NORTHEAST REGIONAL CHAPTER

NORTHEAST JOURNAL
OF TRENCHLESS TECHNOLOGY PRACTICES

2021 FALL EDITION

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MESSAGE FROM NASTT-NE CHAIR

Babs Marquis, CCM, NASTT-NE Chair

We are delighted in welcoming the fall and change in season as we welcome our members and readers to OUR Fall 2021 edition of the NASTT Northeast Regional Chapter's ***Journal of Trenchless Technology Practices***. It has been a great year given where we were about the same time last year. The Northeast Regional chapter embarked on a forward-looking agenda by staying the course in keeping the chapter engaged, offered and presented a chapter sponsored webinar in lieu of our annual event last year, continued with our twice yearly journal publication and the board members continued to meet monthly planning and forging ahead relentlessly on advancing the Chapter's mission. We are slowly returning to a new normal with increasing vaccination and travel restrictions being lifted, we can now safely get together for conferences, network, socialize and start to put the pandemic behind us in concert with CDC recommended health and safety practices.

This year, NASTT No-Dig show returned in March in person in Orlando, FL with great attendance, No-Dig North follows the week of November 8 and the Northeast chapter will close out the year with our annul regional conference at the historic West Point Military Academy in NY. A big thank you to our board and regional chapter members for staying the course and continuing to support our mission. Continuing with the Spring message – "The future is looking bright" and we are looking forward to a great event this year as we set the stage to return to the elegant Portland Sheraton at Sable Oaks, Portland Maine in 2022 for the event we missed in 2020.

The Chapter awarded four scholarships to deserving student members of the UMass Lowell NASTT Student Chapter last year during our virtual webinar. We plan to expand the scholarship program and work to attract and enlist more student chapters from colleges and universities from each state within our region. You are invited to join, volunteer and partner with the chapter board of directors to make this a reality. In addition, we continue to solicit input from our regional trenchless practitioners to get involved and support our student chapter as guest speakers, coordinate and invite student to visit active trenchless project sites as we see this as a forward-looking investment in the future of our industry.

Conducting the business of this chapter (especially hosting our annual conferences, providing content for publication of this journal as well sponsorship for our student chapter scholarship) would not be possible without the generous support of our sponsors and vendors. We extend our sincere gratitude for your continued support, participation, and investment to sustain the chapter.

On a happier note, this will be my last message as the Chair for Northeast chapter, it has been a wonderful experience and a great honor to have been the one to steer the chapter through the pandemic. This was only possible because of the dedicated board members who are fully committed to the success of the chapter and NASTT society. Together we can go farther and do great things for a brighter future each year.

I hope the time you spend reviewing the articles and information in this edition of the Journal will encourage you to get involved in the chapter, perhaps with an article or advertisement for the next Journal, or a presentation at the 2022 Conference in Portland, Maine. The Northeast Chapter is a strong voice for trenchless in the region, and we need your support to ensure the Chapter's continued success and growth in its mission, membership, and student chapter outreach.

> ***"WE CONTINUE OUR WORK TOWARDS A BRIGHTER FUTURE!"***

Saving the best news for last – **2024 NASTT No-Dig Show is coming to Providence, RI**. The Northeast chapter will be hosting its first ever No-Dig Show. We need all hands and states (MA, NH, CT, ME, VT, NY and RI) on deck to make this the greatest show ever.

Thank you to all our members for getting involved and sharing ideas that contributed to the NASTT-NE Chapter getting through the pandemic and let us continue to be the engine that drive change because change is inevitable.

In closing, I say thanks to our current Executive Committee, and Board of Directors for your support, time, and dedication as I wish the chapter great success.

Stay healthy, stay safe as we continue our work towards a brighter future for the NASTT and regional chapters.

Babs Marquis

Babs Marquis, CCM
Chair, NASTT-NE
McMillen Jacobs Associates

MESSAGE FROM NASTT CHAIR

Alan Goodman, NASTT Chair

Our Chapter Members and Volunteers are Crucial to our Society

Hello Northeast Chapter Members. The trenchless industry grows stronger every year. Even in the pandemic our membership and regional chapters are moving forward to educate the public. It's amazing when you look back at what we have done in 2021. We had an in-person and virtual No-Dig Conference in Orlando this past March, leading the industry in safely meeting face to face once again. Our Regional Chapters are holding their fall conferences and networking events all over North America. And, of course, November 15-16 is the Northeast Chapter Trenchless Conference in West Point, NY!

