NASTT SOUTH CENTRAL CHAPTER

OKLAHOMA

TEXAS & OKLAHOMA TRENCHLESS REPORT 2021

OFFICIAL PUBLICATION OF THE NASTT SOUTH CENTRAL CHAPTER (NASTT-SC)

- 5th Annual Trenchless Technology Conference
- Pipe Bursting in Houston

2021 ANNUAL EDITION

CONTENTS

Cover Feature:

PEP Talk: Pipe Bursting Houston's Slip-lined Sewer Mains

An early pioneer in the use of the pipe bursting method, the City of Houston is now recognized as one of the largest pipe bursting markets in the world, and the technique has become the City's "go-to" method. Although some still consider slip-lined pipes as "unburstable", pipe bursting contractors in Houston have been using a combination of pipe bursting and pipe slitting tools to replace slip-line sewer mains. Insights into the pipe bursting process are provided by Portland Utilities Construction Co., which has been bursting pipe for 25 years, and is rapidly approaching a milestone of 3 million LF of burst pipe.

Features:

San Antonio Water System (SAWS) W-6 Upper Segment

Details on the microtunneling segments of a sewer main project in to replace existing 48 and 54-inch gravity sewer lines that pass through Lackland AFB with approximately 29,000 linear feet of 104, 78, and 60-inch gravity FRP sewer. Project design called for non-pressurized tunneling for the majority of the alignment, however the W-6 segment specified pressurized tunneling.

Houston Water Capital Improvements

Consolidating three lift stations into a single regional lift station was the best solution to comply with regulatory requirements and reduce operational and maintenance costs. The existing aging wastewater lines were replaced with deep gravity lines, and due to the depth microtunneling was selected as the preferred trenchless method.

Likelihood	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	[illegible]

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Direct Pipe® Installation – The Importance of Pre-planning

A revolutionary technique that is a very useful option for pipeline crossings, Direct Pipe ® installations have many pre-planning items that should be considered in order to ensure successful project completion. Items include utilizing a safety matrix to identify high risk items that may occur during construction, and incorporating detailed specification documents into the contractor selection process.

Telemetry Reduces Risks and Lowers Costs

When faced with the rehabilitation of a major sanitary sewer system, stakeholders with the City of Fort Worth knew they had a significant project on their hands. Details on the associated bypass project and how the PumpSentri telemetry from Sunbelt Rentals provided a level of comfort that team members could track every aspect of the bypass project remotely from their web-enabled devices

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MESSAGE FROM THE NASTT SOUTH CENTRAL CHAIR

Jim Williams, NASTT South Central Chair

Welcome back to the 4th publication of the ***Texas and Oklahoma Trenchless Report***. Established in 2017, the South-Central Chapter of the North American Society for Trenchless Technology (NASTT) is proud to present this journal documenting trenchless projects which are the result of the growth and impressive level of support from professionals within our industry.

The South-Central regional chapter of NASTT represents Texas and Oklahoma, two states comprising a geographic area experiencing significant growth in population. As the population grows, so does the need to expand, upgrade and replace existing infrastructure. Now more than ever, the benefits of trenchless technologies are critical to addressing our infrastructure challenges. The ***Texas & Oklahoma Trenchless Report*** is focused on providing a better understanding of trenchless methods and best practices on a regional level.

The South-Central chapter (SCSTT) was formed in January of 2016, and has since hosted four chapter events in 2016, 2017 and 2019 at The University of Texas at Arlington and at Oklahoma State University in 2018. These events are averaging roughly 150 attendees and include utility owners, engineering firms, municipalities, and contractors. At these events, attendees learn about the trenchless projects that are taking place in their local areas and enjoy the professional networking opportunities to learn from their peers. The 2020 annual conference was planned to occur in Sugar Land, Texas and was postponed due to Covid-19. It is now taking place September 13 and 14th, 2021.

The South-Central Chapter is committed to supporting education through scholarships for our members. A total of 3 student scholarships at $2500 each will be awarded at the 5th Annual Chapter Conference on September 14th in Sugar Land, Texas for the 2021-2022 school year. The South Central Chapter will continue to support eligible student and members through scholarships, education, and future employment within our industry.

> *"The South Central Chapter has seen exceptional growth"*

The South Central Chapter has seen exceptional growth over the past year with a 25 percent increase in membership. I challenge each of you reading this publication to consider joining the South-Central Chapter of NASTT and get involved with our organization. We hope you find this publication to be a valuable resource for all things trenchless and we truly appreciate your continued support.

Sincerely,

Jim Williams

Jim Williams
NASTT South Central Chair


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MESSAGE FROM THE NASTT CHAIR

Alan Goodman, NASTT Chair

> *One thing we know for sure, Infrastructure is essential!*

Hello South Central Chapter Members. Hats off to NASTT and the Board of Directors for making the decision to host an in-person and virtual No-Dig Show in Orlando this past March. The in-person conference was well attended with safe networking and educational events. Both the No-Dig Planning Committee and the No-Dig Development Committee are hard at work to bring you exciting new networking events in Minneapolis April 10 - 14, 2022. Make sure to mark your calendars and save the date for what we expect to be a record level of attendees.

The No-Dig Show in Orlando was a wonderful opportunity to get back to normal and reconnect with our trenchless colleagues. Now that things have opened up throughout North America, we are excited to see the No Dig North Show and regional conferences scheduled to take place in the last quarter of 2021. Our Canadian partners have not been able to participate in events over the last 2 years. There is much anticipation for the in-person No-Dig North conference November 8 – 10 in Vancouver, BC.

Many of the regional chapters have also finalized their conference program/events for this year. There is a lot of excitement around the South Central & Northeast Chapter Conferences being held in Sugar Land, TX & West Point, NY respectively. In many cases these regional conferences are the first exposure people have to trenchless technology. The regional chapters are the grassroots of this society and what continues to grow trenchless technology at a local level. The West, Rocky Mountain, Midwest, & SE Chapters will soon be providing both dates and locations for their in-person events so don't miss out on attending your local regional conferences to see what all the excitement is about.

Many of the new attendees do not know what to expect at the regional conferences so we wanted to use the South Central Chapter Conference as an example. The South Central Chapter Conference beginning September 13 offers three NASTT Good Practices Courses on the first day. Choose between Pipe Bursting, CIPP, or HDD Good Practices Courses. Plus join industry professionals who can train your inspectors or employees on the latest methods. These training courses are sponsored by the City of Houston and the City of Sugar Land, TX. Following the day long training course, attendees are invited to a Welcome Reception & Networking Event at Bar Louie in Sugar Land Town Square. This event is a great way to kick off the rest of the conference and catch up with your industry friends and trenchless colleagues.

September 14, day two of the conference, starts with guest speakers which include the Mayor of Sugar Land and the Public Works Directors from the City of Sugar Land and Houston. This is a great opportunity to hear first-hand about the future projects that are scheduled. The program also features technical sessions, networking, and exhibitors. Coffee, breakfast, lunch and refreshments will be served with time to make sure you get all your questions answered.

NASTT Board of Directors has recently published the Strategic Plan 2021- 2023 which identifies the importance of our committees. The growth and leadership within these committees have allowed industry experts to work together for the common good of the trenchless Industry. If you want to represent a part of trenchless technology, then I encourage you to get involved with NASTT committees or at the regional level and reap the benefits. Contact NASTT if you are interested in a committee. Specifically, our students, education, and publications committee are very active working on the next webinar/training documents.

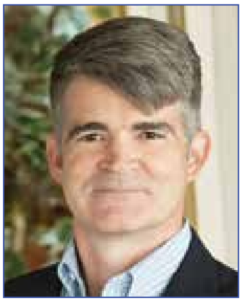
It is an exciting time in the trenchless industry, and we are leading the way in training, education and research. There may be uncertainty in our world, **but one thing we know for sure, Infrastructure is essential.** The trenchless industry is strong and resilient and here to stay! Check out the pages in this magazine for even more details on the educational/networking events that are coming soon in 2021!

Alan Goodman

NASTT Chair

NASTT SOUTH CENTRAL REGIONAL CHAPTER

ELECTED OFFICERS

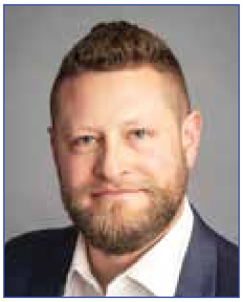


JIM WILLIAMS – CHAIR

jwilliams@brierleyassociates.com

Jim Williams is a Senior Associate with Brierley Associates, located in Austin, Texas where he works exclusively on trenchless projects. He has 27 years of experience in a wide range of projects primarily in horizontal directional drilling and other trenchless methods. His experience includes design, planning, construction, and construction management of trenchless projects throughout North America.

Jim received his bachelor's degree in engineering from the University of Florida and is a licensed civil engineer in 18 states. He began his career working for several engineering firms in Jacksonville, Florida before founding a trenchless engineering firm in 2006 that focused on contractor support services. In 2010 he joined Mears Group as HDD Engineering Manager until late 2017 when he joined Brierley. He has also authored numerous technical papers and taught many HDD training classes in North America, Europe, and Australia.

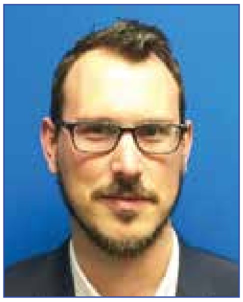


NIK TAYLOR – TREASURER

nikolaus.taylor@subsite.com

Nik Taylor has worked in the underground construction industry for 6 years. Nik began his career with HammerHead Trenchless and is currently employed by Subsite Electronics as the Corporate Accounts Manager for contract locating. Nik began his professional career as an Art Director at a Newspaper in San Diego County and worked in marketing and project management in electrical sign construction before joining the underground construction industry.

Nik has worked with the Ditch Witch dealer channel, assisted damage prevention associations, and has helped develop training and best practices for large organizations. Nik is a certified underground utility locator and is a trained HDD tracking expert. Nik currently serves as the Treasurer for the NASTT South Central Chapter.



JUSTIN TAYLOR – VICE CHAIR

justin.taylor@cciandassociates.com

Justin Taylor, P.E. is the VP of Engineering for CCI & Associates, an engineering, design, and inspection firm specializing in trenchless technology. Justin holds a B.Sc. in Mechanical Engineering from the University of Alberta. After almost 10 years of various engineering and management roles in the Western Canadian CCI offices, Justin moved to Houston, Texas to head the engineering team in CCI's first stateside offices. Justin is a licensed P.E. in multiple states including Texas. In his time with CCI, Justin has worked on trenchless crossings for various high profile projects such as Keystone/Keystone XL, Enbridge Line 3, and Kinder Morgan TMEP Pipelines, and has been involved in the development of tools for real-time measurement of strain and stress on steel pipe during Horizontal Directional Drill installations. Justin is an active member of NASTT, having authored and co-authored several papers for the organization, and being a member of the NASTT Program Committee.

SHAI JOSHI – SECRETARY

shai.joshi@mears.net

Shai Joshi has been involved in the trenchless pipeline industry since 2012. He began his career working as a Project Coordinator for a pipeline installation contractor. Shai spent most of his time in the field documenting on-site activities and learning horizontal directional drilling operations. Two years later Shai accepted the role of Project Manager and became responsible for the planning and budgeting of trenchless crossings and interfacing with clients over the course of construction.

During his time in the industry Shai has been exposed to many aspects of the business including estimating, business development, management, design, and construction. He has been involved with projects in several markets including gas, electric, water, sewer, telecom, and chemical. Over the past eight years he has gained experience with drills in challenging formations, and complex crossings with multiple pipe bundles, large diameter pipe, and intersect crossings at lengths over 9,000 feet.

BOARD OF DIRECTORS 2021-2022

ALAN GOODMAN – PAST CHAIR

agoodman@HHTrenchless.com

Alan Goodman has more than twenty years of experience in the underground construction industry. Alan began his career in the auger boring industry as a sales representative and is currently employed with HammerHead Trenchless as Market Development Manager in the United States & Canada. After learning Japanese in high school, Alan studied abroad in Japan and served as an Ambassador for the Rotary International exchange program. Alan completed his education with a B.A. in International Business from the Stephen F. Austin State University in East Texas, and was a global sales manager for Asia/ Australia in 2015 & 2016.

During his tenure at HammerHead Trenchless, he has worked closely with municipalities and gas utilities including engineering firms and contractors around the world providing customer training, technical support, pre-project planning, project specifications, and installations for pipe ramming, pipe bursting, cured-in-place pipe (CIPP) and other trenchless projects.

Alan currently serves as Chair on the national board of NASTT (North America Society for Trenchless Technology) and involved in most committees. He is also Past Chair of the South Central chapter which includes Oklahoma & Texas.

Alan is also an active member of the following industry associations: DCA (Distribution Contractors Association), AGA (American Gas Association), CGA (Common Ground Alliance), & NUCA (National Utility Contractor's Association).

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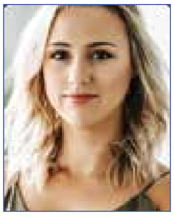

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5TH ANNUAL NASTT-SC TEXAS/OKLAHOMA

TRENCHLESS TECHNOLOGY CONFERENCE

NASTT SOUTH CENTRAL CHAPTER

SEPTEMBER 13 & 14, 2021

SUGAR LAND TOWN CENTER MARRIOTT
16090 CITY WALK, SUGAR LAND, TX 77479

Join us in sunny Sugar Land, Texas for two days of trenchless presentations and networking with breakfast, lunch and refreshment breaks! Highest attendance and largest exhibit hall floor ever!

Three **$2500** Student Scholarships awarded by NASTT-SC!

Click here
$149.00 room rate:
http://www.scnastt.org/educationandevents/upcoming-events

Book Giveaway to select guests - **$10,000 value!**

Monday Events:

- Pipe Bursting & CIPP Good Practice Courses - join industry professionals who can train your inspectors or employees on the latest methods. Sponsored by the City of Houston and City of Sugar Land, TX.
- HDD Good Practice Course - In person classroom instructors - includes HDD book.
- Welcome Reception & Networking Event at Bar Louie, Sugar Land Town Square, across the street from the Marriott, 5pm - 7pm

Tuesday Events:

- Full Day Conference Agenda - Technical sessions, networking, exhibits and field demonstrations on Trenchless Technology PACKED with leading industry professionals there to help you with your projects! New forums this year!
- CEU's, Lunch, and Exhibitor Hours on Tuesday September 14th, 2021.

A great opportunity

to network, build relationships, and develop business opportunities with attendees and exhibitors from all aspects of underground infrastructure including public works officials, utility company personnel, oil and gas companies, engineers, underground contractors, industry suppliers and students. Registration includes complimentary USB of the Conference proceedings.

Limited space available! Act Now!

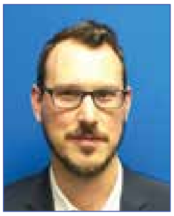
For 2021 Conference Information and Registration Visit: **http://www.scnastt.org/educationandevents/upcoming-events**

NASTT-SC TRENCHLESS TECHNOLOGY CONFERENCE INSTRUCTORS

NASTT Course Instructors – HDD

Dr. Samuel T. Ariaratnam is a Professor and Construction Engineering Program Chair at Arizona State University with over 20 years of experience in trenchless pipeline engineering research and education. He received his Ph.D. in Civil Engineering from the University of Illinois at Urbana-Champaign. He has published over 300 technical papers and reports and is a co-holder of five patents. Dr. Ariaratnam has received numerous awards including the 2012 North American Trenchless Technology Person of the Year.

Glenn Duyvestyn holds a Ph.D., P.E. and P.Eng. and received his doctorate degree in Civil Engineering from the University of Waterloo, Ontario. Glenn serves on NASTT's No-Dig Show Program Committee and teaches our Horizontal Directional Drilling (HDD) Course and our Pipe Bursting Course.



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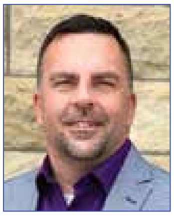
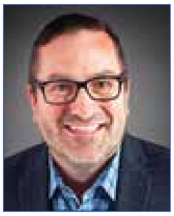
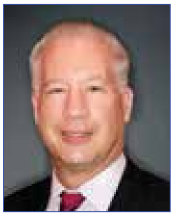
NASTT Course Instructors – Pipe Bursting



Bradley King has served in the trenchless technology industry since 1996 serving in many roles with companies specializing in horizontal directional drilling, sliplining, pipe bursting, CIPP, and tunneling. Bradley has held many different, field-level, supervisory, managerial, and executive roles. Bradley has extensive installation and knowledge of most trenchless pipe products and trenchless pipe installation methods in his 25 years in the industry. He has served as an HDD Operator Training instructor and presented at numerous regional and national consortiums, seminars, conferences, and corporate sales meetings on trenchless methodology.



Matt Timberlake is the Executive Vice President of Corporate Development and Safety for Vortex Companies. He teaches our Pipe Bursting Good Practices Course, and was a coauthor of the Pipe Bursting Good Practices Guidelines Manual -3rd Edition.



Michael Woodcock is Vice President of Portland Utilities Construction Company, LLC where for the past 20+ years he has overseen the growth of their pipe bursting operations from a few laterals here and there to well over 2 Million linear feet. His company has performed pipe bursting projects in over 17 different states and the District of Columbia. Michael has been involved in many different volunteer industry associations, including the International Pipe Bursting Association (IPBA) and serves as the Vice-Chairman of the NASTT's Pipe Bursting Center of Excellence.

NASTT Course Instructors – CIPP

Lisa Arroyo is the founder and President of Arroyo Trenchless, Inc. Prior to starting Arroyo Trenchless, Lisa was the Wastewater System Manager for the City of Santa Barbara. During her 17-year tenure with the City of Santa Barbara, Lisa held progressively increasing roles of responsibility in the areas of engineering design, project development and program management. Lisa holds Bachelor of Science degrees in both mathematics and civil engineering, and she is a licensed professional civil engineer in California. Lisa is the current Chair of the WESTT Regional Chapter.

Kaleel Rahaim is a graduate Chemical Engineer from Mississippi State University. He has experience in many different aspects of Engineering such as project and process engineering and has been involved in the thermoset polymer industry for over 30 years. He recently retired from being the Business Manager, Pipeline Remediation Polymers for the Thermoset Resins Division of Interplastic Corporation.

