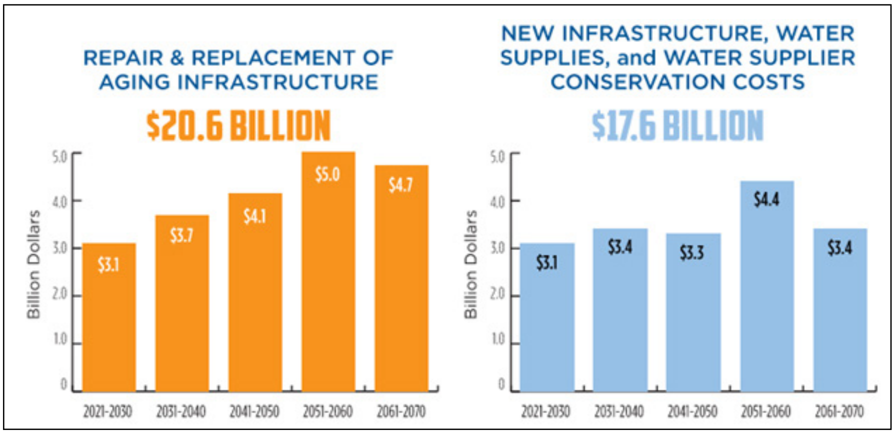
Utah's population projections show a rise from 3.3 million in 2020 to 5.5 million by 2060, with the most significant growth expected in Utah and Salt Lake Counties. Southwest Utah, particularly Washington County, is projected to more than double its population by 2060, making it the fastest-growing area in the state. According to the 2020 Statewide Water Infrastructure Plan, Utah and its municipal water providers will need to spend an estimated $38 billion on repair and replacement, conservation, and new supply projects by 2070. Utah and Jordan River basins alone will require an estimated $21.9 to $24.2 billion.

As Stakeholders increasingly apply trenchless technology to water infrastructure projects, its use in energy infrastructure is just as vital. This minimally invasive technology will also benefit gas pipelines, electric conduits, and other critical energy utilities. Infrastructure improvements in heavily populated areas pose significant challenges for pipeline alignments. Stakeholders are increasingly relying on trenchless technology not only to cross existing infrastructure and geographic features but also to minimize traffic disruptions and reduce construction footprints. Further, trenchless technology can often offer environmental benefits when compared to open cut construction due to reduced trucking needs, reduced construction waste, and reduced backfill quantities. Trenchless technology in Utah requires specialized expertise due to the state's complex and varied geology. Specialists familiar with the region's unique subsurface conditions are crucial to ensuring the success of trenchless projects, particularly in areas with prevalent seismic and landslide risks and difficult ground conditions.

Utah's Geologic Diversity and Its Impact on Underground Infrastructure

Since smaller diameter trenchless techniques are more susceptible to minute changes in geology, it's important to develop a comprehensive understanding of Utah and Salt Lake Counties' unique subsurface conditions.

If you were to draw a line from the Bonneville shoreline at the base of the Wasatch Mountains near Millcreek Canyon, stretching across the Salt Lake Valley to the Oquirrh Mountains at Coon Creek Canyon, you would traverse an incredibly diverse range of geological formations. This line would cross over 20 distinct surficial geologic units, each shaped by the region's complex depositional history. A single geologic unit typically consists of 3 or more separate subunits, each with unique characteristics. As a result, it is not uncommon to see two or three completely



Repair and Replacement Costs, Utah (Source: Prepare60, 2020, "Statewide Water Infrastructure Plan (2nd ed.))

Alternating layers of sand, silt, gravel, and cobble size materials near Riverton, Utah

different soil types within just a few feet of each other.