We are so excited that the Northeast Conference is back again this year. It is a must-attend event for underground infrastructure professionals. The show consists of a full day of technical paper presentations and industry exhibits in the trenchless technology field. There are also multiple networking opportunities to see those industry colleagues you've missed over the last two years and make new connections as well. The value of networking with NASTT members and industry folks is truly priceless. Our members and volunteers are innovative and creative thinkers, always looking for ways to improve technology and infrastructure and protect our environment.

"WE ARE A RESILIENT INDUSTRY!"

NASTT's mission and vision are "to continuously improve infrastructure management through trenchless technology" and "to be the premier resource for knowledge, education, and training in trenchless technology." With education as our goal and striving to provide valuable, accessible learning tools to our community, one of the things of which we are most proud at NASTT is that even during uncertainty we have been able to grow. Recently, we welcomed our latest Regional Chapter to the NASTT family and completed our representation of the entirety of North America. NASTT is so excited to announce that we now have our first chapter in Mexico!

Looking ahead, we are currently planning the NASTT 2022 No-Dig Show to be held in Minneapolis, Minnesota, April 10-14 next spring. We are anticipating over 2,000 attendees and over 200 exhibitors. There are many new features we plan to roll out including enhanced educational forums, more networking opportunities and expanded exhibit hall time. Our industry is constantly growing in innovative ways and the No-Dig Show is a representative of our industry. We are excited to bring new value and educational experiences to you in April. Visit nodigshow.com for all the latest details and to register or exhibit today.

Another exciting development is the recent decision to host the 2024 No-Dig Show in Providence, RI! The Northeast region of the United States is great location to host our flagship conference and bring together industry professionals from all over North America. As one of our most active Regional Chapters, we're looking forward to being in this Northeast hub for the conference.

For more information on our organization, committees, and member benefits, visit our website at nastt.org and please feel free to contact us at info@nastt.org.

We look forward to seeing you at a regional or national conference or training event soon!

Alan Goodman

Alan Goodman,
NASTT Chair

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NASTT-NE BOARD 2022-2023

ERIC SCHULER – CHAIR

Eric Schuler is the Director of Engineering for a public water authority serving 16 municipalities in Central New York. As a Department Head he oversees all of Engineering, Distribution, and Maintenance Operations for MVWA. Mr. Schuler has over 10 years of experience as in both the private and public sectors. He earned his Bachelor of Science in Civil Engineering degree from Clarkson University in Potsdam, NY and has primarily been involved in wastewater, drinking water, civil-site, and stormwater sectors. Eric is a licensed Professional Engineer in New York whose design, project management, and construction-related experiences have helped successfully execute many "trenchless"-focused projects.

Early in his engineering career he gained exposure to various trenchless technologies through utility evaluations and development of utility project design alternatives. He immediately started to envision great opportunities for communities plagued by utility deficiencies and construction constraints to utilize CIPP, HDD, among other trenchless technologies; and for them to be able to benefit from both social and economic perspectives. Eric has also stressed the importance for municipalities to incorporate asset management into utility system evaluations and system rehabilitation designs in order to aid development of capital projects and to determine the most suitable trenchless applications for implementation.

In addition to NASTT-NE, Eric is also a Board Member for the Central New York Branch of the American Public Works Association (APWA), a Director of the Central New York Water Works Conference (CNYWCC), and is active with the New York State American Water Works Association (NYAWWA). Eric continues to push for growth of trenchless technologies in upstate-New York and has trained utility owners on the use of hydraulic modeling methods for proper development of utility rehabilitation project design. He is an advocate for educating (designers & installers) of trenchless applications through proper training and increased accessibility of industry standards/guidelines to ensure successful project design and execution. The successful use and increased awareness of modern-day trenchless technologies that incorporate innovative equipment and materials are what Eric believes will continue to shape and drive the direction of the utility industry for the coming decades.

JONATHAN KUNAY – VICE CHAIR

Jonathan Kunay, P.E., PMP is a Principal Engineer and the global Conveyance Market Discipline Leader for CDM Smith in Boston, MA. He has 18 years of experience working as a design engineer and project manager on a variety of trenchless projects including infrastructure assessment with traditional and state-of-the-art investigative techniques, rehabilitation using CIPP, HDD and pipe bursting, facilities planning and master planning, leak detection of water distribution systems, enterprise asset management and risk/criticality studies.