5th Annual NASTT South Central Chapter Trenchless Conference

September 14, 2021

Sugar Land Town Centre Marriott Hotel & Conference Center

16090 City Walk, Sugar Land, Texas 77479

7:00 AM	Registration, Exhibits, Coffee	
8:00 AM	Welcome and Introduction	
8:15 AM	Sugar Land Mayor Zimmerman Welcome	
8:30 AM	Morning Keynote: Shannon Dunne, City of Houston and Rob Valenzuela, City of Sugar Land	
9:00 AM	Coffee Break / Exhibit Area Open	
		Morning Conc
	Track A - New Installations Microtunnel & TBM **Carl Pitzer - Thompson Pipe Group**	**Track B - Rehabilitation- CIPP** **Clayton Bernard - Freese & Nichols**
9:30 AM	BRH Garver- David Ellet & Akkerman Cecilia Zavaleta - 3,700-feet of 48-inch Diameter Gravity Sewers Installed in Houston via Microtunneling	Trenchless Technology Center (TTC)- John Matthews - E Impact Evaluation of Steam-Cured CIPP Rehabil
10:00 AM	Southland Holdings- Quang Tran - MILL CREEK DRAINAGE RELIEF TUNNEL PROJECT (37’-7” and 32’-6”) Robbins TBM	Granite Inliner- Taylor Savoie - CIPP - City of Sugar Lan System Rehabilitation
10:30 AM		**Morning Brea**
11:00 AM	Lockwood, Andrews, & Newman- Greg Henry & Christine Kirby - Challenges of constructing a 20- and 30-inch water line in Sugarland	RJN- Chris Brooks - CIPP - Outside the Box” Sanita Rehabilitation Design in Downtown Fort Worth
11:30 AM	Brierly Associates- Nick Strater - Box Jacking - Trenchless Methods - Big Tunnels - Connecting the Empire State Trail	IPEX- Robin Hershman - installing expand in place P rehabilitate a 12” sanitary line in Cambridge
12:00 PM	Lunch	
12:30 PM	Lunch Keynote Presentation	Trenchless Projects of the Year Review
1:00 PM	Exhibit Area Open	
		Afternoon Co
	Track A - Culvert Rehab & Replacement **Taylor Savoie - Granite**	**Track B - HDD** **Nick Taylor - Subsite Electronics**
1:30 PM	Vortex- Steve Henning - Geopolymer - Urgent Storm Pipe Rehabilitation as a Result of Lingering Affects and Damage Caused By Hurricane Harvey	HDR- Paul Bearden - HDD - Hydraulic Fracture Cal
2:00 PM	HammerHead Trenchless- Alan Goodman - Pipe Ramming - Solution for Culvert Replacement under TX RR's & DOT's.	GeoEngineers- Danny Crumpton - HDD Surveying: Typ and Methods
2:30 PM	Team IPR- Justin Mouton & Clock Spring/ NRI - Joe Royer- Large Diameter Storm Outfall Rehabilitation with Geopolymer Lining in Houston	Ditch Witch- Seth Mattheson - Fiber Jobsite Best Prac Success
3:00 PM		
	Track A - Trenchlees **Alan Swartz - Plummer**	**Track B - Damage Prevention** **Shai Joshi - Mears**
3:30 PM	UTA - Kawalpreet Kaur - Evaluation of Spray Applied Pipe Linings (SAPLs) as a Structural Renewal for Gravity Storm Water Conveyance Conduits	Ditch Witch - Chris Thompson & Subsite Electronics - Working Together for Damage Mitigation: We All Have
4:00 PM	TBD- PENDING REVIEW	NASTT Natural Gas Track
4:30 PM	Conclusion of Conference and Distribution of Certificates (X PDHs)	
5:00 PM		

PRELIMINARY

current Technical Sessions - 9:30 to 12:00		
	Track C - Engineering/ Pipe Bursting Shawn Garcia - Aegion	**Track D - Oil - Gas - Fiber & Electric Danny Crumpton - Geoengineers**
nvironmental itation	City of Houston-Jack Canfield - Houston's Five Cs - Shannon Dunne - City of Houston Consent Decree	Trenchless Engineering - Cole Byington - HDD - A Case Study of Working in a Pipeline Corridor in Beaumont, TX
d Collection	Portland Utilities Construction Company- Mike Woodcock - Pipe Bursting Challenges for Sewer Replacement	Williams- Webb Winston - HDD - Sabine-Neches Navigation District Waterway Deepening Project and Pipeline Impacts
ak - Refreshments and Exhibit Area Open		
ry Sewer , Texas	No Dig Tec- John Newell - WATER MAIN PIPE BURSTING WITH FPVC IN DFW	CCI & Associates - Stefan Goerz - Direct Pipe Design Considerations
VC liner to , PA	NAPCO Pipe & Fittings- Brian Goad - Pipe Bursting - Keep the Residents Happy! Pipe Bursting in Constrained Jobsite	MEARS- Jwala Raj Sharma - Unconventional Methods of Trenchless Pipeline Installation and Replacement Using Conventional Direct Pipe® and HDD Equipment
	Lunch Sponsor Recognition	
ncurrent Technical Sessions - 1:30 to 5:00		
	Track C - Slip Line & Trenchless Mike Ramierez - Parkhill	**Track D -Pilot Tube/ Microtunnel Cecillia Zavaleta - Akkerman**
culations	Kimley Horn - Marty Paris - Thompson Pipe Group - Carl Pitzer- Sliplining 120-Inch RCP Wastewater in Dallas - Part 2	Southland - Jackson Aldeman - Emergency in El Paso, Fronterra Forcemain Emergency Replacement
es, Concepts	Pacheco Koch- Thelma Box - Dallas Water Utilities uses Sliplining to Rehabilitate aging 24-inch Water Transmission Main	Freese & Nichols- Brian Glynn & Cameron Lawrence- Riverine Microtunneling in Texas along the Neches River & Elm Fork of the Trinity River
tices: Keys to	Ivan Hernandez, PE El Paso Water Utilities- El Paso Water's use of Multiple Trenchless Methods Provides Cost & Time Savings to Lift Station and Force Main Project.	Jones Carter- Michael Gurka - Utilizing Trenchless Construction to Minimize Dis ruptions in the Dove Country Community
	Track C -Manhole Rehab TBD - UTA	**Track D - Pipe in Pipe Justin Taylor - CCI**
Nick Taylor - a Part to Play	Garver- Jeff Maeir - Manhole Rehabilitation – Success is in the Details	Flex Steel- Michael Baraky - Rehabilitation of Vintage 49 CFR 195 Steel Line with spoolable Composite Pipe Using Pipe in Pipe Methodology.
	TBD- PENDING REVIEW	TBD- PENDING REVIEW

PEP Talk:

Pipe Bursting Houston's Slip-lined Sewer Mains

By: Joe Bradfield

The slip-lining technique has offered municipalities a reliable method of dealing with infiltration and inflow (I&I) in wastewater collection lines. Simply sliding a polyethylene pipe ("PE pipe" or "PEP") inside a host pipe in need of replacement minimizes excavation while providing a structurally sound, corrosion-resistant solution. However, the slip-lining technique also imposes significant limitations. Shannon Dunne, Senior Assistant Director of City of Houston Wastewater Operations, said his office "avoids it at all costs."

One reason is that the slip-lining method unavoidably reduces a line's capacity. Another is that once slip-lined, a pipe cannot be subsequently slip-lined again. It is a one-time fix, and one that adds difficulty to future sewer line replacement or upsizing projects.

Although the City of Houston had used the slip-lining technique in the past, Dunne said the pipe bursting technique is "our go-to method." It accounts for over 75 percent of the jobs his office issues to the 20 or more contractors it works with in a given year.

Houston was an early pioneer in the method and is now considered one of the largest pipe bursting markets in the world. It has used the method for the majority of replacement projects performed under a 2005 Agreement Order (AO) between Houston and the State of Texas, resulting in over 11 million linear feet installed to date.

Although slip-lined pipe is still thought to be "un-burstable" by some, Houston's pipe bursting contractors have been successfully using their own fabricated combination of pipe bursting and pipe slitting tool design to replace slip-lined mains.

TOP 100 LIST

Since the 2005 AO, Dunne said, the city has continued to allocate about $65 million of project work a year on its wastewater collection system. The work primarily involves pipeline renovation but includes other projects as well, such as manhole rehab and replacement.

The Wastewater Operations office creates a "Top 100 List" of projects by scoring all of Houston's 1,500 basins (roughly, "neighborhoods"), from worst to least in need of attention. Individual projects range anywhere from 5,000 to 30,000 linear feet of pipe replacement.

The matrix Dunne's office uses to rank the projects factors in such things as age of the neighborhood infrastructure, type of pipe, work order history, etc. Lines with multiple incidents of sanitary sewer overflow (SSO) have greater weight, moving them further up in rank.

The entire project planning process – creating the Top 100 list, drawing up project specifications, bidding out and issuing jobs to qualified contractors – is all done in-house, Dunne said. How a given pipe bursting operation is conducted is left up to the contractor. The contractor must decide whether to pull the PEP liner out before performing a conventional pipe bursting operation or to leave the PEP in place.

ONE CONTRACTOR'S INSIGHTS

Headquartered in Portland, Tennessee, Portland Utilities Construction Company, LLC has been bursting pipe for 25 years.

The pipe bursting method makes pipe replacement feasible despite the confined and crowded workspaces of many urban and suburban properties

A HammerHead PB30G2 cable winch with 30 tons of pulling capability minimizes excavation requirements with little impact on traffic flow

> *Portland Utilities and its experienced pipe bursting crews are up to the challenge!*

Cable fed through this 6-inch VCP line is connected to the Quick Grip burst head with new pipe attached and pulled through the host pipe using the PortaBurst PB30G2 system.

It is rapidly approaching a milestone of 3 million linear feet of pipe installed by the pipe bursting method in a service area that includes 16 states and the District of Columbia.

Although Portland Utilities' expertise covers a range of trenchless techniques, the majority of its work focuses on rehabilitation projects for municipalities like Houston, which it has been serving for more than 10 years. Dunne said, "We can count on Portland Utilities, especially when it comes to some of the more difficult jobs. Portland comes through for us."

IDEAL OPERATIONS

Michael Woodcock, Portland Utilities Vice President, said his crews take all aspects of a job into consideration, beginning with ground conditions. Houston's soils are typically a combination of clay and sand. The pipes lie generally between 6 and 10 feet, with some as shallow as 2 feet.

As is true of any modern municipality, many of Houston's sewer line replacement projects require working in tightly confined spaces on residential and commercial properties with limited access. Some backyard sites, for instance, mean working amid decks, sheds and pools. Having to manually dig pits to expose services and consequent restoration unavoidably increases project difficulty, time and cost.

In an ideal Houston pipe bursting job, the run lies in a straight line, manhole to manhole. The Portland Utilities crew sets its HammerHead® HG 1200, a 12-ton winch with self-deploying boom at one end of the run. At the other, it places a 7- or 8-inch pneumatic bursting tool ("hammer"). The run does not have to be perfectly straight, since the tooling can easily navigate most shallow radiuses that the crew encounters.

The cable winch provides a steady, guiding traction on the hammer. The tension prevents "swim" – the tendency for a reciprocating tool on a return stroke to lose some of the advancement it gained.

Hammers can easily burst pipes made of fracturable materials such as concrete, vitrified clay (VCP) and cast iron. A hammer fractures the pipe's walls as it progresses through it while simultaneously pressing the fragments aside, enlarging the hole and pulling in new HDPE pipe behind it.

OVERCOMING COMPLICATIONS

Not all runs are straight shots from manhole to manhole. Curving pipe paths with sharper radiuses, crowded and confined surface workspaces, limited jobsite access and slip-lined pipe can make a

Constant tension from the HammerHead HG1200AT pulling winch makes most efficient use of a hammer's energy by preventing "swim" – the tendency of reciprocating tools to back up slightly on each return stroke of an internal piston


The self-deploying boom of a HammerHead HG1200 cable winch in the manhole puts pulling power directly in line with the combination slitting/bursting tool entering from the other end


Fabricated fins welded onto the bursting tool cut through slip-lined plastic, enabling the tool to press it along with fragments of original, fracturable host pipe to the side as it progresses along in the same pipe path

bursting job much more difficult. Some of the projects the crew has encountered, had bends whose radiuses were too sharp for either a hammer or static rods to negotiate. Use of either would have resulted in getting stuck midway through a run.

One example was a tightly turning run of 6-inch, vitrified clay pipe (VCP). In this case, the crew used a HammerHead PortaBurst® PB30 Gen 2 to conduct a "static" burst instead of using a pneumatic hammer. The manually transportable, compact, cable-pulling tool with smaller burst head is rated for pipes up to 6 inches and offers up to 30 tons of pulling force.

The run was originally 285 feet, exceeding the reach of machine's 150-foot-long cable. Therefore, the crew divided the run into two pulls. Although this meant digging an extra pit midway down the line, the pits required for this tool are significantly smaller than those for other bursting setups. The machine's two grips assured constant, positive tension on the ¾-inch cable. The installation was successfully completed, as the static burst head and cable were able to negotiate around the sharper bend

PULLING LINERS VS LEAVING THEM IN PLACE

Where lines are straight, running manhole-to-manhole, and the crew can get its preferred winch and hammer setup into place, a PEP liner still presents them with a dilemma – pull it first or leave it in place. It's not an easy decision. PEP flexes too much to be burst easily. "It's not firmly in the pipe, so it can move as you try to burst it," Woodcock said.

For that reason, there are those in the trenchless pipe industry who still consider slip-lined pipe to be "impossible to burst." Portland Utilities' crews have been doing so with great success, although they do prefer to pull PEP liner first and then perform a conventional pipe bursting operation.

Woodcock said which method they choose varies on a case-by-case basis depending on a given case's unique combination of factors: "What is the length of this particular run? What diameter pipe is it? What size liner is in it? How many services are along the run? How many clamps are in there, and how many are there you didn't catch on the video?"

As for length of run, Portland Utilities generally tries to avoid pulling more than 150 feet of liner at a time. "We normally look for a location that has two services in the same pit or are close enough to make one larger pit."

The PE liners the crew has encountered in Houston's 8-inch mains so far have all been high-density polypropylene (HDPE) 6.44

HDPE pipe (white) is simultaneously drawn behind the combination pipe-slitting, pipe bursting tool through a 6.44-inch liner (black) and fragments of the freshly burst, original 8-inch concrete host pipe

> *Houston was an early pioneer in the method and is now considered one of the largest pipe bursting markets in the world.*

inches or 7.125 inches in diameter. Since services along the 8-inch main are typically 4 inches in diameter, a service location creates a significant weak spot in a 6.44-inch PE pipe liner with a DR rating of only 32.

"If a 6.44-inch liner tears during a pull, it's likely to be at a service," said Steven Ham, General Manager at Portland Utilities Construction. "However, the 7.125-inch liner we are replacing has a relatively more robust DR rating of 26. It does not tear as easily and will come out in one pull much more often than the 6.44 liners will."

Finally, the crew wants to know ahead of time if their excavator can travel the full length of the run, since they might end up digging at any point along the line of pipe to create a new pulling location. If workspace or access limitations prevent the use of a Kubota 161-sized excavator, they will most likely leave the liner in place.

PULLING LINERS

Before pulling a 7.125-inch-diameter liner from an 8-inch main, the crew disconnects all existing service connections and as many clamps as possible. Then they insert a 6-inch post into the end of the liner pipe, wrapping a pull chain around it. The post inside the liner prevents it from collapsing as the excavator pulls the chain tightly around it during extraction.

Ham said the process works so well that half the time the liner comes out completely intact in the first attempt. For liners that tear apart somewhere along the run, the crew will adjust its plans on the fly, again on a case-by-case basis. The remedy might be as simple as pulling from the other end or from the service where it broke, minimizing the need for additional excavation.

CUTTING PEP IN PLACE

For pipes made of malleable materials like plastic and ductile iron that are not easily burst, several manufacturers offer commercially available "pipe slitting tools" (also known as pipe "splitting" tools). These tools are designed to slice through the pipe and spread it apart to make room for a replacement pipe.

The plastic liners alone do not pose a difficulty for pipe slitting tools, but a cast iron or cement host pipe can damage slitting tools.

Some contractors have begun fabricating their own "combo" tools, however, capable of first slitting the liner and then bursting the host pipe in one operation. Most designs feature a little square of metal welded on the pilot meant to slice through a PEP liner just ahead of the hammer. As the hammer passes, it presses both freshly sliced PEP and host pipe fragments to the sides of the pipe path.

Foreman opinions differ slightly as to how large the fins should be, how many to use and where they should be located. "Some prefer welding a single blade to the pilot," Woodcock said. Others have two or three blades. "One guy's design even has three little ones and then a larger, single one behind those."

Each design has its place, Woodcock explained, depending on the situation. None of them is the best choice for all occasions. "What might be a perfect solution for one job could up end up being a detriment on the next one."

Cutting the liner in place offers additional benefits. Service connections do not have to be disconnected prior to cutting a liner in place. And the finned tooling that Portland Utilities creates generally cuts through most clamps without a problem, even steel clamps. Should the odd, undiscovered clamp cause a bursting operation to stop, the delay while waiting for the crew to expose and cut through the clamp is only temporary.

PROBLEMS CUTTING LINERS

If a bursting operation is interrupted, it's much more likely to be due to a service connection than a clamp. Its strength weakened by the service opening, the liner may resist the slitting fins, folding up ahead of them "like an accordion," Ham said. But Portland Utilities has discovered how to lower this risk, too. "We've found that leaving approximately two feet of dirt over a service connection minimizes the chances of the accordion effect."

Even when things go well during a PEP-in-place pipe burst, it can still add difficulty to reconnecting services. "PEP left in the ground can come back over the services," Ham said. Clearing away fragments of concrete pipe are one thing, he explained. Ribbons of intact PEP are another. "It takes a little extra time and effort to remove the cut liner pipe so you can properly secure a new saddle to the replacement HDPE."

On the other hand, Ham said, "Since you are leaving the PEP in the ground, the need for disposal is eliminated, saving further on project time and cost."

CONSENT DECREE

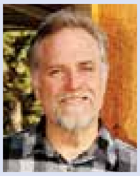
Houston's wastewater infrastructure consists of 39 wastewater treatment plants processing 250 million gallons of wastewater per day on average collected through 6,100 miles of sewer line. Maintenance and upgrading tasks are never ending. Dunne said his office was dedicated to continuing its aggressive pace after the 2005 AO expired.

In an April 1 Consent Decree this year between the EPA and City of Houston, the city has now ambitiously agreed to renovate 800,000 linear feet of wastewater lines each year for the next 15 years.

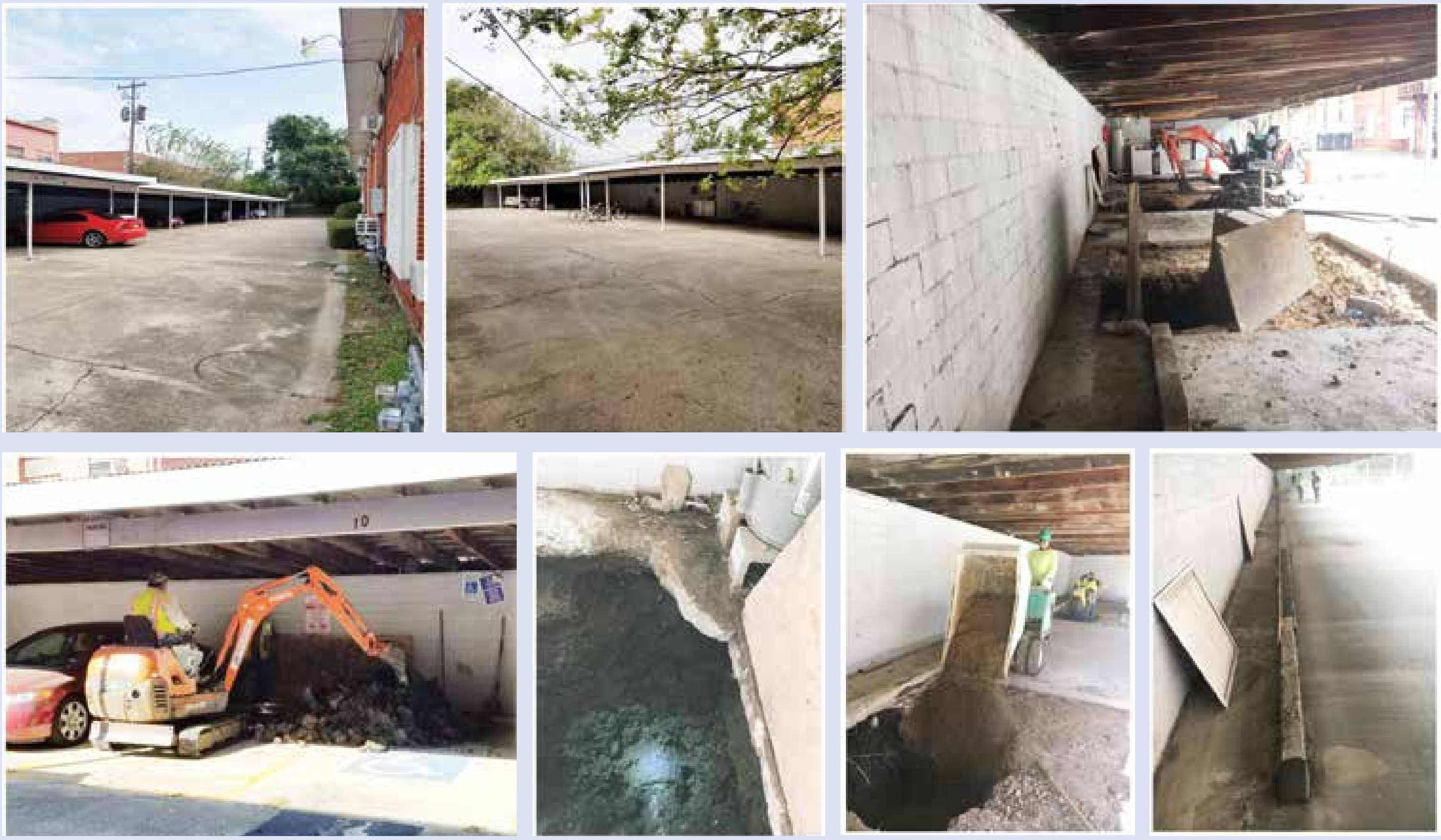
"We have already renovated about one-third of the city's collection lines," Dunne said. "Under the federal Consent Decree, we'll complete another third."