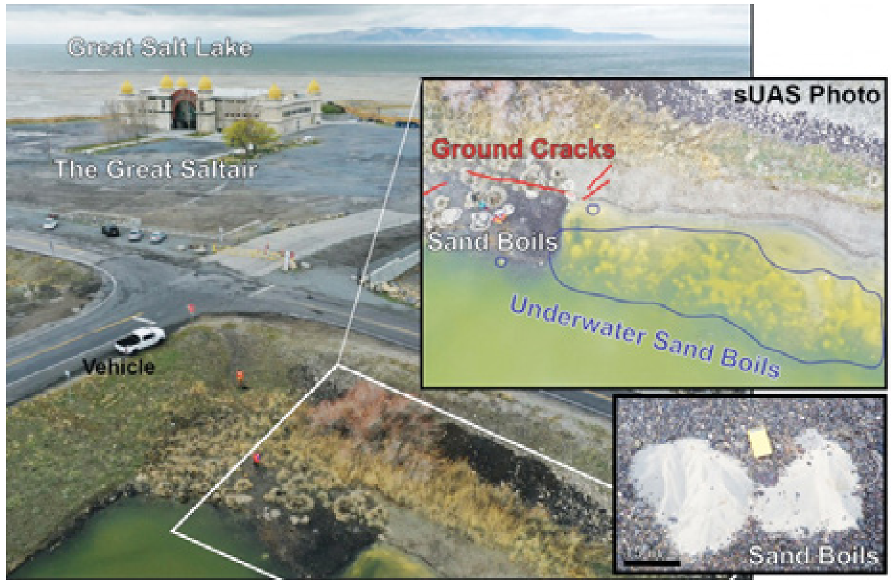
Much of this complexity is due to the deep lake depositional environment ("lacustrine") that covered most of the area during the Pleistocene epoch. This vast body of water, which existed until around 16,000 years ago, deposited alternating layers of fine-grained silts, clays, and sands as the Lake repeatedly expanded and contracted. The constant fluctuation of water levels, driven by climatic changes and geomorphological processes, created a patchwork of depositional environments, including deep water sediments, beach deposits, and alluvial fans. These environments produced fine sediments in deeper water bodies and coarser deposits like gravels and cobbles in areas closer to the shorelines or river deltas.

In the Salt Lake Valley, this results in a highly stratified subsurface where lacustrine clays may be abruptly interrupted by sand or gravel layers, complicating both engineering design and construction. The interbedding of these various materials, often deposited during different stages of the Lake's history, can create significant variability in soil behavior over short distances. These transitions can present challenges for trenchless projects, as soils with drastically different properties can behave unpredictably under load or exposed during excavation, making it tricky to match means and methods appropriately for the varying behavior.

Hard rock geology in Utah varies dramatically across different state regions. In northern Utah, areas like Little Cottonwood Canyon feature granodiorite, a coarse-grained igneous rock that forms some of the state's most rugged and visually striking landscapes. This type of hard rock is typically the result of deep volcanic activity, with large crystals of quartz, feldspar, and mica creating a dense, abrasive material. Adjacent to these are crystalline limestones, and steeply dipping shale and quartzite.

In contrast, southern Utah is famous for its red sandstones, such as the Entrada and Navajo sandstones, which offer an entirely different geologic setting. These iconic rock formations in places like Zion and Arches National Park consist of ancient windblown sand dunes that have been compressed and cemented over time, creating layers of red, orange, and pink hues. Unlike the granodiorite of the north, sandstone is sedimentary, formed from grains of sand rather than molten rock, and its porous structure makes it more susceptible to erosion, which has carved out the arches, cliffs, and canyons for which southern Utah is known.

From granodiorite in Little Cottonwood Canyon to the sandstones of southern Utah, the state's diverse geologic profile demands adaptability in both underground engineering and construction.



Liquefaction (Source: Utah Geological Survey, n.d., "Liquefaction." Retrieved from https://geology.utah.gov/hazards/earthquakes/liquefaction)

Geologic Hazards and Risks

The geological complexities in Utah are only part of the challenges faced by stakeholders, as the region is also home to numerous geologic hazards that can severely impact underground infrastructure. One of the most significant risks is seismic activity, particularly along the active fault zones of the Wasatch Front. Earthquakes in this area can cause ground shaking, surface rupture, and, in some cases, displacement along fault lines, all of which pose severe threats to buried pipelines. The seismic forces can lead to pipeline deformation, joint failures, and even catastrophic ruptures, compromising the integrity of critical conveyance conduits.