While trenchless technologies have been his primary focus over the past 15 years, he also has worked on civil site design for commercial developments and municipalities, navigated Consent Order driven long-term programs, designed new pumping stations and developed alternatives for sewer separation projects. Jonathan is based in New England; however, his diverse project experience has brought him many places to experience unique perspectives in the trenchless marketplace. He has worked on trenchless projects all over the United States including California, Texas, Illinois, Tennessee, Louisiana, South Carolina, Nebraska, Virginia, Florida and Georgia. He has also implemented trenchless projects and programs internationally in the Middle East, China, South America, the Pacific Islands and Europe.

Jonathan was the project manager and design engineer responsible for helping to bring service lateral lining into the New England market in 2008 as part of a comprehensive sewer system rehabilitation program. This comprehensive model has now been adopted across the country as a proven methodology by which infiltration and inflow can be removed in large quantities from the sewer collection system. This comprehensive approach has been presented at conferences to showcase the validity of utilizing a holistic trenchless methodology when large percentages of I/I by volume must be eliminated.

Jonathan has a Bachelor of Civil Engineering and a Minor in Environmental Engineering from the University of Cincinnati, is certified in NASSCO's Pipeline Assessment and Certification Program (PACP), Manhole Assessment and Certification Program (MACP), and Lateral Assessment and Certification Program (LACP), and is involved in multiple committees in the National Association of Sewer Service Companies (NASSCO).

EXECUTIVE COMMITTEE

CHARLES TRIPP – TREASURER

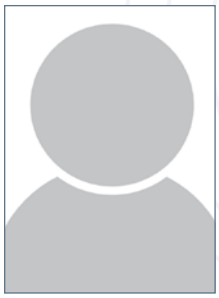
Charles Tripp, P.E. is a Project Manager and has 15 years of experience working as a design engineer and project manager on a variety of trenchless projects including condition assessment, rehabilitation, risk modeling, and general asset management. His varied design experience also includes collection systems design and peer review, wastewater treatment, water resources, and site-civil design to improve municipal infrastructure.

Charles was first introduced to trenchless technologies through his involvement in multiple sanitary sewer rehabilitation projects starting early in his career. He also briefly served as a Field Engineer for a world-leading CIPP construction company. This experience has provided a wealth of exposure, and instilled a desire to pursue and advocate for the use of trenchless technologies in projects as a way of mitigating the impacts of excavation in urbanized areas, but also as a means of cost-effective design.

Charles studied Civil Engineering at the University of Massachusetts Amherst earning his B.S. and went on to receive his M.S. in Environmental Engineering from the Worcester Polytechnic Institute. He is a licensed professional engineer in Massachusetts, New Hampshire, Rhode Island, and New York, and is also PACP/MACP certified by NASSCO.

As Treasurer for the Northeast Chapter of NASTT, Charles continues to capitalize on his devotion to trenchless technologies and in advocating for its use in the local construction market. He will look apply his experience to the effective management and administration of fiscal matters of the organization.

SECRETARY – POSITION VACANT



TBD at NASTT-NE Conference November 16, 2021.

BABS MARQUIS – PAST CHAIR

Babs Marquis is presently the Trenchless Practice lead for the East Coast and Construction Manager with the Burlington, Mass., office of McMillen Jacobs Associates. He previously worked for Jacobs Engineering Group for 10 years and Stone & Webster for 11 years. During his extensive career in the trenchless industry, Babs has been involved in major tunneling and trenchless projects in the Northeast for clients such as the Massachusetts Water Resources Authority, Boston Water & Sewer Commission, the Metropolitan District Commission (Hartford, CT), Narragansett Bay Commission (Providence, RI), NYC Dept. of Design & Construction, NYC Dept. of Environmental Protection and continuing his work on a recently awarded New York State Department of Environmental Conservation/Nassau County Design-build Bay Park Conveyance Project in Long Island, NY.

For the past 25 years, he has focused on underground construction management for tunnels and conveyance including water and wastewater pipeline design and construction projects, with emphasis on trenchless construction methods. He has worked on various pipeline projects utilizing microtunneling, pipe jacking, horizontal auger bore, pipe bursting and other pipeline renewal methods.