The pipe bursting technique will continue to be used for about 75 percent of the upcoming project work. Portland Utilities and its experienced pipe bursting crews are up to the challenge.

ABOUT THE AUTHOR:



Joe Bradfield is a freelance writer specializing in case stories, technical writing and photography for the construction, mining, drilling, and energy industries. His background in education, science, and technology with a Master of Arts degree in writing create an ideal skillset for telling the stories of the trenchless industry's applications, innovations, and people. Bradfield has been providing remote and on-site coverage of high-profile projects around the world since 2010.



The pipe bursting method requires much less demolition and restoration, significantly lowering project time and cost compared to open cut replacement. For example, this job called for replacement of 400 feet of previously slip-lined, 8-inch concrete pipe beneath two covered parking areas

PIPE BURSTING ADVANTAGES

The pipe bursting method usually requires less than 15 percent of the excavation that would be required to dig up a line for replacement. And while the slip-lining method always decreases diameter of the line, the pipe bursting technique can be used not only for size-on-size wastewater pipe replacement but also for upsizing lines.

Although the HDPE pipe typically used as replacement pipe in a pipe bursting project provides a long-term solution against I&I, a variation of the pipe bursting method known as pipe slitting (or pipe splitting) can be used if necessary or desired for subsequent size-on-size or even upsize pipe replacement in the same line.

Pipe bursting offers advantages over the horizontal directional drilling (HDD) method to install a new pipe, as well. In a pipe bursting operation, the replacement pipe follows exactly in the path of the existing pipe. No new path for the line is required. There is no crowding of utilities nor need to create a new easement. The method inherently minimizes the potential for interference with shared utilities and associated risks, such as charged line strikes.

Replacing slip-lined pipe using the pipe bursting method is not an easy process. A contractor must decide on a case-by-case basis whether to first remove the PEP liner before performing a conventional pipe bursting operation, or to leave the liner in place. Each project's time and cost depend on making the right choice and competent execution.

San Antonio Water System (SAWS) W-6 Upper Segment:

Breaking Through Segments 3 through 5

By: Daniel Maine, P.E. Brierley Associates

The W-6 Upper Segment: Highway 90 to SW Military Drive Sewer Main project is underway for San Antonio Water System (SAWS) in San Antonio, TX. The project replaces existing 48 and 54-inch gravity sewer lines that pass through Lackland AFB with approximately 29,000 linear feet of 104, 78, and 60-inch gravity FRP sewer. The contract solicitation was released in the Spring of 2020 and SAK Construction, LLC was selected by SAWS to construct the project. The project is being tunneled with 142-inch and 96-inch Lovat TBMS with the ability to run in non-pressurized, semi-EPB, and EPB modes. Additionally, several hundred feet is being constructed by open trench, several short sections of hand-mining, a short section of slip-line, and two trenchless installations via 30-inch microtunnel. The project alignment is shown in Figure 1 along with the construction segments.

The design called for ribs and lagging, pre-cast concrete segments, or liner plate as means of initial support with non-pressurized tunneling for the majority of the alignment. Pressurized tunneling was specified beneath the Leon Creek crossing and at the W-6 Middle Segment tie-in adjacent Leon Creek. The contractor selected to utilize W4x13 steel ribs with 3-inch lagging boards throughout the majority of the alignment. Gasketed concrete segments or liner plate were specified as allowable initial support in pressurized tunnel segments. The contractor proposed a cost saving alternative for the initial support in pressurized tunnel segments of steel ribs with gasketed steel lagging (depicted in Figure 2). Additionally, the contractor proposed utilizing a 96-inch TBM in lieu of the 142-inch TBM to install the 60-inch sections of pipe and to excavate a 865-foot section of Segment 5 specified as hand-mining.

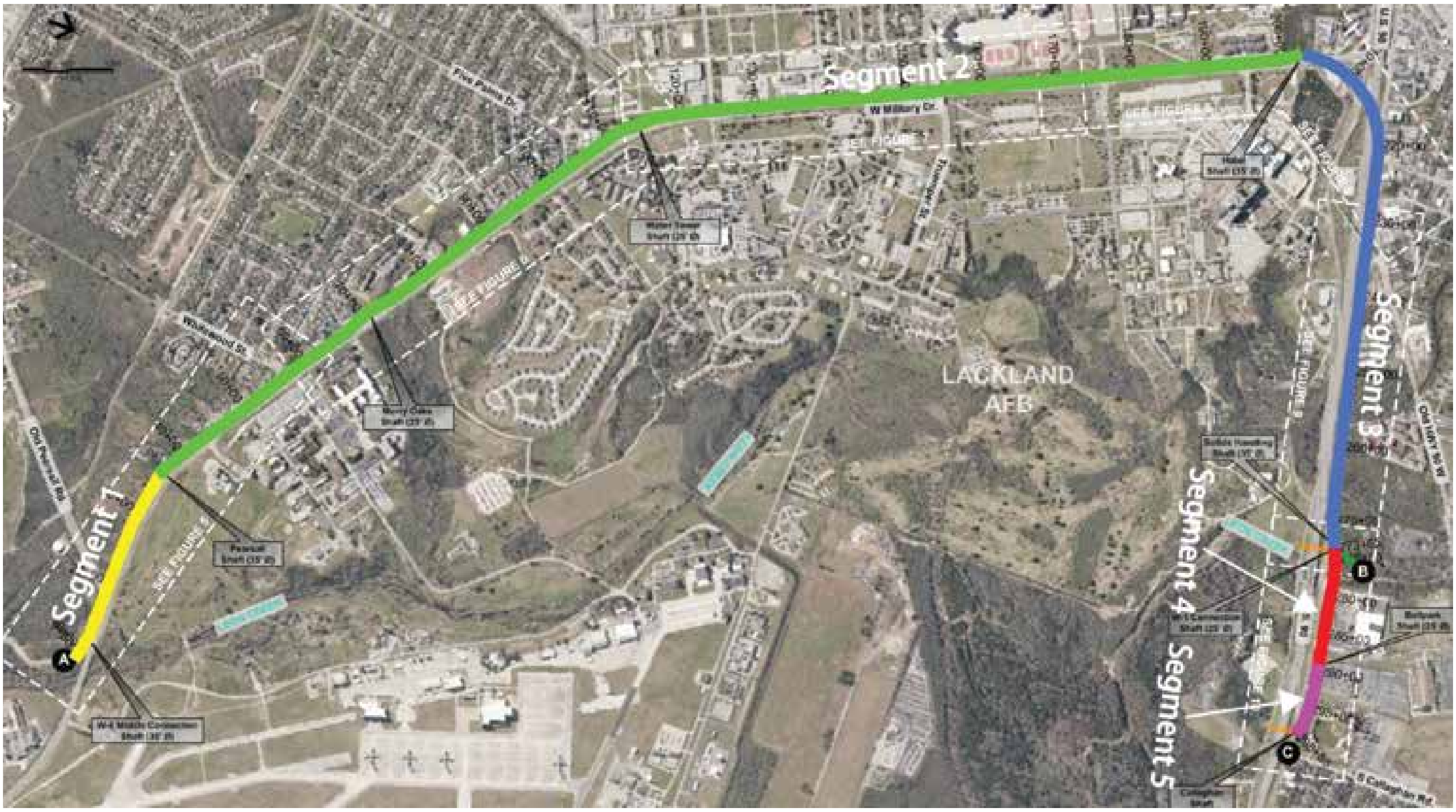


Figure 1. Project alignment shown with five construction segments

Figure 2. Gasketed Steel Ribs and Lagging along Segment 4

Shafts were specified as ring beams and liner plate or secant piles in the overburden and shotcrete with rock bolting as required through the Navarro Formation claystone. Secant pile shafts were specified at the shafts adjacent Leon Creek where pressurized tunneling was also specified. The contractor provided some cost saving alternatives for the shafts including utilizing ring beams and lagging through the Navarro formation and ring beams and gasketed liner plate in-lieu of secant piles at the two shafts adjacent Leon Creek.

Figure 3. 96-Inch TBM break through into interim construction shaft at end of Segment 5

The contractor has broken the project into five total segments between the nine total access shafts. As of May 2021, they have completed Segments 3, 4, and 5 totaling approximately 6990 feet, 1570 feet, and 865 feet, respectively. This accounts for approximately 30 percent of the total amount of tunneling within 7 months of the approximately 34 month baseline schedule.

Figure 4. Steel ribs and wood lagging along Segment 2

Figure 5. 142-Inch TBM 'Miss Jocelyn' delivered onto site at beginning of Segment 3

Segment 3 was constructed with the 142-inch TBM while segments 4 and 5 were constructed with the 96-inch TBM. The tunnel along Segments 3 and 4 were performed in the Navarro Formation Claystone while Segment 5 was constructed in the Leona Formation clays with sand gravel and cobbles. Tunneling along Segments 1 and 2 will take place from 2021 to 2022 with substantial completion on the project occurring mid-2023. The contractor has constructed the project ahead of the baseline schedule and is seeking to meet the deadline for an early completion bonus available in the contract.

Figure 6. 142-Inch TBM breakthrough into Solids Handling shaft at end of Segment 3

Tunneling in the Navarro claystone has been successful to date with average production rates of 97, 31, and 31 feet in Segments 3,4 and 5, respectively. Peak tunneling rates in each of these segments was 206, 55, and 80-feet, respectively. Two 10-hour shifts were performed for Segments 3 and 5 while only one 10-hour shift was performed in Segment 4.

The Navarro claystone encountered along Segments 3 and 4 was a fairly homogenous gray material which generally acted as an aquiclude having little to no groundwater with the exception of seepage along discontinuities near the Leon Creek crossing in Segment 3. Little to no groundwater was encountered beneath Leon Creek on Segment 4 despite anticipation during design that this could occur due to the geology and presence of a significant amount of water in the creek 10 to 15 feet above the crown of the tunnel.

The Leona formation along Segment 5 consisted of a brown lean to fat clay with interbedded sand, gravel, and cobbles. Some perched groundwater was encountered during excavation which saturated the material in some areas of Segment 5. Overall, the proposal by the contractor to tunnel Segment 5 with a 96-inch TBM versus the specified means of hand tunneling was successful and carrier pipe will be placed and grouted in the upcoming months.

The W-1 Connection, Solids Handling, and W-6 Middle Segment shafts, as titled on the project, are located within the 100-year flood plain of Leon Creek at the junction of Segment 3 and 4 and at the start of Segment 1, respectively. In order to help limit the risk of flood waters entering the tunnel, the contractor, opted to install an additional outer ring of liner plates and grout the interface between the shaft liner plates as well as install a bulkhead at each tunnel connection to the shafts. The bulkhead to Segment 4 from the W-1 Connection shaft is shown in Figure 7. These bulkheads will help limit the impact on the tunnel in the event of high waters which can occur quite regularly during the seasonal rains. The 100-year flood elevation is approximately 15-feet above the ground surface at the W-1 Connection and Solids Handling shafts which are directly adjacent to one another.

Figure 7. Bulkhead at entry to Segment 4

The contractor, SAK, continues to construct the project with cooperation from the owner, San Antonio Water Systems, the construction management team of CAS Consulting and Services, LLC and Black & Veatch, and the project design team led by Kimeley-Horn with tunneling sub-consultant Brierley Associates, structural sub-consultant JQ Engineering, geotechnical sub-consultant Arias, and design sub-consultant K Friese and Associates.

ABOUT THE AUTHOR:

__Danny Maine, P.E.__ received his bachelors and masters of science degrees in Civil Engineering from Virginia Tech and is a licensed civil engineer in the State of Texas. He has over 10 years of experience in the design of tunnels, underground construction, and geotechnical engineering. He worked primarily in transportation design before moving to Texas where many tunnel projects are focused around underground utility construction. He joined Brierley Associates in 2017 and has worked as a project manager on projects in the central Texas region.

Houston Water Capital Improvements through the Abandonment of Three Existing Lift Stations

By: Markos E. Mengesha, P.E.,CCM, City of Houston Public Works,
David Ellett, P.E.,BRH-Garver Construction, LLC
Laura Anderson, Akkerman Inc.

Houston Water operates and maintains 39 wastewater treatment plants and 382 lift stations. Houston Water Master Plan (2005-2025) aims to consolidate existing wastewater treatment plants and lift stations, to meet the regulatory requirements, improve reliability, and reduce operation and maintenance costs.

The abandonment of Westheimer No.1, San Felipe No.2, and Bering lift stations were designed to improve about a 3K acre service area in southwest Houston. The area is heavily commercial with some residential areas primarily north of Westheimer Road. The lift stations had been in service for more than 40-years and needed upgrades to meet current regulatory requirements and future demands. The capacity of the lift stations ranged from 6.34-20 MGD.

Upgrading lift stations to current standards with adequate odor control within urban areas has always been a challenge. Therefore, consolidating the three lift stations by diverting flows with deep gravity lines and constructing a regional lift station was the best solution to comply with regulatory requirements and reduce operational and maintenance costs.

The new Fountain View Regional Lift station was designed with a 23.5 MGD capacity at the southwest corner of Fountain View and Skyline Drive. The improvements are expected to reduce overflows and odor issues, and inflows and infiltrations, which are a result of the existing aging wastewater lines.

The 48-inch microtunneling portion of the Fountain View Project used an Akkerman SL44 microtunneling system in four separate drives ranging from 600 to 1091 feet

Microtunneling is required for installation at up to 42-foot depths in varying silty-sands and fat clays, all below the water table

Implementation of these improvements is divided into three construction packages. The first package, or downstream segment, included the installation of 2.85 miles of 54-inch diameter gravity wastewater line from Gulfton Street to discharge into a manhole to an existing 72-inch diameter gravity wastewater line along North Braeswood Boulevard. BRH-Garver Construction, LP (BRH) competed the 100 percent microtunnel installation project in 2017.

The middle segment, the Fountain View Regional Lift Station Construction and Abandonment of Westheimer No. 1 Lift Station project, runs from Gulfton Street to Westheimer Drive, and includes 3,700-feet of 48-inch diameter gravity wastewater lines and 4,200-feet of a 36-inch diameter force main. Decommissioning the Westheimer No. 1 lift station and construction of the new proposed Fountain View Regional Lift station was also part of this package.

Due to the depth of the gravity wastewater line, ground conditions and heavy traffic along the alignment, microtunneling was the preferred trenchless construction method to install the 3,700-feet of 48-inch gravity diversion lines. Microtunneling is required for installation at up to 42-foot depths in varying silty-sands and fat clays, all below the water table.

BRH performed the 48-inch microtunneling portion of the Fountain View Project using an Akkerman SL44 microtunneling system in four drives. BRH has worked with the City of Houston on microtunnel projects since 1986. This project was the second to use the Akkerman SL44 microtunnel boring machine (MTBM).

The SL44MTBM is capable of 70,000 lbs. of thrust capacity and configured with an increase kit to 50.8-inch to match the outside diameter of the Hobas® pipe. The MTBM's robust variable frequency driven motor and gearbox provide up to 61,700 foot-pounds of torque. A soft-ground cutter head, outfitted with carbide tipped bullet and chisel teeth tooling was the best fit for the soft, wet, and easily displaceable ground conditions presented in the region.

The MTBM is monitored and adjusted using a proprietary guidance system software in an above-ground control cabin. A reference laser projects onto the MTBM's active target and the target reads the laser and transmits coordinates to the control console.

After the MTBM is launched, the jacking frame advances each pipe axially to reduce pipe stress loads, with 400 tons of thrust for minimal diameter shafts.

To reduce jacking forces and enhance pipe installation productivity, BRH elected to use their Akkerman Bentonite Injection System (ABIS). The ABIS consists of a control skid featuring a monitor touch screen and flow meter assembly. The operator uses the touch screen monitor controls to inject lubrication from the remote station box valves inside the pipe at customized intervals and flow volumes.

The execution of the project requires a high level of planning and coordination to deliver these projects on time, within budget, and with minimum inconvenience to the community.

At the time this article was released, BRH-Garver has installed nearly all of the 48-inch Hobas® flush-jacking pipe in four reaches ranging from 600-1,091 feet. The final 908-foot drive is anticipated for completion in July 2021. The MTBM has encountered areas that include cemented sandy materials, adding to these challenging installations.

The Fountain View Regional Lift Station construction and remaining scope of work on this project is currently scheduled for completion by January 2022.

After the MTBM is launched, the jacking frame advances each pipe axially to reduce pipe stress loads, with 400 tons of thrust for minimal diameter shafts

ABOUT AKKERMAN INC:

Established in 1973 based in Brownsdale MN Akkerman develops, manufactures and supports quality pipe jacking guided boring, microtunneling and tunneling equipment that accurately installs a variety of underground infrastructure. We partner with contractors to explore project solutions for a wide range of geology, pipe diameters and lengths.

Direct Pipe® Installation – The Importance of Pre-planning

By B. Kerby Primm, P.E.

Williams Companies Inc. (Williams) completed a crossing of the Bogueloosa Creek in Alabama over the summer of 2019 using Direct Pipe® Installation (DPI) technology. This revolutionary technique is a very useful option for pipeline crossings, however there are many pre-planning items that should be considered in order to ensure successful project completion. There are some steps that were implemented by the Williams project team with the assistance of CCI & Associates Inc. (CCI), prior to start of construction intended to mitigate and resolve potential issues swiftly during the construction phase. Some of these techniques included utilizing a safety matrix to identify high risk items that may occur during construction, as well as incorporating detailed specification documents during the contractor selection process.

Contractor selection was a very important part of the preplanning process, and this included a detailed technical review, incorporating CCI's experience and knowledge of DPI and the specification documents written by Williams. After the pre-planning for the project was complete, regular meetings, oversight during construction and reference to the Williams specification during construction ensured communication between the contractor, consultant and owner company was maintained. From a project management perspective, confined space entry was a large issue that was detailed in the pre planning documentation and, rather than having delays associated with the project, the proper protocols were prepared quickly, and delays were minimized when these issues arose during construction.