Another primary concern is the presence of shallow groundwater throughout Utah's valleys, which increases the likelihood of liquefaction during seismic events. Liquefaction occurs when saturated soils lose their strength and behave like a liquid, causing the ground to become unstable. This can lead to pipelines settling unevenly, buckling, or even floating to the surface, potentially disrupting service and requiring repairs. The combination of high seismic activity and liquefaction potential makes Utah's valleys particularly hazardous for buried infrastructure.

Legacy and active landslides also pose a risk in many areas, particularly along the foothills and river embankments. Landslides can shift large volumes of soil and rock, exerting high pressure on pipelines and potentially leading to lateral displacement or pipeline breaks. The topographic relief between the low lying valleys and the higher cliffs and mountains also provides gravitational energy for historic and current mass wasting events. It isn't uncommon to find hard rock boulders in the low lying valleys or lacustrine deposit due to rock fall or ancient glacial action. The unpredictability of these movements adds a layer of complexity to the design and maintenance of pipeline systems in the region.

Exploration Methods and Site Assessment

The most effective way to reduce risk on a trenchless project is through thorough and well-planned geotechnical investigation. In areas with complex geology, it's essential to have a deep understanding of various exploration methods and their limitations. Utah's diverse subsurface conditions require different approaches depending on the site. For instance, hollow stem auger drilling is effective only in shallow, stable soils and may not be suitable for deeper or unstable layers. Cone Penetrometer Testing (CPT) offers a continuous log of soil transitions, providing more detailed data than split spoon sampling in the varved clays common throughout Utah's valleys. Still, it has limitations in gravelly or dense sand conditions.

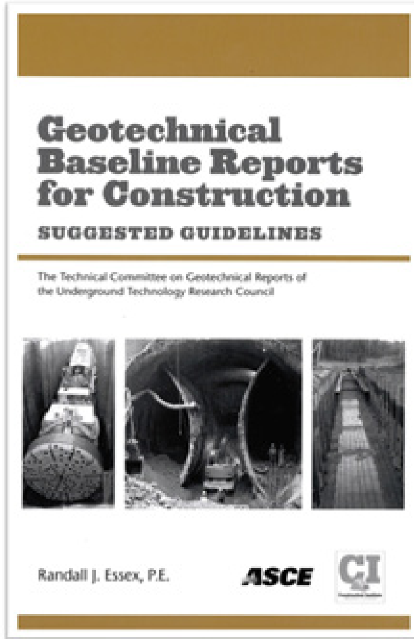
When dealing with challenging soils like gravels and cobbles, drilling techniques such as Overburden Drilling Excentric (ODEX) and Sonic drilling become essential, as these methods can penetrate hard or variable ground conditions. Selecting the proper exploration method is critical to understanding the subsurface and minimizing project risks. Experienced geologists and engineers familiar with local conditions and geological data can determine the most appropriate methods based on their expertise and the site's specific challenges. Stakeholders can execute trenchless projects with greater confidence and fewer surprises by matching the right exploration technique to the ground conditions.

In areas such as the foothills and benches along Utah's valleys, a comprehensive geologic hazard assessment may be necessary to identify seismic fault zones, landslide risks and other forms of mass wasting. Test pits and trenching are common tools to assess seismic fault traces when planning pipeline alignments or assessing the resiliency of existing pipelines to earthquakes. Instrumentation like slope inclinometers, piezometers, and strain gauges can be installed directly on or near pipelines to monitor these risks effectively. These instruments provide valuable data on the stability of the surrounding slopes, monitoring ground movement, water pressure changes, and strain on the pipelines. This real-time insight is crucial for assessing the ongoing integrity of pipelines and identifying potential slope instability that could compromise their safety in these geologically active areas.