DIRECT PIPE®

The overall Hillabee Expansion project consisted of three phases totaling approximately 43.5 miles of 42-inch and 48-inch-dimaeter pipeline in Alabama. As part of the Phase II Rock Springs Loop portion of the project, a 42-inch-diameter crossing of the Bogueloosa Creek and an associated wetland was required. The area surrounding the creek is considered an environmentally and culturally sensitive area and therefore required trenchless techniques to cross with minimal disturbance. Horizontal Directional Drilling (HDD) techniques were considered and evaluated; however, the risk of inadvertent returns (I.R.) was deemed to be unacceptable for this site, and therefore HDD was determined to not be feasible. Following the HDD feasibility assessment, Direct Pipe® Installation technology was considered. DPI requires much less annular fluid pressure and smaller fluid volumes than HDD, which allows this trenchless method to pass beneath environmental features with less depth of cover, generally reducing overall length of the crossing. DPI was chosen as the best option and the planning commenced. DPI has become a well-known crossing technique, and therefore the focus of this article is not to describe the DPI process, but describe some of the techniques utilized by Williams and CCI prior to and during construction of this challenging crossing to ensure it was a success

TRENCHLESS CROSSING EVALUATION AND DESIGN

Analysis to determine the risk for hydraulic fracture and the inadvertent release of drilling fluid to the surface was integral in determining the depth required beneath Bogueloosa Creek and the cultural site. The design included quantifying the risk of IR to these sensitive areas by commonly accepted industry practices to calculate the limiting overburden formation pressures and estimated annular fluid pressures. A factor of safety against hydraulic fracture was calculated by dividing the formation limit pressure by the estimated annular fluid pressure. The results of the analysis indicated that the factors of safety against hydraulic fracture ranged from 1.5 to 2.6 within the Bogueloosa Creek area during the DPI process. It is accepted that a factor of safety above 1.5 is considered moderate to low risk.

An analysis to determine the risk of settlement to existing pipelines and the road being crossed due to the DPI was important for Williams' overall assessment. The cutter head of the Micro-tunnel Boring Machine (MTBM) creates an overcut resulting in excavation of a tunnel that is larger than the outside diameter of the product pipe. While the overcut is generally small (1 to 2 inches), it creates an annular space (potential void space) around the product pipe. The potential settlement over the pipeline was estimated using methods developed for soft ground tunnels by Schmidt and Peck (1969) and Cording and Hansmire (1975) and adapted to trenchless construction by Wallin and Bennett (1998). Settlement was estimated with a 42-inch-diameter MTBM (46-inch-diameter overcut, 2-inch-radial) and the 42-inch-diameter product pipe. Williams also had an open hole case-evaluated in the event the DP MTBM needed to be extracted from the hole. Settlement due to the DPI to pipelines within the corridor and West Butler Road were found to be acceptable in both short-term and long-term scenarios.

DIRECT PIPE® CONFINED SPACE ENTRY RISK ASSESSMENT

After the DPI design was completed, the project team evaluated the need for confined space entry into the pipe during DPI operations. Confined space entry is a standard practice required during DPI construction. Although it is considered standard practice, confined space entry is still a very dangerous act, and extensive plans need to be created and upheld during the construction phase of the work. In order to perform repairs on the machine or internal components within the pipe once tunneling is in progress, a mechanic must enter the pipe from the open end of the lift section. The mechanic then traverses through the pipeline section to the internal Direct Pipe® component that requires repair.

The project team performed a site-specific project risk assessment to identify the major steps in the DPI construction process, the associated hazards or risks in the steps, and mitigations/safeguards to remove or reduce the hazards or risks. A part of this assessment included a scenario-based risk assessment process where situations were discussed along with the probability and consequences for the various task. Key activities in this assessment included:

Situations to cause Direct Pipe® Entry (planned and unplanned):

- Emergency scenarios with entry (e.g. personal health problems, loss of fresh air, flooding, etc.)
- Safeguards to minimize risk (e.g. backup breathing air systems, rescue teams, entrant training, entrant physicals, etc.)

An internal risk probability and impact tool was used to determine the appropriate level of management to present the findings. The risk assessment was presented to the company management to convey the project risks and explain the safeguards that were planned to be in place to minimize the risk. These mitigation measures were then included in the bid package that was sent out for contractor bid.

Impact

Likelihood

	Negligible	Minor	Moderate	Significant	Severe
Very Likely	Low Med	Medium	Med Hi	High	High
Likely	Low	Low Med	Medium	Med Hi	High
Possible	Low	Low Med	Medium	Med Hi	Med Hi
Unlikely	Low	Low Med	Low Med	Medium	Med Hi
Very Unlikely	Low	Low	Low Med	Medium	Medium

Figure 1 Sample Probability and Impact Matrix

CHALLENGES DURING CONSTRUCTION

General

The preparation that was completed during the pre-planning phase was very important for contractor selection and division of labor for the construction phase. However, there are always unexpected challenges faced during construction. During the construction of the Bogueloosa Creek there were multiple challenges, however from a project team perspective, three were most apparent. The first challenge was the differences in the design drawing topographic survey and the final survey that was used for the DPI alignment during construction. The second challenge that was apparent was the specialized welding inspection procedures that are required during DPI. Finally, confined space entry was an imperative part of the contractor's safety plan, and deviations from the plan were required during construction. These deviations were difficult to implement and gain approvals required in short order during construction.

Survey

Changes in survey data between design drawings and construction grade may be a common occurrence, however for DPI trenchless crossings these differences can be cause to major delay. The topography at the Bogueloosa Creek crossing was moderately sloping down towards the creek. With the launch of the DPI alignment located near the crest of the slope, it is important to have the final construction grade and crossing design drawings matching.

DPI normally has relatively shallow launch and receiving angles and in this case the shallow angles are compounded by the slope where the shafts are constructed. The geometry of the entire design is affected by the launch angle and elevation. The balance between depth of cover and radius of curvature is fine and redesigns may be required to make the crossing feasible. In this case, the misalignment between original grade survey and final grade after contractor workspace development required modifications to the launch pit and caused delay to mobilization of the project. Once the launch pit was redesigned and constructed, and the new DPI alignment was finalized, the crossing could commence.

Confined Space Entry

A detailed confined space entry plan was assembled by the contractor and submitted with the bid for the project. The plan submitted as part of the pre-planning stages of the project contained features such as:

- Electric Cart with SCBA
- Fixed gas/oxygen monitors throughout the pipe
- Personal 4-gas monitor
- Handheld radios and airhorn
- Standby CSRT and paramedic

As the project moved closer to construction, due to site specific constraints, availability, and feasibility there were some proposed modifications to the plan that differed from the mitigations that were included in Williams' confined space entry risk assessment. These proposed deviations included:

- One person entry
  - This was denied by Williams
- No Cascading Air System
- No tracking system

As some deviations were accepted by Williams, there were updates to the confined space entry plan that were approved and considered to be imperative to the approval and success of the confined space entry. These upgrades included:

- Two-person entry included
- Grade D breathing air system
- HADES video/audio system for communication of personnel

It is important to note that the confined space entry is a very high risk yet crucial part of the project. However, appropriate controls implemented by the contractor for their confined space entry plans can mitigate many of these risks. It is very important to have the plan completed and approved prior to the beginning of construction in order to mitigate standby costs caused by potential delays in approval from the owner company. Following the approval of Williams, it was implemented during construction and repairs that were required during construction could be completed in a timely manner.

CONCLUSION

Pre-planning during direct pipe construction is a very important part of the project process. There are various parts of this construction technique that differ from other crossing techniques. Many of these challenges can be mitigated by planning and considering the owner safety requirements and work procedures prior to construction. From a project management perspective, the preplanning process and selection of a contractor that complies with the owner specifications and requirements can mitigate a lot of the risks during construction and allow the contractor to implement the approved procedures without delays. Concerted time and efforts on the front end by the project management team in order to evaluate all risks and set in place all mitigation measures prior to construction ensures any delays, costs, and other impacts are minimized during construction and lead to a successful project.

ABOUT THE AUTHOR:

***B. "Kerby" Primm** has spent over 15 years as an engineer involved in multiple specialties including civil site design, transportation, and trenchless design. He is a Senior Project Manager for CCI & Associates based out of Houston, TX.*

Telemetry Reduces Risks, Lowers Costs on Sanitary Sewer Rehabilitation

By: Jason Chambers, Sunbelt Rentals

When faced with the rehabilitation of a major sanitary sewer system, stakeholders with the City of Fort Worth knew they had a significant project on their hands. They also knew they needed the right partners to get the job done efficiently, safely, and on time.

CDM Smith Inc. served as the design engineer for the City of Fort Worth for the project and created the initial suggested plan for the rehabilitation and bypass. S.J. Louis Construction was awarded the contract for the construction work and was instrumental in coordinating contracts and the upfront logistics. Their team also collaborated closely with Ryan Lynch, project manager at Sunbelt Rentals. Together, S.J. Louis and Sunbelt Rentals built out schedules and managed all aspects of the bypass project — from the start in November 2020 to the finish in June 2021.

But there were more than just solid partnerships that ultimately helped tackle the bypass needed to complete the rehabilitation. There was also a new means to monitor every aspect of it: PumpSentri telemetry from Sunbelt Rentals. The decision to use telemetry and the ability to employ it successfully turned out to be an impressive feat given the scope of work. It also provided a level of comfort that team members could track every aspect of the bypass project remotely from their web-enabled devices.

When faced with the rehabilitation of a major sanitary sewer system, stakeholders with the City of Fort Worth knew they had a significant project on their hands. They also knew they needed the right partners to get the job done efficiently, safely, and on time.

THE PROJECT DETAILS AND CHALLENGES

This sanitary sewer rehabilitation project had several unique features and challenges. First, the junction structure S.J. Louis was responsible for demolishing and rebuilding was very large and deep: approximately 15 feet by 15 feet and 28 feet deep. It also required S.J. to open cut 730 feet of 90-inch sewer pipe and 700 feet of the 90-inch cured-in-place-pipe (CIPP). In addition, the job entailed the installation of a standby pumping system for wet weather events. There was the added challenge that the project was in an active city park featuring a sports complex with soccer and baseball fields, along with a high volume of pedestrian traffic.

There were parallel 90-inch sewer lines, one of which would handle the daily flow diverted during dry weather. The sewer lines were interconnected by two large junction structures “A” and “B” that shared a 72-inch pipe. There were 24-, 60-, 72, and 84-inch sewer lines upstream feeding the structures. By plugging the interconnection of the 72-inch sewer pipe and the upstream 60-inch sewer line that entered junction structure “A”, all the flow could be diverted through junction structure “B” to the parallel 90-inch sewer line. As part of the remaining plan, CDM Smith included a 100MGD standby bypass pumping system that would turn on during a rain event.

Sunbelt Rentals used eleven 12-inch HV pioneer diesel bypass pumps for the projects. The primary and standby system

Telemetry may be relatively new to pump bypass projects; however, it can reduce risk and provide stakeholders with a level of comfort knowing they have 24-hour remote monitoring from anywhere.

Sunbelt Rentals installed PumpSentri telemetry on six of the primary pumps that were also set in automation mode for double insurance.

utilized independent 18-inch HDPE DR17 suction tubes with an independent 18-inch HDPE DR 26 discharge pipe. These connected to a common manifold isolated by gate valves. From the manifold, the team utilized four 24-inch HDPE DR 26 discharge pipes to the discharge location.

In addition, Sunbelt Rentals was able to design and add an ADA ramp detouring pedestrians around this construction while still providing them with access to the part and sports complex.

GOING ON STANDBY WITH PUMPSENTRI

Typically, pump bypass systems require 24-hour pump watch — employees managing the pumping system, including monitoring the flow, equipment inspections, deragging pumps in case of clogs, and adjusting the pumps engine RPMs up and down as necessary.

Because of one of the parallel 90-inch sewer lines on this project could handle average flow during dry weather, there was no reason for a bypass pump to operate on a daily basis on the other sewer line. The pump needed to be at the ready only during a rain event. As a result, there was also no need for 24-hour employee pump watch.

That's where PumpSentri telemetry came into play.

After the Sunbelt Rentals team pressure tested the entire bypass system — and it passed the 24-hour live pump test to confirm everything was working properly — the project was able to go on standby and be monitored remotely through the telemetry technology.

Sunbelt Rentals installed PumpSentri telemetry on six of the primary pumps that were also set in automation mode for double insurance. This entailed the use of liquid level transducers to accurately monitor the surcharge level in the sewer. The automation mode safeguarded the project since the pumps would activate in the event the water flow reached full pipe capacity. The PumpSentri telemetry system complemented the automation mode with its remote monitoring and alerts.

PumpSentri operates by sending texts, emails and/or phone calls to the project's emergency contacts during a wet weather event, informing them that the standby pumps had turned on and water flow was higher than normal. Using this telemetry, team members like Lynch could also activate the pumps remotely and adjust flow, while also receiving data about the job conditions — all from his phone. The technology is also desktop compatible.

During the approximately 6-month project, PumpSentri alerted stakeholders about active standby pump activity approximately 20 times. Each time, it was Lynch's responsibility to dispatch two pump watch employees to the project site, with a planned arrival within two hours. Their job was to evaluate the situation and take over the system via pump watch control to monitor the live bypass.

In addition to pump activation alerts, PumpSentri also allowed the stakeholders to:

- Regularly monitor pump activity throughout the day and night.
- Track equipment location.
- Monitor pump vacuum and discharge pressure.
- Check engine status and runtime.
- Receive detailed engine data, including fuel levels, oil pressure, engine temperature, and fault codes.
- Assess pump end vibration to check for cavitation or clogging.
- Monitor surcharge levels in the sewer line with the use of liquid level transducers.
- Provide the capability of remote operation.

The teams could also rely on PumpSentri to access documents related directly to each pump; track pump location though built-in GPS, which helps protect against loss or misuse; and optimize pump operating parameters. This telemetry also stores run-time data to help assess any issues that may occur over a period of time.

The real value of all of these features is two-fold. It not only provided stakeholders with the peace of mind about the project, but also helped to reduce costs for the City of Fort Worth. On such a large standby system, it's uncertain when there will be a rain event; pump watch would be charged while pump technicians are onsite at all hours. In this case, additional costs were only incurred during the actual pump watch deployment and the subsequent onsite project monitoring. Once the pumps were back on standby, the cost reverted to a standard contracted price.

PumpSentri operates by sending texts, emails and/or phone calls to the project's emergency contacts during a wet weather event, informing them that the standby pumps had turned on and water flow was higher than normal.

LOOKING TO THE FUTURE

Telemetry may be relatively new to pump bypass projects; however, it can reduce risk and provide stakeholders with a level of comfort knowing they have 24-hour remote monitoring from anywhere. It is especially helpful on a standby bypass project, but can be used on typical bypasses, too. It helps take the guesswork out of watching weather forecasts, planning for rain events, and activating emergency plans to prevent flooding and site damage.

In the case of the City of Fort Worth sanitary sewer rehabilitation project, the decision by S.J. Louis and Sunbelt Rentals to deploy the PumpSentri telemetry proved beneficial on all levels — and it opens up the opportunity for project owners and contractors to specify this technology to improve efficiencies and costs on future projects.

ABOUT THE AUTHOR:

***Jason Chambers** is the Regional Account Manager for Sunbelt Rentals Pump Solutions, covering the sewer rehab market segment in Texas, Oklahoma, and Arkansas. He specializes in large sewer rehab bypass projects. Jason began his career in 2001 when he joined the general tool Sunbelt Rentals team, working as an inside sales rep, then an outside sales rep before taking on his current role. With over ten years of pump experience, Jason has been involved in some of the largest bypasses in his region and continues to grow this market.*

El Paso Water's use of Multiple Trenchless Methods:

Providing Cost & Time Savings to the Canutillo Bosque Road Lift Station and Force Main Project

By: Ivan Hernandez, P.E., M.ASCE, C.D.T., Victor Morales, P.E., R.A.S., El Paso Water

ABSTRACT

El Paso Water (EPWater) constructed a new pumping lift station and force main that conveys sanitary sewer from new service areas into EPWater's existing collection system. After an unsuccessful first attempt to bid and award the construction contract, the design team revised their approach to simplify the construction methods and complexities of the project. The revisions to the design consisted of the realignment of the force main to reduce the amount of possible utility conflicts; designing shorter boring runs to mitigate risks; use of an abandoned 12-inch PVC gravity sewer main as a casing for the slip line installation of the new force main to reduce the project costs, duration and impact to the surrounding residents; and revisiting with the permitting agencies to allow for the installation of the force main using a combination of boring and open-cut installations across their infrastructures (in lieu of a single, longer and deeper auger bore installation across the Rio Grande River levee and river, an active railroad and state highway SH-20). An additional consideration was sequencing the time of year for construction to anticipate the fluctuating groundwater elevations to minimize the amount and time of dewatering necessary to perform the critical trenchless installations. The revised design was let for bid and was successful in attracting multiple contractors with very competitive bids where the winning bid was 13 percent lower than the engineers' estimate. The use of multiple trenchless applications provided both cost and time savings to EPWater on this project.

INTRODUCTION

EPWater has seen a steady increase in water and wastewater service demand across all El Paso, Texas. This poses some challenges as El Paso's unique geographic location has it bound by the New Mexico state border to the north, the Rio Grande River to the west and the international boundary with Mexico to the south. Additionally, a major geological formation known as the Franklin Mountains splits the city in half, which makes extending service to the different areas of the city somewhat complicated. Not only has the City of El Paso seen growth, but the neighboring communities have as well. These communities tend to operate private water systems and often become overwhelmed when growth exceeds their capacities.

The Canutillo Independent School District (CISD) is currently operating and maintaining a wastewater treatment plant that serves Canutillo Middle School. The plant was operating near the end of its service life and needed to be replaced or risk becoming non-compliant. In anticipation of this, the CISD approached EPWater requesting sanitary sewer service for the school; unfortunately, the school is located west of the Rio Grande River, outside of the corporate limits of the City of El Paso and, thus, sewer service was not available. Additionally, the neighboring community of the Village of Vinton was experiencing residential and commercial growth, yet their private water system lacked the capacity to meet the increased demand. The Village of Vinton secured funding for first time public sewer service and they too approached EPWater seeking wastewater service for conveyance and treatment. In order to provide the necessary sanitary sewer service, it was determined that a new wastewater pumping lift station and sanitary sewer force main were required. Both the CISD and the Village of Vinton entered into participation agreements with EPWater to construct a new lift station and force main capable of conveying the anticipated wastewater flows into a nearby EPWater collector.

DESIGN CHALLENGES

To provide service to the CISD, the location of the proposed new Canutillo Bosque Rd. Lift Station (LS) had to be situated west of the Rio Grande River. The discharge points of the new 6-inch force main were just under 6,400 LF to the nearest sanitary sewer interceptor; however, the alignment required coordination with various entities due to the need to cross the US Army Corp Engineers (USACE) Rio Grande River Levee, the Rio Grande River controlled by the US International Boundary and Water Commission (IBWC), BNSF Railroad, Texas Department of Transportation (TXDOT) State Highway SH-20, and El Paso County Road & Bridge, all abutting one another.

Figure 1 – Project Site Crossing Various Entities ROWs (Original Design)

Figure 2 – Revised Design Crossings of the Various Entities' ROWs and Slip Line Alignment

FIRST ATTEMPT

The site constraints led EPWater and the design team to search for the "apparent" most feasible pipeline alignment that would utilize existing pipeline easements to cross east of the river. This proved to be extremely challenging as the grantors of the existing easements and licenses imposed various restrictions that ultimately led to the design requiring a continuous 700-LF bore at an 18-foot depth across the Rio Grande River and levee and another bore 214-LF, 10 feet deep across the BNSF railroad and TXDOT highway. This resulted in an unsuccessful bid as the construction community expressed concerns with the overall design approach. The bids received were 79 to 126 percent above the engineers' estimate and thus all bids were rejected. It was determined that the high bids received were due to the complex nature of the project, the time of year the project was advertised, the location of the project and, ultimately, the lack of interest from potential bidders due to the aforementioned concerns and risks.

SECOND ATTEMPT

EPWater and the design engineer, Frank X. Spencer & Associates, re-visited the project approach and revised the design to simplify the scope of work. Outreach was performed to identify key risk areas; the most common concern was the length required for boring the 30-inch steel casing across the Rio Grande and the RR & TXDOT rights-of-way. This concern was mitigated by seeking an installation variance from the IBWC to cross the Rio Grande using an open-cut installation method. This was approved on the condition that the force main be installed inside a 30-inch steel casing and that the casing be encased in concrete. In turn, the length of the required bore was reduced to 140-LF from the original 700-LF. The Rio Grande is a "seasonal" river along the El Paso corridor with water supply available for a short irrigation season, typically between March and October of every year. Because of the seasonal water supply from the Rio Grande, the groundwater table elevation fluctuates by several feet depending on the time of year. Therefore, the contract documents required construction sequencing where the installation of the force main across the river was performed during the non-irrigation season (October through February). This would result in reduced groundwater dewatering and the ability to perform the bores using an auger-boring trenchless method.

Also, in anticipation for future growth of the area and the need for expansion of the lift station and sewer system, it was decided to install a 16-inch diameter force main now at the river, RR & TXDOT crossings and not have to return in the future and go through the same procedures again. This was done by requiring fully restrained, gasketless, and low profile Fusible PVC (FPVC) for various segments of the force main where the 6-inch FPVC pipe "piggy-backed" on the 16-inch FPVC pipe within the 30-inch diameter casing. The greatest O.D. of 6-inch FPVC is 6.90-inches (no bell) and is 17.40-inches for the 16-inch FPVC (no bell). This allowed for minimal spacing being required between the two pipes and the casing thus allowing for a reduction in the steel casing size to 30-inch, which resulted in construction/installation cost savings.

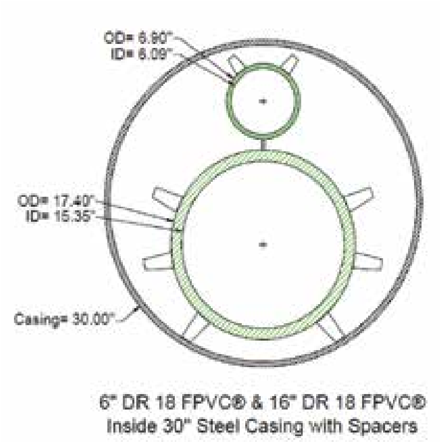


Figure 3 – "Piggy-Back" Design

Additionally, during the re-design of the project, EPWater identified an abandoned and dry 12-inch PVC line that had been intended to be used as a sewer main over 15 years prior to this project. A change in prioritization from the developers in the area rendered the existing 12-inch sewer line useless and it was abandoned in place. This resulted in the perfect opportunity to use this existing line as a casing and slip-line the existing 12-inch pipeline with a 6-inch FPVC force main for a stretch of over 2,840-LF. The result was a design that required approximately 8,000 SY less pavement restoration and, subsequently, overall cost savings to the project.

The revisions to the design were successful as they attracted multiple contractors with very competitive bids. The winning bid was 13 percent lower than the engineers' estimate.

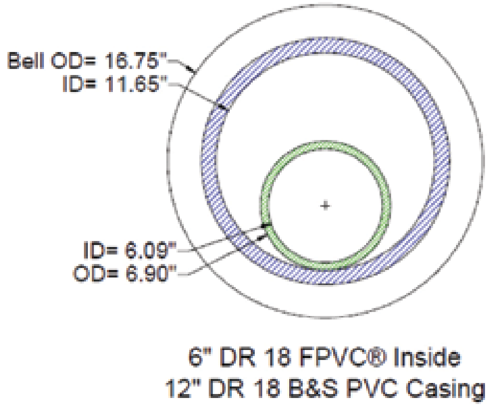


Figure 4 – Slip lining new 6-inch FPVC Force Main within existing 12-inch PVC pipeline

CONSTRUCTION

The Public Service Board (PSB) awarded the construction contract to the low bidder, Smithco Construction, Inc. (Contractor), during the August 2019 board meeting. The scope of work for the projected included:

- Construction of a 1.0 MGD Wastewater Lift Station to include the necessary preparations for a future expansion to a 5.0 MGD lift station;
- Installation of 6-inch and 16-inch force mains to include the installation of 30-inch steel casing as called out by the design;
- Installation of all necessary equipment, fittings and appurtenances necessary to complete the project design intent.

The first major task for the contractor was to develop a groundwater dewatering plan. As the plan was being developed, EPWater contracted with an environmental engineering consulting firm to install 3 groundwater monitoring wells, approximately 60 feet deep. Groundwater samples were obtained and sent to a water quality lab for testing of which the groundwater quality was found to fall within the required parameters and was deemed safe to discharge into the Rio Grande. Immediately after the installation of the dewatering operation was completed the contractor began installation of the force main within the limits of the pipeline route that required dewatering. The contractor opted to use a FPVC pipe along this segment to significantly speed up the installation time.

The Contractor was concurrently performing the work necessary for the installation of the force main via bores across

Figure 5 – Dewatering System Installed at Rio Grande River and Levee

Figure 6 – Six inch Force Main FPVC Pipe Lined up to be installed in trench

the levee and RR & TXDOT rights-of-ways. The horizontal auger boring method (HAB) is typically not recommended in groundwater conditions. However, the contractor was successful in lowering the groundwater table elevation that the installation of the 30-inch steel casing with 16-inch and 6-inch FPVC carrier pipes via horizontal auger boring was completed without any setbacks.

Contractor shifted the dewatering operations to the lift station site and at the same time was able to focus on installation of the 6-inch force main using the slip lining method. Contractor first inspected the 12-inch casing pipeline for any deflections, once confirmed no deflections were present the slip lining commenced. The slip lining consisted of installation of the new 6-inch FPVC inside the existing 12-inch PVC pipeline for approximately 2,840 LF.

Figure 7 – 30-inch Steel Casing being driven via HAB method

This required a total of three pits, one insertion pit midway the alignment and two receiving pits at each end of the slip lining run. The slip line was completed in two 1,400 LF pulls.

As anticipated, the project saw significant reduced paving repair costs because of the slip line installation. This method also produced an unexpected benefit over the traditional open-cut excavation methods. The soil in the area was prone to sloughing

Figure 8 – 16-inch and 6-inch FPVC Carrier pipe being pulled through 30-inch steel casing

and despite the relatively shallow excavation necessary for the installation of the pipeline, the sloughing of the soil and subsequent undermining of the existing paving adjacent to the trenched areas meant that in some cases it was necessary to replace larger areas of paving (sometimes from curb to curb) rather than what would normally be required under the El Paso County's guidelines. If the project continued with the open-cut construction approach instead of the slip lining method, it is expected that it would have been necessary to repair larger sections of roadway and thus increasing overall project costs. Fortunately, the slip line installation method used allowed the project to realize greater than expected savings both in construction time and repair costs for the project.

Figure 9 – 6-inch FPVC Install via Slip Lining existing 12-inch PVC pipeline

The undermining of the existing pavement also created an additional safety issue that the construction team needed to work around. This resulted from the need to exercise additional care around the undermined pavement to avoid collapsing it and possibly resulting in injuries or equipment damage and subsequently project delays.

Additionally, the reduced construction time due to the installation of the force main pipeline via slip lining helped reduce the impact on the community. The force main was routed through a busy residential collector street therefore by taking advantage of the existing pipeline and using it as a casing for the new force main piping, it was possible to avoid deploying traffic control along the majority of the slip lined route. The need to repair only the insertion and receiving pits resulted in less inconvenience to the community by shortening the time necessary to restore and re-open the roadway.

Figure 10 – 6-inch FPVC strung out for slip line installation

Figure 11 – 6-inch FPVC slip line being pulled via cable/pulley system

Figure 12 – Open-cut trench excavation experiencing trench wall failures and undermining existing roadway

When asked about their experience using FPVC for this project and the benefits from being able to install via slip line in-lieu of open cutting along 2,840 LF, the Project Manager for the Contractor stated that *"...It was a lot less invasive, so definitely better in that aspect..."* and *"...Overall, for this particular project, it worked great."*

The remainder of the project scope of work was completed with minimal setbacks and delays. Although construction change orders did arise during construction of this project, they were mostly driven by unforeseen conditions or owner ordered changes.

BENEFITS OF USING MULTIPLE TRENCHLESS METHODS

EPWater considers this to be a successful project, in part due to the lessons that were learned from its development. Developing this project improved EPWater's ability to consider and use different construction technologies and methodologies available.

Figure 13 – Reduced amount of pavement restoration at slip line insertion and receiving pits

Some of the immediate benefits that stand out the most to this approach include:

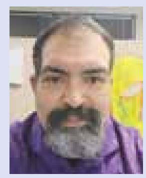
- Reduction in overall construction project duration;
- Increased cost savings due to reduction in pavement restoration required;
- Reduced impact to the community by limiting the traffic disruption;
- The cost savings obtained from the ability to install the casing using the horizontal auger boring method versus any other boring methods (i.e. microtunneling or HDD) by lowering the groundwater table elevation below proposed pipeline during construction;
- And, the ability to make a project more attractive to bidders by increasing the confidence in the success of a project's design.

As an owner agency, EPWater is always looking into advancements in construction methods and trends in order to manage its water supply, protect the environment, and provide the best possible service to its customers. Developing a project that meets its design intent in a way that is both innovative and fiscally responsible is the ideal outcome for EPWater.

ABOUT THE AUTHOR:

__Ivan Hernandez, P.E., M.ASCE, C.D.T.__ oversees the Construction Project Management division for El Paso Water which includes the implementation of capital improvement program projects for water, wastewater, reclaimed water and stormwater infrastructure. His professional career includes over 12 years of experience in the water & wastewater industry and is a licensed professional engineer in the State of Texas. Mr. Hernandez earned a Bachelor of Science in Civil Engineering degree from the University of Texas at El Paso in 2008 and currently serves as the Branch Director for the ASCE El Paso Branch and as the Texas AWWA – Desert Mountain Chapter Treasurer.

ABOUT THE AUTHOR:



__Victor Morales, P.E., R.A.S.__ is a Utility Engineer for El Paso Water with 22 years of professional experience in construction, engineering, and project management. He has worked on numerous infrastructure projects in the areas of water, wastewater, stormwater, transportation, and mass transit. He is a licensed professional engineer, a registered accessibility specialist and a licensed master plumber in the state of Texas. Mr. Morales earned a bachelor of science in Civil Engineering from the Massachusetts Institute of Technology as well as a Master of Engineering in Civil and Environmental Engineering from the University of Texas at El Paso. He currently serves as a member of the Texas Registered Sanitarian Advisory Committee.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Texas Water System Tackles Fractured Pipeline

Miles of Potable Supply Mains Replaced with HDPE Pipe Using Various Installation Methods

By: Plastics Pipe Institute Inc. (PPI)

While Eagle Pass, Texas can't solve the high heat and the low amount of rainfall it receives every year in the arid southwest, it has been able to fight water loss due to breaks in its pipeline. The city recently completed an upgrade to its mainline potable water service that saw some 100,000 feet of PE4710 high-density polyethylene (HDPE) DR 11 pipe installed in diameters from eight to sixteen inches to replace old cast iron lines. Using open cut, horizontal directional drilling (HDD) and pre-chlorinated pipe bursting, Murphy Pipeline Contractors, Inc. (Jacksonville, FL) completed the job in early 2021.

The Eagle Pass Water Works System (EPWWS) has nearly 20,000 customers and a potable water system that has more than 500 miles of main lines and services and nearly 1,600 fire hydrants. The Rio Grande River is the city's only means of water supply. According to one report, the existing amount of water rights owned by both EPWWS is not sufficient enough to provide adequate water to the area.

While the project was first considered in 2013, the need for funding delayed the bidding solicitation process until 2018 for the city that has nearly 30,000 residents. The majority of the project was funded through the State of Texas drinking water program enabling the city to secure the needed $17.4 million. In its entirety, the project replaced nearly 100,000 linear feet of existing cast iron water pipe and added 1,300 new water services using HDPE tubing to connect the water main to existing and new water meters.

HDPE Pipe is versatile, and adaptive to different field conditions encountered during construction

"Originally, Eagle Pass started looking at this project probably going back more than 10 years ago," explained Todd Gafenauer, Educational Director for Murphy. "HDPE pipe was selected as it solved one of the main reasons why the existing cast iron was failing. Many of those mains would fail due to shifting soils caused by the extreme heat and lack of moisture in the soils. Oklahoma and Texas generally deal with both freeze/thaw and dry/wet cycles causing severe breaks in the old pipe.

"The EPWWS general manager came to one of our other pre-chlorinated pipe bursting projects in Texas to get acquainted with the technology. He knew that this work was coming up. Eagle Pass, like most municipalities in the country, are at a very challenging position because they have old cast iron that is leaking everywhere. They also have very poor fire flow protection because of the corrosion inside the lines. So, they have been kind gearing up for the project for a number of years, came out and saw the technology and knew that is what they wanted."

The pre-chlorinated pipe bursting method has a history of more than 40 years and was developed by the United Kingdom water industry to address its failing cast iron water mains. The HDPE pipe is bacteriologically disinfected and pressure tested above grade prior to installation, which produces multiple construction efficiencies. The crews will often also set up temporary services to keep homeowners and business connected to water service throughout construction. Murphy introduced the process to the North American market in 1999.

There are other advantages to using the pipe according to the Plastics Pipe Institute, Inc. (PPI), the major North American trade association representing the plastic pipe industry.

"The use of HDPE in drinking water systems continues to grow and is specified per the ANSI/AWWA C901-20, ANSI/AWWA C906-15 and NSF 61 for service, distribution and transmission, and is designed and installed per AWWA M55-20," stated Camille George Rubeiz, P.E., F. ASCE, co-chair, Municipal Advisory Board and senior director of engineering, Municipal and Industrial Division of PPI.

"HDPE pipe has been used in municipal water applications for more than 50 years. HDPE's heat-fused joints create a leak free, self-restraint, monolithic piping system that can be pulled from one area to another with minimum disruption to traffic or the surrounding communities. The fused joint also eliminates infiltration into the pipe and exfiltration into the environment. HDPE has other benefits which include resistance to water hammer, fatigue, ground movements, freezing temperatures, earthquakes, corrosion and tuberculation."

> *"Eagle Pass is an example of HDPE providing for the needs of the contractor who had to make decisions in the field."*
>
> - Camille George Rubeiz, P.E., F. ASCE, Co-Chair, Municipal Advisory Board

Rubeiz also said that HDPE pipe is versatile and can be used in methods of underground installation. "Eagle Pass is an example of HDPE providing for the needs of the contractor who had to make decisions in the field. It didn't matter that a change at the last minute had to be made from trenchless to open cut, the HDPE pipe could be used immediately for either."

Because trenchless methods of installing HDPE pipe have grown in popularity, the Municipal Advisory Board (MAB) has published several free technical documents such as *The MAB Guidelines for PE4710 Pipe Bursting of Potable Water Mains (MAB-5-2019)* and *MAB Guidelines for Use of Mini-Horizontal Directional Drilling for Placement of HDPE (PE4710)*

In entirety the project replaced nearly 100,000 linear feet of existing cast iron water pipe

> *"The leak-free HDPE pipe will provide safe, desirable drinking water and fire protection for Eagle Pass residents and businesses."*
>
> - David Fink, President, Plastics Pipe Institute

Pipe in Municipal Applications (MAB-7-2020). All documents and software are available at: https://plasticpipe.org/municipal_pipe/mid-mab-publications.html

MAB serves as an independent, non-commercial adviser to the Municipal & Industrial Division of the Plastics Pipe Institute.

"This water system project was critical for the citizens of Eagle Pass," stated David Fink, President, PPI. "The water system was not adequate for the needs of the existing population, and would not be able to accommodate any future growth. Plus, the amount of water leaking through the old pipes cost the Eagle Pass Water Works System and its customers untold amounts of money, and, more troubling, was the amount of wasted water in a region that treasures every precious drop. But, now and for many, many years to come, this project will improve the quality of life for residents of Eagle Pass and even the nearby areas. The leak-free HDPE pipe will provide safe, desirable drinking water and fire protection for its residents and businesses."

The 50-foot-long sections of HDPE pipe from JM Eagle were fused together by the Murphy crew using a McElroy Trackstar 500, and the Scandinavian No-Dig T87 with a pulling capacity of 92 metric tons was used for the pipe bursting segments. The HDPE pipe has a pressure rating of 200 psig at 80 degrees F and can handle total pressure during recurring surge of 300 psig and total pressure during an occasional surge of 400 psig.

The pre-chlorinated pipe bursting used nearly more than 20,000 feet of eight-, 10- and 12-inch diameter HDPE PE4710 pipe.

"The original idea was to use pipe bursting for the entire project," explained Murphy Pipeline's Gafenauer. "But one of the challenges we ran across was that some of the lines were extremely shallow. It was more of a design build project on-site. We would dig down, find out what we had and then make the decision in the field. But because our crews have experience with all the ways to install the pipe, it wasn't a problem to change on the fly.

"Taking on a project of this size, using pre-chlorinated pipe bursting produced a significant savings in terms of impact to the community during construction and helped to reduce the project's schedule," he offered. "This is one of the largest, HDPE water main projects done in one time in North America that I'm aware of and our team is proud to be a part of it."

PPI is the major trade association representing the plastic pipe industry. More information can be found at www.plasticpipe.org.

HDPE's heat-fused joints create a leak free, self-restraining, monolithic piping system ready for pullback

ABOUT PPI:

*The **Plastics Pipe Institute, Inc.** (PPI) is the major North American trade association representing all segments of 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. For additional information, go to the Plastics Pipe Institute's website at: www.plasticpipe.org.*

HDD Drilling Fluids Management

More than Slingin' Sacks and Flippin' Switches

By: Zachary Maassen, PE, PMP

The principles and benefits of correct fluid maintenance remain important

Debatably the most vital and least discussed portion of the trenchless industry, is the fluids used to achieve these excavations. These fluids are essential in ensuring that all excavated solids are removed and transported to the surface for disposal, the hole remains cleaned and sealed from additional groundwater influx, potential "sluff ins" are mitigated, and that the progression of the hole continues at a consistent rate by lubricating the cutting tools. Insufficient care of and knowledge about these fluid's properties, their maintenance, and the tools used to ensure their quality can have a detrimental effect on the hole being excavated, leading to longer than anticipated project durations and costs. By developing a basic understanding about liquid/solid separation technologies and how they are applied, project stakeholders can better plan for the success of their trenchless implementations.

DESIGN FOR SUCCESS

After your drilling fluid program has been designed to the project's specific geotechnical conditions, it is crucial for the success of that fluid program that the necessary time be spent on the correct layout and implementation of the equipment that will be used to clean and maintain your drilling fluid. With the overlying goal of minimizing the amount of drilling fluid required to complete the project, separating out and disposing of all unwanted solids in the most efficient manner is your key to achieving this goal. The system used to perform these tasks should be assessed according to the following guidelines:

- What volume of drilling fluid will be held in my active system?
- What flow rates will be encountered?
- What size particles will be generated from the cutting face and formation?
- What is my allotted footprint for solids control equipment?

Identifying these key parameters will develop a framework from which an efficient fluid management system can be designed that minimizes the amount of equipment required while maintaining a closed loop process from which all drilling fluid is recycled and able to be reused continuously. By investing the proper time and resources toward ensuring a successful closed loop system is deployed, projects are setting themselves up for increased production times, minimization of waste and environmental impacts, and overall project cost savings. Failure to identify these key parameters could adversely impact your project via the degradation of your drilling fluid causing hole issues, accelerated wear of equipment, increased waste from dump and dilution, etc. all contributing to potential increased project times and overall project costs.

DILIGENCE IN THE FINER DETAILS

Recognizing the need and comprehending the reasons as to why a successful closed loop system is vital to the operation is something that is often overlooked by Project Managers, Superintendents, and even the Operators themselves; that is, until they receive their fluid/disposal bills. Most understand that some type of equipment is required for solids removal from the fluid, but for simplicity's sake, they often package the equipment they receive from their fluid provider as it is what they recommend.