Engineering Strategies for Trenchless Projects

Once a Geologist or Engineer identifies subsurface conditions, the project team can effectively manage trenchless projects by implementing front-end engineering strategies and construction methodologies. A detailed understanding of the subsurface conditions allows engineers to tailor their design approach to the specific challenges presented by each geologic unit and hazard. These challenges can vary widely, from dealing with loose, unstable soils to encountering hard rock, groundwater issues, or zones of seismic activity. Engineers can select the most suitable equipment, techniques, and materials to minimize risk and improve project outcomes by thoroughly analyzing these conditions during the planning phase and designing an alignment that allows for means and methods well suited for mitigating identified risks.

This approach was highlighted by Glen Wheeler of J.W. Fowler, who noted the benefits of early collaboration on the Deer Creek Intake Project: *"On the Deer Creek Intake Project, the alternate delivery contract method allowed for the designer and the contractor to collaborate through the design process, particularly with the tunnel alignment and geotechnical exploration. This allowed for identification of the varying project challenges and risks including hard rock to clay interfaces, tool change interventions, and wet MTBM recovery below more than 75 feet of water. Identifying the known risks early in the design process provided the engineer and owner available mitigation measures as well as adequate schedule and budget contingencies."*



On projects where alternative delivery is not possible, an experienced trenchless designer can offer a lot of the same risk mitigation and constructability benefits. The level of geotechnical detail required will depend on the complexity of the project and the specific site conditions. Engineers can present site data in various forms, each offering different levels of analysis and interpretation. A Feasibility Report provides a high-level overview, assessing whether a trenchless project is viable given the site's conditions. A Geotechnical Investigation Report (GIR) offers detailed information on soil properties, potential hazards, and recommended construction methods. For projects requiring more extensive documentation, a Geologic Baseline Report (GBR) is often used. This type of report establishes a baseline understanding of the site's anticipated geology and anticipated ground behavior, and identifies potential risks and uncertainties that could arise during construction. Design Data Reports (DDR) offer a comprehensive level of detail, providing all the geotechnical data needed to guide the final design and construction stages.

The Importance of Contractor Expertise

The success of any trenchless project is highly dependent on the expertise and qualifications of the contractor. A qualified contractor brings invaluable experience and specialized knowledge to the table, which is crucial when navigating the complexities of underground construction in geologically challenging environments like Utah. An experienced contractor understands the technical aspects of trenchless methods and how to adapt to unexpected conditions, such as encountering unexpected soil types, cobbles or boulders, or geological hazards. They are skilled in selecting the right techniques and equipment to minimize risk, reduce delays, and ensure the project stays within budget and on schedule. Alternatively, an experienced contractor in tandem with a knowledgeable owner can develop a suitable contingency plan to address geologic risks. Ultimately, partnering with a knowledgeable contractor is one of the most important decisions in ensuring the success of a trenchless project, particularly in regions with complex geology and high-risk factors.

Common Challenges for New Trenchless Installations

Expanding the utility service network to meet demands posed by population growth requires a thorough understanding of complex ground conditions, and the trenchless techniques capable of installing infrastructure within it. Utah is currently buzzing with activity with numerous techniques utilized annually. Some project examples are shown in the table above:

Technique	Project Examples	Notable Geologic Challenges
Microtunneling	Deer Creek Reservoir Lake Tap MP12 – Bangerter Highway (72-inch)	Extremely soft silt, sand and clay affecting slurry processing and machine steering
Guided Auger Boring	Weber Basin 1800 North (30 inch) North Davis I-15 Crossing (48 inch)	Extremely soft silt, sand and clay affecting steering. Varved soils with confined water pockets affecting face stability.
Guided Pipe Ramming	Salt Lake City 1800 North (60 inch) MP12 UPRR Crossings (72 inch)	Extremely soft silt, sand and clay affecting steering. Boulders requiring contingency change in technique to hand mining
Tunnel Boring Machine	Hidden Valley Trunk Sewer (54 inch)	Cobbles and boulders affecting ground stability, machine steering and roll.
Horizontal Directional Drilling	Dominion Belt Line 7 (16 inch) 800 N Roadway and Waterline (24 inch)	Gravel to cobble sized materials affecting steering, drill rates, and borehole stability. UPRR and UTA Restriction.