This approach tends to lead to multiple problems, most commonly that while your fluid provider is also providing the equipment used to clean the fluid they build, have little incentive to maximize the efficiency of the equipment since they can increase their profits the more fluid additives that are consumed. Another common scenario is the rental and deployment of equipment without the proper personnel to provide oversight/knowledge of its operation and impact on the fluid parameters. Behind every effective closed loop system is the dedicated personnel with the experience of maximizing efficiency of each piece of equipment used in the process, in addition to developing positive, clear communication and understanding with the fluid provider.

UNDERSTANDING YOUR CLEANING EQUIPMENT

Several variations, brands, and companies are at the industry's disposal when it comes to equipment providers for solids/liquids separation & closed loop technologies. Most offer relatively the same equipment but vary greatly in how they use and modify it to stay ahead of the competition. With that in mind, the methods of performing the solids/liquids separation stem from three basic types of equipment: Shakers, Centrifuges, and Hydro-cyclones.

Shakers

Perhaps the most effective, important, and commonly used piece of solids control equipment is the Shaker. This basic piece of equipment operates on the simple premise of being a glorified screen box. Spent fluid flows over the screens with particles over a certain size being removed from the fluid which is retained under the screens and pumped away for reuse and/or further treatment. Although simplistic in nature, many variables can be adjusted to optimize the use of Shakers, most notably is their conductance and conveyance.

A Shaker's conductance (how effectively a fluid is transported through a medium, i.e its screen) is addressed through their use of interchangeable sizes of screens that are mounted to the deck of the shaker. This wide range of screening options contributes to the versatility of the Shakers by allowing them to remove solids

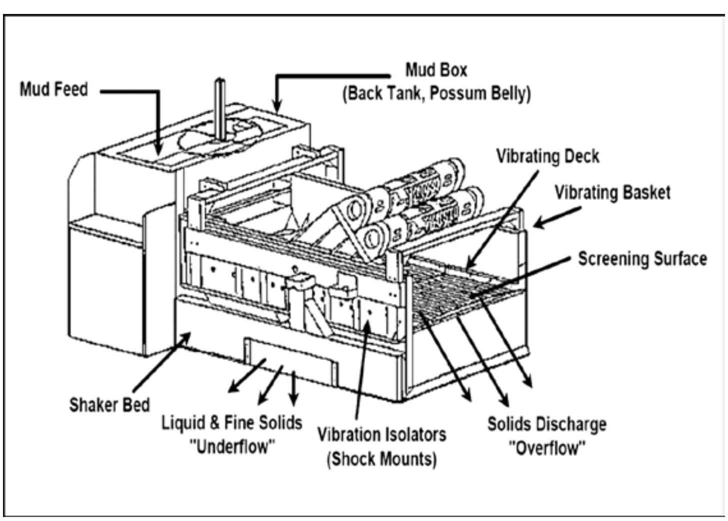

Figure 1: Shaker Components Overview

from a fluid depending on the treatment and disposal objectives. Conveyance relates directly to the retention time of the fluid on the shaker screens. Proper Shaker design will manage both the capacity allotted by the Shaker that dictates the rate that solids must be moved off the screens in addition to the dryness of solids exiting the Shaker.

Shakers should be used as the first line of defense for any closed loop system by removing larger excavated solids, with the option of deploying several subsequent Shakers each outfitted with differing sizes of screens to target smaller and smaller unwanted solids from your fluid. The project's fluid and disposal goals play a significant role into how many Shakers are deployed and how they are utilized as one of the drawbacks to the waste of Shakers is that when using them to treat out fine solids, a great amount of liquid waste can be generated.

Decanting Centrifuges

Arguably the most efficient and versatile piece of solids/liquids separation technology, centrifuges specialize in removing solids from a variety of different fluid types by applying high levels of G-Force. The spent fluid is pumped into the decanter centrifuge through the feed pipe or inlet. The product goes through an inlet tube into a horizontal bowl which rotates. The separation takes place in the cylindrical part of the bowl. The fast rotation generates centrifugal forces up to 4000 x g. Under these forces the solid particles with higher density are collected and compacted on the wall of the bowl. A scroll (ie screw or screw conveyor) rotates inside the bowl at a slightly different speed (ie differential). This way the scroll is transporting the settled particles along the cylindrical part of the bowl and up to the end conical part of the

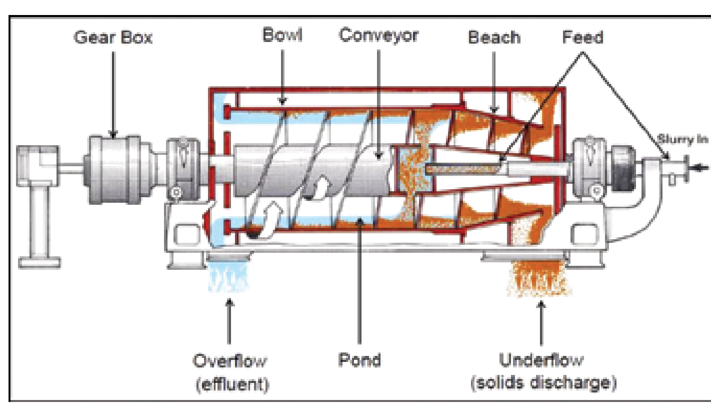

Figure 2: Centrifuge Operation Cross-Sectional View

Fluid's importance to overall project success needs to become a staple in stakeholders thought processes

bowl. At the smallest end of the conical part of the bowl, the dried solids leave the bowl via discharge opening; conversely the reusable fluid is discharged at the opposite end. (Foodec, 2018)

Skilled Centrifuge operators will consider the fluid properties, centrifugal forces, retention times, and conveyor torque when deploying this equipment to ensure that the centrifuges biggest advantages over other technologies is maintained: continuous processing with no consumables and removal of solids down to 10 μm. Additionally, Centrifuges can perform dewatering functions, which is unique among the other technologies described in this article. Centrifuge dewatering is performed on fluids that are no longer necessary to a project, generally at the end of an installation or periodically during a project when the fluid has an excess of fine solids or contamination from formation. Utilizing coagulants and flocculants injected into the Centrifuge with the used fluid results in producing clear, reusable water (varies project to project) and dried solids for disposal. In most successful closed loop deployments, Centrifuges paired with Shakers fitted with larger

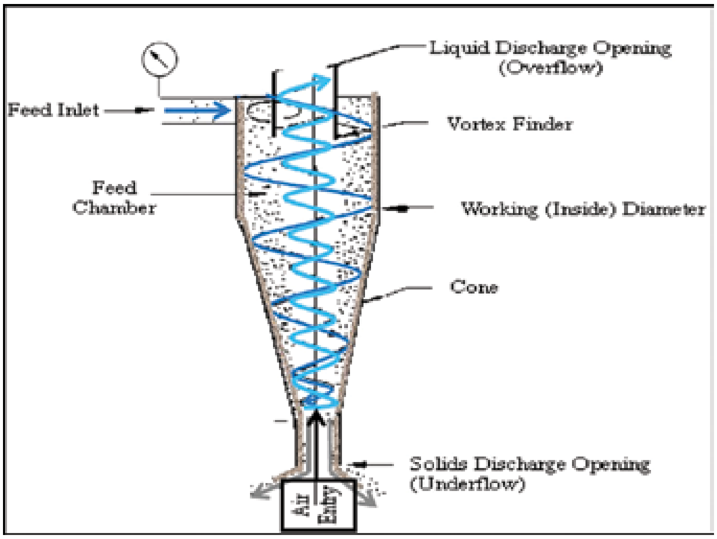

Figure 3: Hydro-Cyclone Operation Cross Sectional View

screens will produce the cleanest fluid and incur the smallest amount of downtime and consumable costs.

Hydro-Cyclones

By far the most common deployed piece of solid/liquid separation technology in the trenchless industry is the Hydro-Cyclone. These high flow capacity instruments also utilize centrifugal force with additional constant head pressure to remove undesired solids. During operation, a feed slurry of solids and liquid is fed through the inlet at a high velocity obtained by steady pressure or feed head as recommended by the manufacturer. A centrifugal pump is used to obtain the desired head. The high velocity into the feed chamber creates a spinning velocity and resulting centrifugal forces. The vortex finder causes the stream to spiral downward toward the underflow solids discharge. Centrifugal force and inertia cause the solids to settle outward toward the Hydro-Cyclone wall, in the downward spiraling stream. The solids separate according to the weight and size of the particles. As the cone section narrows, inner layers of the downward spinning liquid turn back toward the overflow because of the increasing centrifugal forces near the center. In this balanced design cyclone, as the last of the liquid moves to the center and back upward toward the overflow, the downward spiraling solids continue out the underflow, unable to turn back because of their greater inertia and high downward velocity. See Figure 3. (Robinson)

Popular for their high flow capacities, these instruments are capable of processing anywhere from 75 – 2,200 gpm per cone depending on their size and can target particle sizes >30 μm. Typically known by other names throughout the industry, such as Mud Cleaners, Desander or Separation Plants, these Hydro-Cyclones are mounted on top of Shakers as an all-in-one solution for fluid treatment and have merit when handling certain fluids.

While appealing on the surface with their high flow capacities and sophisticated looking designs, this technology brings more challenges, steeper investments, and warrant further inspection to the details. Most notably, these systems are not able to target the wide range of solids sizes that can be handled by a Centrifuge, thus contributing to excess fine solids accumulation within your reused fluid and routine cone failures due to plugging off the overflow and underflow discharges with larger solids. Consumable costs have also been observed to be higher while utilizing these systems (in terms of replacement shaker screens) as operators tend to place blame on the actual shakers or screens themselves when seeing increased sand content or LGS (Low Gravity Solids) during routine mud checks. While screen failure can be a cause, generally these issues can be assigned to the Hydro Cyclones themselves. Like most equipment, Hydro Cyclones have an ideal operating range for maximum efficiency, which is based off maintaining a constant, specified feed pressure to the cones and proper solids target in terms of size. These failures contribute to significant amounts of maintenance time and replacement parts, lessening fluid treatment, degrading fluid properties, and slowing operations.

SEE THE BIG PICTURE

The question that is always asked or comments that are made from the key stakeholders of these trenchless projects who don't take a vested interest in proper fluid maintenance always revolves are the same premise, "So what? Who cares?" "Not my budget." With a small portion of the overall project budget and a priority behind simultaneous tasks like pipe and fuel deliveries, it is understandable why fluid management gets pushed to the side. Nevertheless, the fluid's importance to the overall project's success needs to become a staple in stakeholders thought processes as its reach into every aspect of the operation is underestimated. Take the time, understand the entirety of the fluid process and just how important it is to your installation and don't be hesitant to explore new options or companies you haven't used in the past. Fluid products, consumables, separation equipment while on the surface looks the same as ten years ago, has come a long way. Due to these advancements, there are a variety of professionals waiting to implement on your next project that can help your installation go faster and with less issues than you maybe thought possible. Whether you are installing a 40-foot diameter tunnel or 4-inch conduit, the principles of correct fluid maintenance remain and can benefit you the same.

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ABOUT THE AUTHOR:

Zachary Maassen, PE,PMP, is General Manager of HD Energy Services. He graduated from Montana Tech University with a B.S. in Environmental Engineering; Licensed Project Management Professional & Professional Engineer in Texas and Montana. Has managed several solids control, dewatering and fluid programs on multi-billion dollar projects throughout North and Central America in the Trenchless, O&G, and Deep Foundations industries since 2015.

Corpus Christi Ship Channel Relocation and Improvement Project

By: Chris Jones, HardRock Directional Drilling

The Corpus Christi Ship Channel Improvement Project is a massive undertaking that started in 2018 with a completion goal of 2022. The primary goal is to widen and deepen the current ship channel and water ways from the Port of Corpus Christi to the Gulf of Mexico to allow increased vessel sizes for larger offshore transport as well as for international trade.

The Port of Corpus Christi is one of the largest and busiest ports in the nation, with numerous refineries and docking stations. This results in a very complex and abundant infrastructure and a maze of pipelines. Many of these lines cross the actual ship channel. Some of these lines crossing the channel were installed many years ago by various methods and don't have much cover. These lines are at risk when the dredges deepen the channel, which means the existing owners have to remove and/or relocate these pipelines to a greater depth. Some of the pipelines are old and abandoned and can simply be removed. Others are currently in service and utilized on a daily basis.

AVERY POINT

Avery Point is located in the Port of Corpus Christi. This location is one of the main corridors and contains the majority of the existing pipelines under the ship channel (all in a 100-foot wide ROW). In 2018, approximately 29 existing lines (pipe sizes ranged from 6 to 16 inches) had been identified as needed to be removed or relocated. Sixteen were declared old or abandoned and required removal only. The other 13 were scheduled to be reinstalled by HDD to a safer depth.

HardRock became involved with his project in the early stages (2018). The initial role was to consult on constructability and assist the owners for budgeting purposes. Because of HardRock's extensive experience in this area (specifically numerous HDD crossings under the ship channel), we were able to help identify the most advantageous layers for the reinstalls. We also shared our experiences of the numerous challenges and potential cost impacts that could be expected, in regards to this specific area.

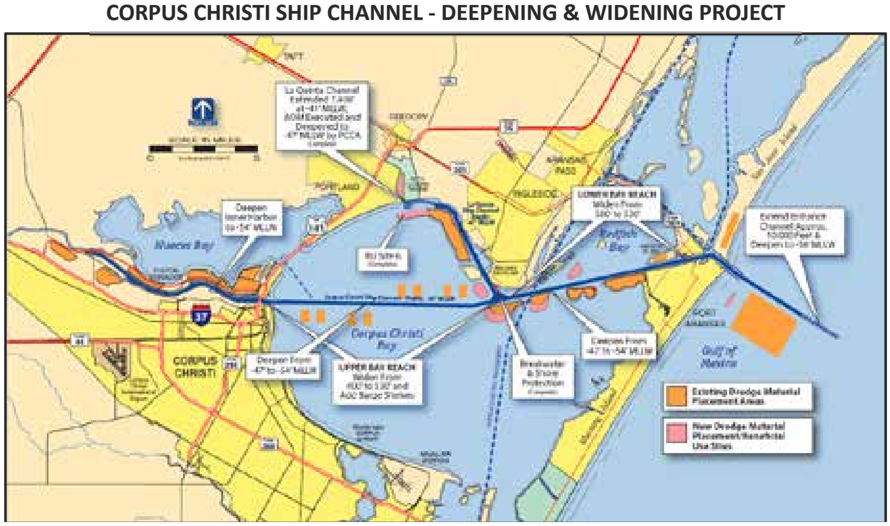
CHALLENGES

This project had numerous challenges. The first is the extreme underground infrastructure of pipelines that feeds the port facilities and refineries. This results in a maze of both in service and out of service pipelines. Many are marked and located, but there as just as many that are so old very few people know of their existence or locations. This made identifying all lines in the path of the new installations critical before a constructible design could be produced.

Being a coastal location, the next challenge was the actual ground conditions. The topsoil is a very loose and sandy material, with a very shallow water table. This makes locating the necessary pipes very difficult. The ground conditions also pose potential load limits for setting up equipment to perform the reinstallations. The below ground conditions were a challenge as well. The first 20-23 feet consisted of a soft sandy material with a high water content, then transitioned to a sandy clay until the 100-foot mark. This required surface casing to support the drill stem for pilot operations. After the 100-foot mark the conditions turned to a stiff clay formation as well as layers of oyster reefs. A jetting assembly was not always able to proceed through these harder formations, and a mud motor had to be utilized. Once the mud motor got thru the stiffer conditions, it was often necessary for it to be tripped back to surface, and the jetting assembly reinstalled, in order to make the steep incline to the exit point. A combination of experience in these conditions and pre construction planning were critical in the success of these installations.

At Avery Point there are approximately

CORPUS CHRISTI SHIP CHANNEL - DEEPENING & WIDENING PROJECT



> *A challenge that is being accepted by HardRock and the entire HDD Industry.*

12 different owners of the 29 existing pipelines under the ship channel. All had to be removed, and five different owners were relocating to a deeper depth. Each owner was responsible for their portion of the project. The challenge was each owner had their own construction specs, schedule, and contractor lists. In addition to the owners, numerous governmental agencies were also involved. The Port of Corpus Christi, The US Army Corp of Engineers, City of Corpus Christi, and Mott McDonald. This made communication with all parties involved imperative.

HARDROCK

HardRock partnered with both the owners and TTL Engineering to help mitigate and navigate all the challenges presented with this project. The first step was to create a constructible design for each of the owners. The ship channel itself is less than 900 feet across at Avery Point, with a deep bulkhead on both sides of the channel. This made the average crossing length between 1600 – 1800 LF. The catch is a depth of 100 feet was required under each of the bulkheads. And the bulkheads were less than 500 LF from both exit and entry points. This created some fairly steep entry and exit angles, some as steep as 17 degrees. In addition both entry and exit points were extremely congested and required some creative and out of the box thinking of how to avoid all these lines. After the existing utilities were located, the team was able to produce a safe and constructible design.

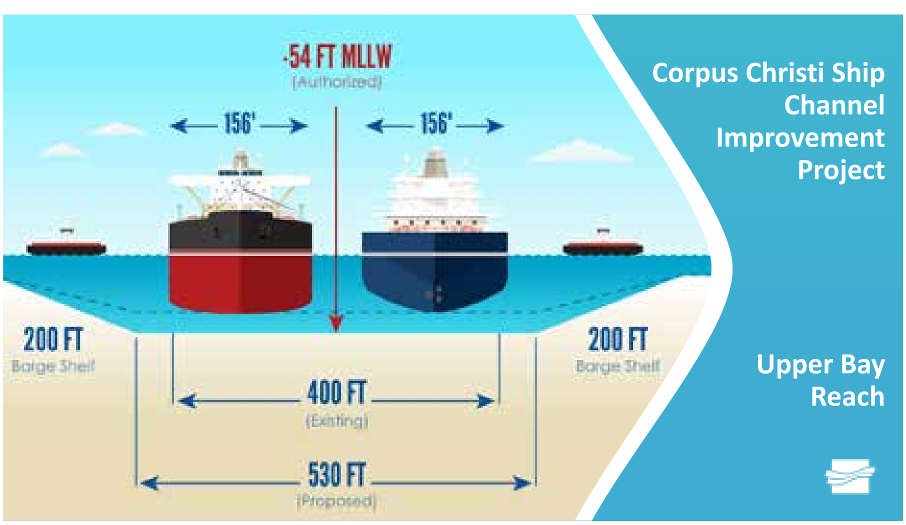
After the designs were finalized each owner then had to coordinate their respective construction schedules. The work site for the HDDs was extremely congested and tight. This resulted in only one owner being able to perform their HDD at a time. With communication and planning a schedule became to form, and construction commenced at the end of 2020. At the time this article was written the majority of the HDDs on this project have been successfully installed by HardRock, and are contracted to complete the remaining.

REMOVALS

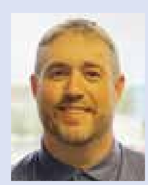
Once the new installations are completed and the owners have product flowing, they are still tasked with removing their existing lines (29 total). Each owner is required to achieve this by their own methods. Many owners are electing to utilize HardRock and our above ground extraction methods. Each removal is just as specific as a new install. There are many variables that determine what extraction method can be utilized. Many of the lines to be removed have been under the ship channel for as long as 50-60 years. Some have been conventionally laid others have been drilled in. Additionally, many have been encased in concrete. Each removal is being evaluated and the applicable extraction methods utilized. For the ones that cannot be removed by above ground extraction, a marine extraction may be needed.

INDUSTRY

This project has been and continues to be a massive undertaking. But it is not entirely unique. The demand for larger water vessels and the thriving offshore exportation is increasing. There are many projects similar to the Port of Corpus Christi Improvement Project in the development and construction phases, not only in Texas, but also across the nation. Actually, some of these are significantly larger regarding the number of lines that need to be removed and relocated. In some cases, up to 3-4 times more. The same challenges exist and in some cases are even more prevalent. With the same preconstruction planning and communication, these projects can be as successful as the one in Corpus Christi. It's a challenge that is being accepted by HardRock and the entire HDD Industry.



ABOUT THE AUTHOR:



Chris Jones is currently the Vice-President of Business Development at HardRock, and has been there for over 9 years. Chris oversees all sales and estimating, and is responsible for the continued growth of both HardRock and the HDD industry. Chris has been in and around the HDD industry for over 14 years, and has consulted and worked on many of the largest crossings and HDDs in the country. Chris is a proud member and recently elected Board Member of APCA, and currently a member of HPL (Houston Pipeliners) and SAPA (San Antonio Pipeliners) associations.

Jerry's Trenching Service Conquers its Longest HDD Job to Date with All Terrain Technology

Company pushes through difficult ground conditions, environmental challenges for fiber-relocation project

By: Ditch Witch

On its own merit, a horizontal directional drill (HDD) shot spanning more than five football fields long is a substantial task. But when you add in both volcanic and clay ground conditions, a tight deadline and an environmentally protected jobsite, it becomes all the more challenging.

This was the task for Jerry's Trenching Service in October 2019. The company, an underground construction contractor with a history dating back to 1964, was called to Clear Lake, California, to move an existing AT&T intercontinental fiber line for a bridge expansion to take place.

"When my father founded Jerry's Trenching, he focused on efficient and creative solutions to problems," said Jerry Berlin Jr, CEO of Jerry's Trenching Service. "When I think about jobs that test those values, the Clear Lake job is the right at the top of the list. We encountered a variety of issues and we needed to trust our technology and our crew."

The AT40 is designed for increased control and productivity when drilling in hard rock conditions


Compact size of AT40 minimizes the overall job footprint

A LONG SHOT AND A LONG LIST OF CHALLENGES

When Berlin's crew, led by Jose J. Sandoval, arrived on-site in Clear Lake, they quickly realized the challenges facing their 1,540-foot shot.

To start, the crew was drilling under an environmental reserve – eliminating the possibility of excavation or potholing to provide visibility or relief. The good news was that there weren't any existing lines in the area outside of the original line that the crew was splicing over to and they were allowed to trench in the last 15 feet of the job to make sure the tedious splicing process was safe. That said, the reserve also happened to be full of poison oak, forcing the crew to wear personal protective equipment from head-to-toe to protect themselves.

The ground conditions added further difficulty. While HDD jobs of this length are commonly through dirt, this job was through hard volcanic rock, with scattered pockets of clay along the route. The rock would test the horsepower limitations of any machine, but the clay pockets complicated matters further.

Each time the crew found clay, they needed to completely pull out of their established hole, clean the hole and then mix new mud to drill through the new conditions. Then they would need to retool and repeat for the hard rock once

> *"The jobsite was a challenge. We knew it was a long drill shot going in..."*
>
> - Jerry Berlin Jr, CEO, Jerry's Trenching Service

"Once we fully realized the challenges of the conditions, we got on the phone with Ditch Witch"

they returned to those ground conditions.

Lastly, the clock was ticking. The team had an extremely tight deadline they needed to meet in order to accommodate scheduled downtime for the existing intercontinental fiber line, which was responsible for transferring vital information to companies throughout the United States. The downtime had been planned months earlier and missing the mark would be extremely costly financially and operationally to the businesses that depended on that fiber line.

"The jobsite was a challenge," Berlin said. "We knew it was a long drill shot going in, but as we got to work and found out about the other factors, we knew it would be difficult. Once we fully realized the challenges of the conditions, we got on the phone with Ditch Witch."

UNRELIABLE CONDITIONS REQUIRE A VERSATILE SOLUTION

Jerry's Trenching Service turned to the Ditch Witch AT40 Directional Drill for the project. The AT40 is newest Ditch Witch directional drill with the company's All Terrain drilling system. Designed for increased control and productivity when drilling in hard rock conditions, All Terrain technology would limit the impact of the ground conditions on the job.

"We've always used AT30s, but we really wanted the AT40 for this job because the larger 15-foot bore rods would help us on the longer shots," Berlin said. "Also, the AT40 has an inner pipe that we could get air through, so we could run an air hammer with it. We knew the AT40 would help us out. It got to the point where we were counting days and shipping hours until the AT40 would arrive."

The arrival of the AT40 and its All Terrain technology opened up the opportunity to use much less drilling fluid than is needed with typical mud motors. The compact size of the AT40 also minimized the overall footprint of the job – an important benefit due to the environmentally sensitive nature of the jobsite.

With the use of All Terrain technology and the crew's expertise, they hit their

mark in just over three weeks. The 1,540-ft bore was a new record for Jerry's Trenching Service, beating out the previous mark by over 300 feet – a mark that had been set two decades ago in dirt, not volcanic rock.

STARTING A ROCK GROUP

Experience on complicated rock drilling jobs and with All Terrain technology have become valuable assets for Jerry's Trenching Service, so the company recently started taking them on the road. Since many cities don't have an abundance of rock jobsites, Jerry's created a traveling rock drilling team to support rock drilling jobs across the region.

"We've always had All Terrain technology on site for when we were faced with rock, but now we've seen how it can help on difficult, unpredictable rock drilling jobs," Berlin said. "And we have an experienced, energetic crew that wants to travel. Now we can find and conquer any rock drilling jobs."

ABOUT DITCH WITCH:

Ditch Witch doesn't just sell equipment! We pledge to be there when you need us. With a promise to help you be more productive. A passion to help you be more profitable. And the simple understanding that time is money. Greater stability, greater horsepower, a higher-capacity pump, and advanced electronics all in one machine? Our engineers love a challenge, and you'll love the AT40 All Terrain! For more information visit www.ditchwitch.com.

Hard Work and Diversification Produces Results for Dakota Utility Contractors

By: Christine Smith, Vermeer Corporation

"We've got the majority of our smaller rigs, 40,000-pounds (18,143.7-kg) or less, working on more fiber jobs this year than in previous years. Then there's the Vermeer D220x300 S3 Navigator® horizontal directional drill (HDD) that just wrapped up a water job in Frisco, Texas, and is now working a water line relocation project in Rowlett, Texas," explained Aaron Graff, president for Dakota Utility Contractors Inc., when asked if his 21 HDD crews were keeping busy this year.

The fact is, since starting Dakota Utility Contractors in September of 2000 with his dad and wife, Aaron has had to work extremely hard to get his business to where it's at today. "We started with a used Vermeer D24x40A Navigator® HDD that we bought from the Vermeer Texas-Louisiana dealership in Irving, Texas, and headed straight to Indianapolis, Indiana, where we worked through the rest of year. After that, we headed to Kentucky, then spent some time up north before settling for a bit in Florida doing mostly fiber work," he explained. "After a couple of years of doing that, we landed our first steady customer in Texas, where we are today. Over the next couple of years, we hired a few employees and added a couple of utility drills to keep up with the fiber work. Then, around 2008, we bought our first 'big' rig — a Vermeer D80x100 Navigator® horizontal directional drill — and started going heavier on the pipeline side."


More than enough power to pull-back long pipe strings

Today, the Ennis, Texas-based utility and pipeline directional drilling company splits its time between small-diameter fiber and electrical installs and large-diameter gas, water and sewer work. Aaron said their team has a lot of dedicated resources for doing large-diameter and pipeline work, but he never wants to forget where the company got its start. "Electrical and fiber companies gave us a chance when we first opened our doors, so it's very important to me to make sure that, even though we do a lot more than large-diameter work today, we make it a priority to continue provide quality service to those organizations."

DIVERSIFICATION

Aaron also credits having a diversified customer base for maintaining a steady stream of work. "When the pandemic hit, oil and gas pipeline work fluctuated around the country," he said. "We've been fortunate to have other projects outside of the oil and gas market to keep our team busy. Utility work is going strong, and we've been working with several municipalities to install water and force sewer lines."

For one of Dakota Utility Contractor's crews, they have been doing large-diameter forced sewer HDD work in downtown Frisco, and water line relocation in the Dallas suburb Rowlett.

"Large-diameter work in city environments is always unique," said Aaron. "Space is usually tight, there's traffic and mud drilling fluid management is always more complicated."

FRISCO SEWER JOB

Like many cities throughout Texas, Frisco is growing at a rapid rate. To meet the rising needs of new residents and businesses, it was time to increase the capacity of the the city's sewer system — a 20-inch (50.8-cm) HDPE forced sewer main right through the median of one of the city's main traffic arteries.

A good portion of the new sewer line was installed using open-cut methods, but HDD and auger boring was employed in the most congested areas, where intersections could not be shut down. Dakota Utility Contractors got the call to perform a 2,400-foot (731.5-m) bore stretching several city blocks, near several other buried utilities and crossing several intersections.

"On the entry side of the project, the site is surrounded by housing subdivisions, and on the exit, there are restaurants, gas stations and retail stores," said Aaron. "Also, many of the area's other utilities were buried in the same stretch of ground. So, we needed to be diligent with our planning and then execute that plan perfectly."

To begin, Dakota Utility Contractors sent out its two in-house wireline engineers to survey the area and identify above and below ground obstacles. They mapped out the bore path, took soil samples, came up with a plan and submitted it all for approval. After that, the drill crew went to work.

With limited space between roadways, and the 2,400 feet (731.5 m) they needed to drill out, the team determined the Vermeer D220x300 S3 was the best machine for the job. "For a large directional drill, that machine has a narrow footprint and plenty of power, which is exactly what we need for these types of projects in the city," explained Aaron. "We also brought in a mud recycling system, a pump, generator and excavator on the entry side of the job."

The bore plan called for the crew to drill deep — 48 feet (18.6 m) below the surface, to be exact. "In populated areas, inadvertent returns can lead to more issues than in more rural areas," explained Aaron. "Boring deeper gave us a lot more ground cover to help avoid this from happening. And, the ground was a soft clay, so keeping our returns was a huge battle for us."

Dakota Utility Contractors employ mud engineers to handle the drilling fluid management side of the operations on big jobs like this one. The challenge on the Frisco job was coming up with a way to maintain the drill path's integrity, keep the clay from balling up and causing an inadvertent return, and minimize flow to the exit side of the bore.

"We were crossing several intersections, so we couldn't pump slurry back to the mud recycling system. It had to be hauled with vacuum excavators," explained Aaron. "To delay flow to the exit side, we performed the pilot bore and the first couple of reamer passes without punching out, so the fluid only had one way to go. Our onsite mud engineer monitored our fluid returns to make sure we were getting the majority of it back and made adjustments to our drilling fluid mix when needed."

Before pulling back the 20-inch (50.8-cm) HDPE pipe, the bore was opened up to

Dakota Utility Contractors crews crisscross the country performing utility and large-diameter bores

For a large directional drill, the D220x300 S3 has a narrow footprint and plenty of power

a 30-inch (76.2 cm). After the pilot bore, the crew push-reamed with a 18-inch (45.7-cm) mill-tooth, roller-cone reamer. After the first pass, they tried to step up to a 30-inch (76.2-cm) reamer, but the returns were too thick and the clay was balling up, which was pulling down their rate of returns. To avoid a potential inadvertent return, they swapped out that reamer with a 24-inch (61-cm) reamer and then stepped back up from there. On the final pass, the crew punched out and made two swab passes before pulling back.

Aaron said from start to finish his crew was on the job for less than a month and were able to successfully avoid any inadvertent returns.

Rowlett water relocation project

While one team was wrapping up the Frisco job, another one of Dakota Utility Contractors' crews performed a 1,400-foot (426.7-cm) pilot bore in Rowlett for a water line relocation project with a Vermeer D100x140 S3 HDD. Plans to expand the nearby road from two lanes to four prompted the project, and the site sat right between a causeway and a lake.

The D100x140 S3 would later be swapped out with the larger D220x300 S3 to ream and pullback the 30-inch .500 (12.7 mm) wall steel casing. Aaron said that on several large-diameter projects under 2,000 feet (609.6 m), they use their small drills to do the pilot bore and make a reamer pass or two because it helps reduce their operational costs. Then when it's time to open the hole wider and pull, they move in the D220x300 to complete the job.

With water on both sides of the jobsite, the ground conditions were a combination of really wet sand and clay. This pairing kept the project's mud engineer busy changing the fluid mixture through the bore's length. After punching out on the pilot bore, the crew ran a tail rod throughout the reaming process.

"The ground conditions made everything touch-and-go," said Aaron. "In the clay, we pulled and pushed ream, and then in the sand areas, we would go all the way through. We had to fight conditions the whole way. We were all anxious to get this one done."

KEEPING BUSY

As all of Dakota Utility Contractors' crews crisscrossed the country performing utility and large-diameter bores, Aaron took a minute to reflect on what got the company to where it is today. "We've been working with the same core customers almost from the beginning. They know us and trust that we'll always do an excellent job for them. We have also been successful at retaining our talented crew members and have several celebrating their 10-year and 15-year anniversaries.

"And finally, we've invested in quality equipment and have great partnerships with the people at the dealership," he finished. "We purchased our first drill from Vermeer Texas-Louisiana, and they've been supporting us ever since. All of those factors have taken us to where we are today and will be tomorrow."

ABOUT THE AUTHOR:

Vermeer

Vermeer Corporation offers one of the most comprehensive product offerings serving the underground construction industry. Products include horizontal directional drills, guided boring systems, trenchers, vibratory plows, rockwheels, piercing tools, vacuum excavators, core saws, and mini skid steers, as well as a range of tooling, accessories, and support equipment.

HDD Guidance in Extremely Energized Ground

Utilizing All Available Resources on Hard Jobs

By: Subsite Electronics

A handful of horizontal directional drilling (HDD) specialists had each failed to complete a scheduled installation of fiber optics in a Greenville, South Carolina, project that was by now more than a year overdue. Bore-path complications included two heavily vegetated ravines, a road, two restrictive railroad right of ways and a reinforced concrete parking lot.

In addition, the path ran between two abandoned underground gasoline storage tanks that had been filled and alongside a mismarked fiber optics line that had remain up and running. Magnetic field anomalies confounded utility locators and HDD guidance systems. Regional contractors either refused to take the job or begged off after beginning it.

These are exactly the types of jobs Atlas Group's HDD division pursues. Atlas Group President KJ Woody said, "We are called in to finish jobs other contractors can't finish. You could say that's our niche, drilling in hard rock, doing the most difficult jobs."

Founded in 2001 in Buckhannon, West Virginia, by KJ and his brother, Kyler, Atlas Group is a family-owned, family-operated company serving the needs of underground utility and construction customers throughout the East Coast region. HDD applications typically involve fiber, natural gas and waterline installations.

The 672-foot run along a busy highway began directly beneath high-tension power-transmission lines

Job specifications

The overdue 672-foot run along a busy highway began directly beneath high-tension power-transmission lines. The massive magnetic field completely masked a typical drill string's beacon signals. The path then descended beneath the heavily vegetated surface of a 40-foot ravine before crossing deep beneath a side road.

Beyond the road, the surface descended again. Here the bore path crossed beneath a decommissioned railroad track and then further on beneath two active railroad tracks. The railway company forbids any locating activity within 10 feet of the rails.

Once past this obstacle, the surface above the path rose to an elevation beneath an old gas station's parking lot. The bore must rise beneath the parking lot to pass between two abandoned tanks lying just before the exit point. Adding further interference was an existing fiber optic line that lay parallel to the bore path along its full length, also passing between the abandoned gas tanks.

Energized ground

Atlas was introduced to the job after finishing a separate HDD project for the same Greenville customer in similar energized ground conditions elsewhere in the city.

Since the two sites were located close together, KJ anticipated they'd have similar problems with signal reception and interpretation. Their initial BPA using

A benefit of the TK Recon 4 is the beacon compass

their own Subsite TKQ receiver confirmed it. The TKQ is a four-frequency tracker especially designed for larger rigs and longer bores with a locating depth range rated to 110 feet and tracker-to-rig range rated at 2,000 feet.

Despite the receiver's power and accuracy, in many of the places where Atlas crews could get signals, they couldn't consistently trust them.

The shallow noise floor they discovered meant even after a successful start, portions of this job would have to be either drilled blind or exposed. Obtaining a visual verification at the depths specified for this run, and working on the slopes in rough terrain, would add enormously to project time and cost.

Consulting with a ready resource

The Woodys were confident that they'd succeed in spite of the job's complexity, but they wanted to see if they could get better signal reliability. They decided to bring in Subsite rep and application specialist Brett Romer to demo the newest HDD guidance equipment.

Romer brought along a four-frequency Subsite TK RECON 4 receiver, Subsite 17T4 beacon and Subsite Commander 7 remote display. What's more, KJ said, Romer brought a "wealth of knowledge" that further increased his and Kyler's understanding of how interference affects a receiver's interpretation and how to use that knowledge to their advantage.

Innovations in HDD guidance systems have made them so user-friendly over the years that they are a cinch to learn and operate. However, interpreting what they say in actual field conditions entails a much deeper grasp of the underlying operating principles.

Second BPA

Romer hooked up the Commander 7 to Atlas' Ditch Witch JT3020 All Terrain drilling rig and calibrated the receiver. Then using both of the receivers on hand, the team initiated another BPA, comparing the results to the first BPA. Comparisons are useful because they can show, for instance, whether anomalous variations remain consistent from one BPA to the next or if they have changed with time of day or other variables. Both instruments recommended frequencies of 29 kHz and 12 kHz to mitigate ambient interference.

Next the crew reexamined the noise floor for the run, determining a maximum depth of about 55 feet. Knowing they would not be allowed to perform locates near the railroad tracks while running at a depth of 35 feet, they set up the beacon for 29 B power and 29 X power.

The 17T4 beacon Atlas was using in their Ditch Witch Rockmaster housing on this job is capable of emitting its signal in four frequencies at three field-configurable power levels. Preset frequency and power combinations can be switched from one to another on the fly by putting the beacon to "sleep" and restarting within a designated period of time.

Then they began drilling. One of the benefits of the TK Recon 4 was its beacon compass. The crew no longer needed to track steering by having the receiver operator cross back and forth 20 feet at a time to verify nulls. Another benefit was its pitch-assist tracker boot, which came into play due because of the rough, irregular terrain and varying slope of the surfaces above the bore.

Day 2

The crew got more than halfway through the full length of the run on the first day. Day two's drilling would include the railway crossings and the pass under the rebar-embedded concrete of the old gas station's parking lot before exiting on target.

When the crew got to within 12 feet of the active railway tracks, they switched guidance techniques from the TK system's walkover mode to its DrillTo mode. In spite of the distance to the receiver, the driller easily tracked bore progression to the target on his Commander 7 display. The setup had

When the crew got to within 12 feet of the active railway tracks, they switched guidance techniques a continuously reliable signal with the bore 14 feet beneath the rails, progressing at about 2 feet a minute for each rod.

The final peak of the bore path topped out about 150 feet away from run completion. The trick here would be steering the bore precisely enough to avoid the fiber optic line running alongside the bore path and the abandoned gas tanks on the other side of the lot.

Even using a Subsite Utiliguard locating system, it took two hours to locate the fiber optic line. The crew finally had success after running out an additional 50 feet of fish tape and grounding the transmitter to the air conditioner ground of a nearby business. They first detected the signal by running the unit at 13,000 Ohms. Setting the power to level 5 and using 8.01 kHz enabled the crew to get down to reliable reception at 5,000 Ohms.

Despite being satisfied with their utility locator's settings, the crew did not believe the reading it was giving them. They knew the fiber as marked was mislocated, but they were showing it at just one foot, one inch below the concrete.

Right on target

Atlas called in a ground penetrating radar (GPR) contractor to ascertain the fiber optic line's true location, only to learn their readings had been almost dead on. The GPR showed it to lie exactly where they determined but slightly deeper at one foot, nine inches.