Trenchless Technology for a Sustainable Future

As Utah continues to experience rapid population growth and faces increasing environmental challenges, the importance of upgrading and expanding critical infrastructure is vital. Trenchless technology offers a promising solution for upgrading critical underground infrastructure within the complex geologic and environmental conditions present across the state, but its success depends on thorough geotechnical exploration, informed engineering practices, and the selection of experienced contractors. By leveraging the right expertise and planning strategies, trenchless methods can help meet Utah's future water and energy demands while minimizing disruptions to the surrounding environment and communities. As the state prepares for its continued growth, investing in trenchless technology and its supporting infrastructure will ensure sustainable and resilient development for years to come.

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ABOUT THE AUTHOR:

Colby Willis has seven years of experience in trenchless and geotechnical engineering. He collaborates closely with owners, engineers, and contractors, providing solutions that balance efficiency and project success. Colby's expertise spans a range of trenchless methods, with a focus on mitigating geotechnical risks and optimizing design through thorough subsurface analysis.

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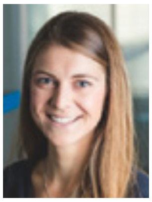
“Because of NASTT, I have a pretty stacked tool belt that helps me bring innovative approaches to infrastructure concerns. My experiences with trenchless technologies gives me a ‘leg-up’ over others.”

~ Eric Schuler, PE, Onondaga County Department Water Environment Protection

Education Second to None

“NASTT is far and away the leading educator and networking pool in the trenchless industry. If your company plays a part in the trenchless industry, you will benefit from NASTT membership much more than you realize.”

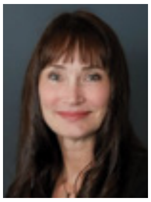
~ Joe Lane, Azuria Water Solutions



Tops at Staying on Top of the Industry

“I first joined NASTT to stay current on technological developments, best practices and market trends. Participating in NASTT committees and events and accessing its expert mentors and professionals is essential to the success of almost any project.”

~ Marya Jetten, AECOM



Amazing Network

“NASTT has been the most significant vehicle relative to the industry-specific connections I’ve made and cultivated throughout my career.”

~ Cindy Preuss, PE, CDM Smith

Membership Helps Me Strut My Stuff

“I would not be doing what I love to do without the presence and impact of NASTT. I wanted the industry to know about a record HDD project and NASTT gave me the access and opportunity to tell to the industry.”

~ Jim Murphy, UniversalPegasus International

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WYDOT Ralston North Reline - Powell, Wyoming:

A Case Study

By: Adam Wickam, Contech Engineered Solutions

Installation Date: June 2023

- Owner: WYDOT
- Engineer: WYDOT
- Contractor: Mountain Construction Company
- Subcontractor: Wilson Brothers Construction

Technical Description

- Product: DuroMaxx® SRPE
- Diameter: 72-inch
- Length: 216 LF (triple-barrel each segment 72 LF)

In the Ralston North Badger Basin of Powell, Wyoming, an 84-inch diameter triple-span culvert had outlasted its original design life and necessitated either replacement or repair. To circumvent potential delays and road closures, the Wyoming Department of Transportation (WYDOT) explored the feasibility of a reline solution.

Initially, WYDOT had proposed a 72-inch HDPE liner pipe for the culvert's rehabilitation project. However, upon careful consideration, they recognized the potential for greater efficiency and cost-effectiveness with a DuroMaxx® SRPE liner solution compared to the original plan. Consequently, they approved the solution proposed by Mountain Construction Company, marking the first instance of integrating a DuroMaxx® SRPE liner solution into a WYDOT reline project.