ABOUT SUBSITE ELECTRONICS:

SUBSITE® ELECTRONICS
subsite.com

Subsite® Electronics provides underground construction professionals a comprehensive suite of electronic products, including utility locators, Horizontal Directional Drilling (HDD) guidance equipment, utility inspection systems, and equipment machine controls. Subsite has established itself as a premier source of electronic technology supporting the installation, maintenance and inspection of underground pipe and cable.

> *"Why not use all your resources on hard jobs?"*
>
> - KJ Woody, President, Atlas Group

Despite Atlas Group's excellent performance record, KJ and Kyler agreed they still come away from every job knowing something more.

"The best advice we have to give is, why not use all your resources on hard jobs?" KJ said. "Everyone gains from each locating experience. Maybe it's not something we use on the next job, but it adds to our expertise."

Emergency in El Paso:

Trenchless Toolbox Used In Urgent Force Main Replacement

By: Jackson Adelman, Southland Holdings
Doug Jenkins, Jacobs Engineering Group Inc.
Carl Pitzer, Thompson Pipe Group

After four major leak repairs to the Frontera Force Main in three years, the El Paso Water (EPWater) declared a state of emergency and began searching for a new permanent solution. This solution required the existing Frontera Force Main to either be rehabilitated, replaced, or a combination of both. To overcome the state of emergency, EPWater contracted with Oscar Renda Contracting (ORC) and hired Jacobs Engineering Group Inc. (Jacobs) as consulting engineer and construction manager, respectively. EPWater and Brierley Associates Corporation (Brierley) served as the engineers of record. During the preconstruction and design phase the team identified key issues:

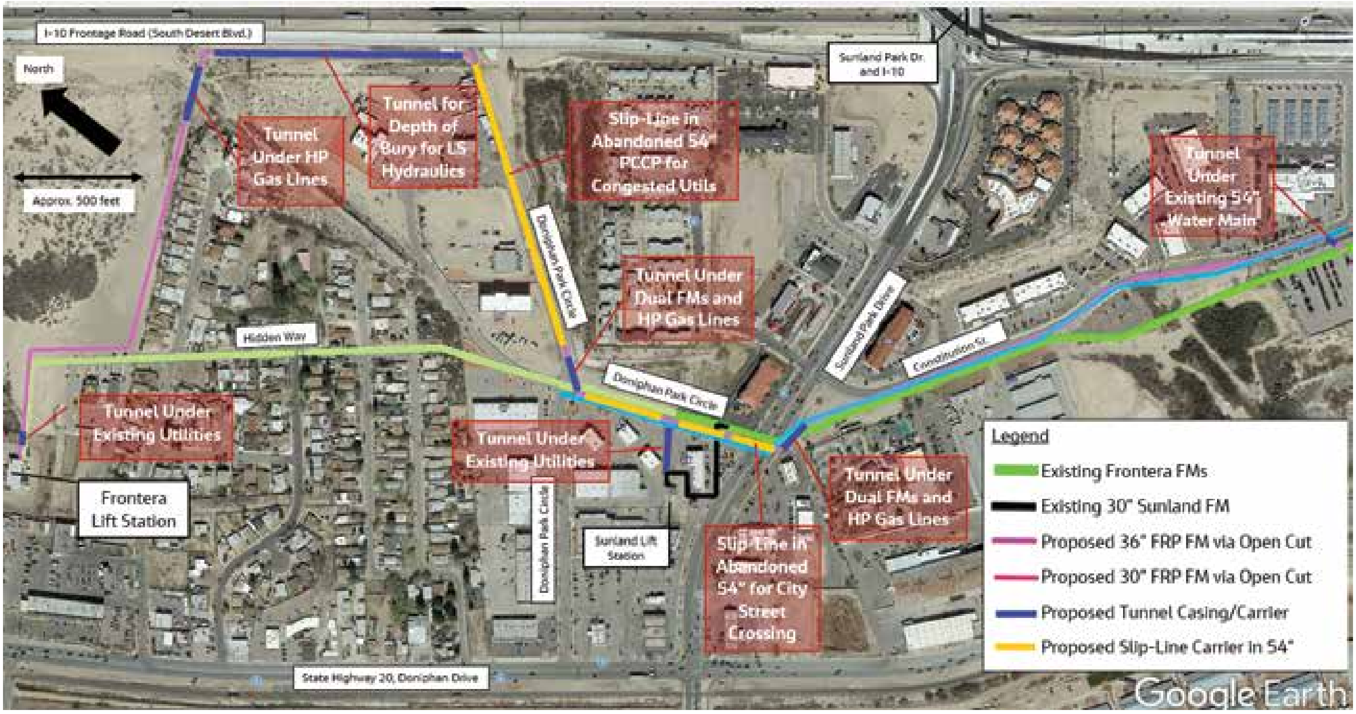
- rights-of-way versus easements versus existing utilities
- pipe material
- hydraulic constraints based on the existing Frontera Lift Station

The team began exploring different trenchless installation technologies and the potential reuse of an abandoned 54-inch diameter prestressed concrete cylinder pipe (PCCP).

The existing Frontera Force Main is a nearly 30 year old dual steel line that includes 30, 36, and 42-inch diameters. The pipeline is approximately three-and-a-half miles long and begins at the Frontera Lift Station and terminates at the John T. Hickerson Water Reclamation Facility. Based on system hydraulics the team decided the first 7,200 LF should be replaced with 36-inch diameter pipe. Engineers selected fiberglass reinforced pipe (FRP), manufactured by Thompson Pipe Group, because of its high resistance to domestic sewer and soils normally encountered in pipeline installations. EPWater requested the new 36-inch diameter FRP be fully restrained.

Laminated butt-wrap restrained joint

Contractors used two restraint methods; the



Location of tunneling and sliplining sections

36-inch TPG FRP sliplines the abandoned waterline

keylock restrained joint and a fiberglass layup known as a butt wrap. Contractors mechanically installed the keylock joint by inserting a nylon lock rod into grooves between the pipe spigot and coupling.

For the remainder of the line, Jacobs, Brierley, and ORC analyzed the alignment and planned the installation. The team performed an extensive nine-month utility investigation and determined the project required multiple trenchless and open cut installations. Furthermore the investigation uncovered a live 54-inch diameter water main near the 36-inch installation route.

To ensure the abandoned 54-inch diameter water line was structurally sound to be used as the host pipe for the sliplining process Oscar Renda hired Ground Penetrating Radar Systems Inc. (GPRS) to perform a condition assessment and survey of the line. The condition assessment of the 54-inch diameter abandoned water line produced CCTV video, grades, and elevations. The condition assessment and survey determined how much of the abandoned waterline could be slip lined.

ORC determined that sliplining the abandoned 54-inch waterline would eliminate digging up the street. and encase the sewer force main in concrete down Doniphan Park Circle per the El Paso Standard Details while also reducing the risk of disturbing the live 54-inch Waterline. Once contractors completed slipling the new 36-inch diameter pipe, they filled the annular space with grout.

Sliplining the abandoned waterline with 36-inch TPG FRP and the keylock restrained joint

Photo of the FRP force main carrier pipe in the J&B casing under the 54-inch existing watermain

Utilizing additional trenchless methods reduced project costs and above-ground impact.

One such location was at the intersection of Doniphan Park & Doniphan Park where gas lines and a pair of 30-inch force mains intersect. Slip lining through the abandoned waterline eliminated the painstaking job of excavating around the existing utilities and reduced risk of disturbing those lines and dealing with the associated fallout.

Two hand tunnels were planned totaling 1042 LF. The reasoning for these two tunnels were to get underneath the Kinder Morgan

Hand Tunneling

Gas Lines and avoid having to remove and replace the abandoned 54-inch water line. Remove and replace in this area would have been extremely difficult with the overhead powerlines, a live 54-inch water line, and extreme grade/elevation changes.

Along the I-10 Corridor a 705 LF tunnel was planned. Because of hydraulic head limitations of the Frontera lift Station and the high ground elevation of the I-10 Corridor the depth of the new force main is approximately 40 feet. This tunnel will be dug by hand and supported with tunnel liner plate to produce a 60-inch diameter tunnel to host the 36-inch FRP force main. Hand tunneling was the selected method of installation because of the overall length, soil conditions, and the accuracy that is needed. The FRP force main will be installed by a combination of jacking the pipe and pulling it in place. After the pipe is in its final location the annular space will be grouted.

The 750 LF hand tunnel is not the only tunnel on the project. A 300 LF hand tunnel as well as two auger bores will be utilized to finish the work.

The biggest challenges have been dealing with the unknown. The discovery of the active 54-inch diameter live water line led

30-foot diameter hand tunneling shaft

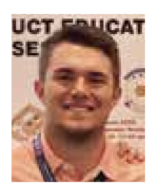
the team to completely change the auger bore approach. The inaccurate record drawings of the existing force main led to many field adjustments to the pipe which was manufactured to the line drawings. Crews field fit and adjusted connections, cut the fiberglass pipe and used laminate butt wrap joints.

Pipelines which require rehabilitation are more congested, technical, and challenging than ever before. It is important to know the various tools in the trenchless tool box. The Frontera force main project is a great example of all parties working together, utilizing the trenchless toolbox to facilitate rehabilitation in the most economical and least impactful approach.

ABOUT THE AUTHORS:

Carl Pitzer *graduated with a bachelor of science in construction engineering from Oregon State University. After graduating he worked for Kiewit Infrastructure West on the SR520 Floating Bridge in Seattle, Washington as the structures field engineer. In 2015 he left the bridge world for pipes and started with Thompson Pipe Group. He is currently located in DFW, TX and manages Thompson Pipe Group's trenchless focus in North America.*

Doug Jenkins, PE *is a Conveyance Principal Technologist for Jacobs. Mr. Jenkins has extensive experience serving in a variety of leadership roles – senior technical lead, QA/QC support, project manager, program engineer, task lead, lead project engineer, and resident engineer--on conveyance and wastewater facility projects. His areas of expertise are in many conveyance techniques such as pressure pipe design, gravity pipe design, pipeline condition assessment, rehabilitation, pipe materials, and construction. Doug holds a Bachelor of Science and Master of Engineering degree in Civil Engineering from Old Dominion University.*



Jackson Adelman *has been a Project Engineer for Oscar Renda Contracting for two years. He is currently involved in managing multiple water/wastewater pipeline projects throughout the southwest region. Jackson received his Bachelor of Science degree in Construction Engineering from Oklahoma State University.*

The "SOONER" The Better

Oklahoma City Pressure Pipe Inspection and Condition Assessment: *Witcher Force Main Case Study*

By: Jerry Trevino, Mechanical Jobbers Marketing, Inc.

The day after Independence Day, I found myself surrounded and outnumbered at the Atlanta Airport gate by a sea of Oklahoma University (OU) fans while they were waiting for a plane to return them to Oklahoma City. Toddlers to older generations alike, they wore all kinds of red logo OU clothing, packpacks, cell phone protectors, face masks and other contraptions and gadgets bearing the red OU logo. I believe I was probably the only one out of several hundred people at the gate with a University of Texas Longhorn emblem on by back pack. I knew for sure I was heading to my alma mater's college football rivalry territory, Oklahoma City - OU Country!

As being the third person to board the plane, I was sure some were questioning my reasoning and logic for going to Sooner Boomer land with a Burnt Orange Longhorn back pack. As soon as I sat on the plane, my thoughts immediately changed to focus on the task at hand. To review the proposed project plan, maps, drawings and known data of the pressure pipes and to rethink all the possible risks involved in the upcoming project the following day. I tried to imagine all the ways possible to prevent and reduce the risks of failure. While I was flying, my crew was taking the long drive from Atlanta to OKC with vital equipment needed to launch/insert, and then capture and retrieve, precious little ball shaped "Pipers" tools needed to perform a pressure pipe condition assessment project.

Oklahoma City Water Utility Trust (OCWUT) issued a purchase order to Mechanical Jobbers Marketing a few weeks earlier to perform the insertion and capturing these relatively very small balls when compared to the very large diameter forced main sewer transmission lines with a transport capacity of up to 75 millions of gallons of sewage per day.

OKLAHOMA CITY

Oklahoma City, Oklahoma the Capitol of the State has a population of over 638,000 people, covers an area of 620 square miles. It is the 8th largest land base city in the United States.

GENERAL

Infrastructure becomes more critical and more essential when it personally affects you as when it suddenly fails. We really do not pay too much attention to all the roads, bridges as we are driving on them or pay attention to water and sewer lines and other utilities until they are suddenly and without warning shut down. The Texas 2021 freeze in February is a painful reminder of the criticality of infrastructure. Unfortunately people died in that event. It also affected its surrounding states and Mexico. Therefore, it is essential that municipalities start inspecting and assessing the condition of infrastructure "the sooner the better." The assessments will provide important data to help prioritize maintenance work and design the required upgrades on a planned basis versus an unplanned shutdown. This will save taxpayers funds and in some cases save lives.

SITE VISIT

A couple of months before, we had done a site visit to evaluate the insertion/launch site at the Witcher plant, and to evaluate and select the possible extraction manholes and underground chambers that were located a few miles away from the plant. We met with the OKC manager of the Line Maintenance Department, and during lunch when we were inquiring about other potential and future work in OKC, it was made very clear to us with a statement that is etched in my brain to the effect that "there would be no other potential future work if we were not successful in catching these balls." So in my mind we had to develop a mindset of "Failure Is Not An Option". Although this was not the Apollo 13 mission, which also involved launching and retrieval, it was just as important to me, my field crew, and to the many other personnel and stakeholders involved.

There was a recent history of a similarly funded project where others had very recently failed to catch any of the similar free flowing balls. Therefore, no data was collected nor any deliverable data was issued to OCWUT after a great expense. So I had a lot of mental pressure to succeed.

Joe Wells of PICA had previous contact with OKC regarding this project and helped with its conception and coordination. The date and project schedule was established before anyone knew OKC was to experience a 12- to 14-inch rain event just the week before the extraction project. Hurricane Elsa was also moving through Cuba towards Florida and Georgia creating some concern back home. While one carefully creates plans on how to execute a project, these sometimes change due to further evaluation and because of other circumstances, such as weather.

Therefore we had to quickly make several last minute changes to the plan. The change in plans involved a change in scope of work. We had previously reached out to CPM, another PICA contractor, for support in this project, in which they had agreed to do, however, the combination of the downpour of rain, and because the change in scope of work, we decided to perform the work ourselves. I had originally planned one permit required for confined space entry, and changed that to two entries on two different structures at the same time in an effort to reduce the risk of losing the smart balls, due to higher flows. Also, due to the rain event we could not park large heavy equipment immediately adjacent to the extraction sites as we had planned, such as a vac truck and other support equipment.

There were two possible extraction structures we selected. One was a huge underground piano shaped chamber 30 feet by 20 feet with an 8-foot high ceilings buried 5 to 8 feet underground. This chamber had a flat bottom without any flow channels. It had two force mains feeding it, a 42-inch and a 36-inch with a 72-inch exit pipe. The other was a 16-foot deep manhole with a 72-inch entry and exit sized pipe. We did not know before the project started the extent of the solids built up in the large chamber. As in most projects, there are many unknowns and one has to attempt to reduce the unknowns and to reduce the potentials for failure. We were prepared to do some shoveling if we had to since the vac truck would not have access.

CASE STUDY

The Oklahoma City Water Utilities Trust took a proactive approach to managing a critical buried asset by requesting a contractors to provide data on the live force mains. The Witcher Force Main is the largest sewer force main in Oklahoma City sewer collection system. It consists of two twin lines, one is 36 inches in diameter and the second one is 42-inch diameter ductile iron pipe. The two twin parallel lines are each over 8000 feet long. The pump station has the capability of pumping 75 MGD.

Based on the location there is a concern with respect to corrosive soils, age, and wear and tear on the twin lines. OCWUT recognized the need to know and understand the internal and external condition in effort to prolong the life of this asset.

Based on its importance, previous repairs and a need-to-know mindset, OCWUT made the decision to assess the condition of these twin lines using the “Ingu Piper” tools provided by PICA to identify any leaks, gas pockets, and debris build up. After identifying areas of concern, the PICA Bracelet Probe, which utilizes a high-resolution pulse eddy current technology for measuring loss in wall thickness, will likely be used in validation of the this condition. The Remaining Useful life (RUL) of the pipe will be calculated based on the operating conditions, surge pressures and other factors. All verified areas of concern will then be scheduled for repairs or replacements of these sections of the sewer lines. This will result in savings to OCWUT and the citizens of Oklahoma City by preventing future pipe breaks and failures.

TEAM WORK TO REACH A COMMON GOAL

To execute this project successfully, it took the planning and collaboration of numerous stakeholders working together to achieve a common goal. The Witcher pump station is operated by the management company Inframark on behalf of OCWUT. Inframark met the City’s criteria and expectations, improved

> *I believe I was probably the only one out of several hundred people at the gate with a University of Texas Longhorn emblem!*

performance efficiency including strict adherence to compliance regulations, protection and preservation of the facility. It helps maximizing operational efficiencies and minimizing energy consumption including odor management, improved public and employee health and safety guidelines along with improved biosolids disposal processes. Inframark managed the sewer pumps flow rates, pressures, volumes and flow velocity as recommended by Ingu engineers and scientists within the parameters of the Piper ball operational conditions to acquire data. OCWUT Line Maintenance and their manager were present to provide assistance as needed. The City’s crews are well trained and provided unprecedented level of expertise and provided a “can do” attitude towards this project and were present and available from start to finish. Mechanical Jobbers Marketing / PICA provided the tools, technology, technicians, the operational plan, and the custom-designed smart ball catching mechanism in order to successfully execute a safe insertion and extraction process.

All was executed by establishing proper communications of the plan via various Zoom phone calls, on site meetings, and constant communications throughout the project. The successful completion of this project demonstrates that regardless of your sport team affiliations we all can work together to reach common goals.

PRE-PROJECT PLANNING & EXECUTION

OCWUT Line Maintenance provided 4-inch valves on each of the twin lines to

> *It is essential that municipalities start inspecting and assessing the condition of infrastructure "the sooner the better."*

facilitate the insertion process. We first selected to insert the "Pipers" balls in the larger 42-inch diameter force main. OCWUT assisted first by dewatering the rain water flooded insertion pit OCWUT personnel assisted MJM and Joe Wells of PICA with the insertions. 3 different "PIPERS" balls

were inserted in each of the two twin lines. Each was inserted at 20-minute intervals. Inframark controlled the pumps to achieve 12,000 GPM to provide optimal velocity for the "Pipers." Mechanical Jobbers Marketing crews cleaned and prepared the extraction structures and installed the screening device to facilitate catching the "Pipers. The balls arrived at the expected times on the 42-inch forced main.

We all took a lunch break and called in a local food truck to bring in Mexican cuisine before starting to work on the second force main line. The second pipe insertion took place. Once again all crews and interested stakeholders worked together to successfully insert and retrieve all of the inserted "Pipers." All six "Pipers" will recovered after a very long and hot day.

NEXT STEPS

Oklahoma City Water Utilities Trust will receive the deliverables in approximately 3 weeks from the completion of the field work. This information will provide data for OKC managers and engineers needed to mitigate catastrophic pipe bursts and unexpected service interruptions to tens of thousands of taxpayers. As per Dave Russell's quote "Good Decisions Start with Good Information." The data provided and interpreted by Ingu will indicate potential pipe sections which may require additional pipe wall thickness validations. PICA has additional high resolution tools to assess suspect pipe sections.

ABOUT THE AUTHOR:

***Jerry Trevino** is President of Protective Liner Systems, Inc. and sister company Mechanical Jobbers Marketing Inc., specializing in infrastructure rehabilitation since 1984. As longtime Chair of the NASTT Southeast Chapter, Jerry strongly believes that trenchless and condition assessment technologies offer numerous methods to maintain and upgrade aging infrastructure.*

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