Contech Engineered Solutions manufactured 216 LF of 72-inch plain end DuroMaxx® for this reline project, comprising three

Triple-span culvert had outlived its design life

Contractor adeptly sliplined each section into the existing triple-barrel span

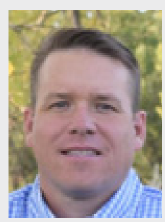
Timely manufacturing, delivery and installation of the 24LF segments met stringent deadlines

> Contech's swift delivery is a game-changer.
>
> - Nick Wilson, Wilson Brothers Construction

24 LF-long pieces per run. The timely manufacturing and delivery of these segments met the project's stringent deadlines. Wilson Brothers Construction, the subcontractor, internally welded these three pipe segments before their insertion into the host pipe. Subsequently, a lightweight grout was pumped through a flowfill header cap. The integration of internally welded couplers joined the plain ends seamlessly. Leveraging their extensive experience in Wyoming, Wilson Brothers Construction adeptly sliplined each section into the existing triple-barrel span, employing a unique technique developed through their numerous reline projects. This underscores the evolving innovation in this construction methodology.

Contractors favor DuroMaxx for large diameter relines due to its low profile, allowing for a larger inner diameter while preserving the desired outer diameter (OD). Nick Wilson of Wilson Brothers Construction attested to this: "I opt for Duromaxx in reline projects of 60-inch diameter and above. Its lower profile compared to other pipes I've used ensures a snug fit, requiring less grout and yielding a superior final product. Plus, Contech's swift delivery is a game-changer."

ABOUT THE AUTHOR:



Adam Wickam *is Contech's Region Sales Engineer for Northern Colorado, Montana, and Wyoming. He has been with Contech for 13 years and holds expertise in product development, design for manufacturing, lean manufacturing and sales of prefabricated infrastructure solutions. His current focus is the development of the reline, sanitary, storm sewer, and irrigation markets. Adam holds a B.S. in Business Administration from University of Northern Colorado.*

Project underscores the evolving innovation in reline methodology

Compression Fit HDPE Pipe – Another Proven Pipeline Replacement Method

ASTM Standard Codifies Method for Gravity and Pressure Pipe for Both Water and Force Main Projects

By: Steve Cooper, SCA Communications

> The thicker HDPE pipe provides structural integrity. In this case, the ovality would have no affect during installation and the HDPE pipe would form a tight compression fit within the old ductile iron pipe.
>
> - Harvey Svetlik, P.E., HDPE Pipe Industry Consultant

It wasn't a typical, normal sliplining job to replace a failing force main line in Sioux Falls SD. The original ductile iron pipe had deformed and had severe ovality. Hydrogen sulfide gas from the sewage flow made sulfuric acid, which collected at the top of the metal pipe and destroyed it. It was thought that pulling through a new pipe wouldn't be possible as it would hang up on the deformed inner wall of the old pipe. Reducing the diameter was not possible -- the diameter of the new pipe needed to be as close to the old one to maintain the rate of flow. The solution provided by Murphy Pipeline Contractors (Jacksonville, FL) was to use high-density polyethylene (HDPE) pipe and compress it to fit, knowing that the thermoplastic pipe would naturally reform itself.

This is one of the inherent attributes of HDPE pipe," stated Camille George Rubeiz, P.E., F. ASCE, co-chair, HDPE Municipal Advisory Board, and senior director of engineering for the Plastics Pipe Institute's (PPI) Municipal & Industrial Division. "As well as being corrosion proof, it is flexible and ductile to go through a special die on the job site that makes it possible to be pulled inside a host pipe even when the pipe is not round. In this case, the ovality would have no affect during installation and the HDPE pipe would form a tight compression fit within the old ductile iron pipe." PPI is the major North American association representing the plastic pipe industry.

More than 8,700 feet of 36-inch ductile iron sewer force main was replaced with HDPE PE 4710, DR 21 pipe using Murphy's CompressionFit™ method, patent pending. The new pipe has a 100-psi operating and a 200-psi surge pressure rating, and is rated as a Class 6 solution in accordance with ASTM F3508. The sewer force main traversed under three city parks, along Covell Lake, through major commercial districts and under state highway SD 115. It was made and provided by WL Plastics (Fort Worth, TX), a member company of PPI.

Opened in 1985, the Sioux Falls system treats some 18 million gallons of wastewater daily. There are 900 miles of pipe in the system that conveys the wastewater to the city's treatment plant. There is a $215 million expansion plan underway that will increase the facility's capacity by 50 percent when completed in 2025.

"One of the questions we were asked was 'Can a 36-inch ductile iron sewer force main with severe ovality be replaced with HDPE pipe using CompressionFit?'", said HDPE pipe industry expert and consultant Harvey Svetlik, P.E. "The answer was an unequivocal 'yes'. Matter of fact, some other recent projects saw 54-inch diameter pipe with a three-inch wall thickness installed using the CompressionFit method. One of the principal things that this technology does is that it preserves the flow rate of the existing host pipeline and seals over holes and leaks, so you have a dual-wall composite pipeline. And the thicker HDPE pipe provides structural integrity."

Svetlik has more than 40 years of experience in the plastic pipe industry, specializing in polyethylene pipes and fittings. He is the inventor of the MJ Adapter, also known as the Harvey Adapter. An active member of PPI for

The new 36-inch HDPE pipe replaces the corroded ductile iron pipe in the Sioux Falls, SD sewer system (Photo credit: Murphy Pipeline)

30 years, he is the author of numerous PPI technical notes, developer of ASTM/AWWA standards, and an inventor who holds 16 patents.

One of the most recent ASTM standards authored by Svetlik is ASTM F3508 for the installation of compressed fit shape memory polymer pipe. "ASTM F3508 codifies the specification of the material to use and deals with the shape memory characteristics of the material such as high-density polyethylene.

"With the CompressionFit technology, instead of elongating a rubber band and letting it recover as is done with Swagelining, they basically do a lot more of radial compression. Instead of stretching it and thinning the wall, they downsize it and radially thicken the wall, such that when it goes into place it enlarges in diameter, and the radial wall thickness stands as it expands out, like rolling out pie dough."

The developer of CompressionFit is Murphy Pipeline Contractors (Jacksonville, FL). "Most cities cannot afford to relocate and replace a 16-inch diameter or larger pipeline within their vast utility network," said Todd Grafenauer, education director for Murphy. "The result of the CompressionFit HDPE pipe lining technology is that a new HDPE pipe will be 'compressive fit' inside the existing host pipe. This lining offers remarkable value over other construction methods such as an increased flow rate over sliplining, we do an average pull distance of 2,000 feet with more than a 90 percent reduction in excavation and there's no new easement documentation

Replacing the Sioux Falls corroded ductile iron pipe that had been eaten away by sulfuric acid caused by sewage, the HDPE pipe is inserted into the destroyed pipe using the CompressionFit method from Murphy Pipeline (Photo credit: Murphy Pipeline)

> In this case, the ovality would have no affect during installation and the HDPE pipe would form a tight compression fit within the old ductile iron pipe.
>
> - Camille George Rubeiz, P.E., F. ASCE, Co-chair, HDPE Municipal Advisory Board

needed. Plus, we simply follow the existing pipe path using GIS maps." Murphy is a member company of the association's Municipal Advisory Board (MAB).

Governed by ASTM F3508, the CompressionFit HDPE pipe lining technology specifies an HDPE pipe with an outside diameter larger in size than the inside of the host pipe to be renewed. After the HDPE is butt fused to correspond to the pull distance, the pipe is pulled through a reduction die immediately before entering the host pipe. This reduces the HDPE pipe temporarily below the inside diameter of the host pipe allowing it to be inserted.

While the towing load keeps the HDPE under tension during the pull, the pipe remains in its reduced size. The HDPE remains fully elastic throughout the reduction and installation process. After installation, the pulling load is removed. The HDPE pipe expands until it is halted by the inside diameter of the host pipe. The effectively natural 'tight' or 'compression fit' is accepted as exchanging an existing failing pipeline with a composite pipe in its place.

"One of the things about the ASTM F3508," Svetlik explained, "is that it can be utilized not only for municipalities for gravity flow, but even more ideally for pressure pipes for water pipeline replacement, or force main replacement."

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

ABOUT PPI:

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.*

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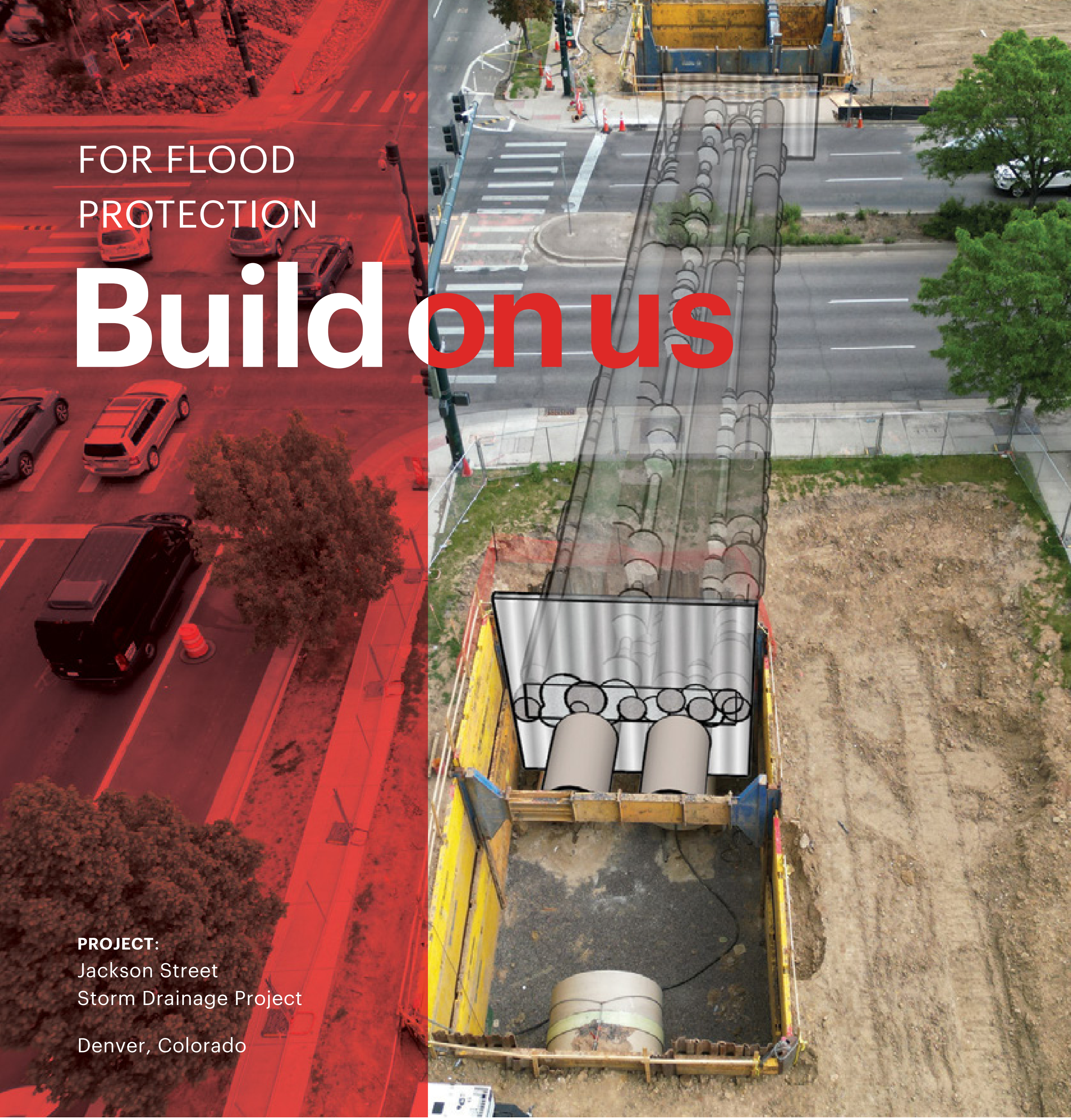

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