Babs views the NASTT-NE Regional Chapter as an important vehicle to promoting greater awareness and understanding of trenchless applications at the local level. He sees the level of interest and confidence in trenchless technology growing among owner groups based on the successful completion of many high profile projects across the Northeast. Drawn to the varied unique and innovative aspects of trenchless technology, Babs believes access to ongoing education is key to even greater owner acceptance and NASTT-NE Chapter is a key component towards achieving this acceptance by making information available at the grassroots level as well as attracting student chapters from the region and a robust local participation in the Chapter activities throughout the region.

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CDM Smith
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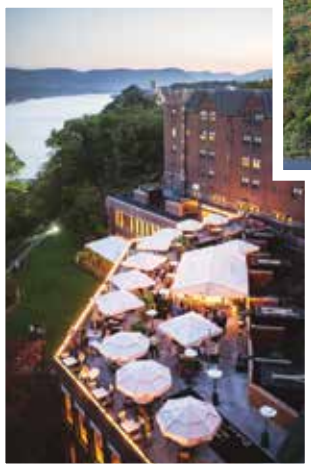

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Evening Social (11-15-2021) @ The Thayer Hotel. 5:30PM-7:30PM		
NASTT Northeast Chapter Technical Sessions (11-16-2021)		
Time	**Presentation**	**Presentation**
7:30 AM	**Registration Desk Opens**	
7:30-8:15	**Breakfast and Networking - Vendor Area Open**	
8:15-8:45	**Opening remarks - NASTT-NE Chair, NASTT Executive Director, UMASS Lowell**	
	AM Track 1 - Gas, Power, Telecommunications	**AM Track 2 - Sanitary/Storm Sewer Evaluation/Rehabilitation**
9:00am-9:25am	Trenchless Challenges, Successes and Lessons Learned: National Grid's Upstate NY 2020 Construction Season	Trenchless Technologies In Tidal/Beach Environments
9:30am-9:55am	Formidable Pipe Geometry Overcome with First-Ever Breakthrough Innovations	Design and Installation Considerations using a Flexible Fabric Reinforced Lining Solution in Force Mains
9:55am-10:35am	**Break - Vendor Time**	
10:35am-11:00am	Trenchless – Evolving With the Times	Structural Rehabilitation of Aging Sewer Interceptors in Queens, NY utilizing Geopolymer
11:05am-11:55pm	Outdoor Trenchless Demonstrations: Pipe Rehabilitation & Pipe Bursting	
12:00pm-1:00pm	**Lunch** **Keynote Speaker - Andrew Fera, Project Director (NYSDEC)**	
1:00pm-1:25pm	**Break - Vendor Time**	
	PM Track 1 - Pipe Busting/Ramming, HDD, Geotechnical	**PM Track 2 - Domestic Water & Sanitary Sewer Evaluation/Rehabilitation**
1:30pm-1:55pm	Trenchless Methods to Facilitate Box Tunnel Installation - Connecting the Empire State Trail	Condition Assessment in Brockton's Twin 24-inch Transmission Mains
2:00pm-2:25pm	Middlebury Vermont Pipe Bursting	CIPP Lining of 42-inch Force Main, Stamford CT
2:30pm-2:55pm	Broadway Railroad Xing – Trenchless Direct Jack	Emergent Rehabilitation of a Critically Deteriorated Force Main using the IDB Approach
3:00pm-3:55pm	Technology Innovations for the Project Lifecyle	SIPP - A Proven Trenchless Technology
3:55pm-4:10pm	**Closing remarks - NASTT-NE Chair and Vice Chair**	

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KEYNOTE SPEAKER

Andrew Fera is a Professional Engineer with the New York State Department of Environmental Conservation (NYSDEC), and is currently Project Director of the Bay Park Conveyance Project. The Bay Park Conveyance Project is the NYSDEC's first design-build project which, when complete, will redirect up to 75MGD of treated effluent to an ocean diffuser, instead of the current outfall in an impaired water body. Andrew returned to the NYSDEC in 2019, after serving as the Design and Project Management Branch Chief of the New York State Division of Military and Naval Affairs.

SPEAKERS & PRESENTATIONS

MORNING TECHNICAL SESSIONS

PRESENTATIONS

TIME	**AM Track 1 – Gas, Power, Telecommunications**
9:00am-9:25am	Trenchless Challenges, Successes and Lessons Learned: National Grid's Upstate NY 2020 Construction Season PRESENTERS: Jesse Lubbers, Kimley-Horn; Seth Herman, National Grid
9:30am-9:55am	Formidable Pipe Geometry Overcome with First-Ever Breakthrough Innovations PRESENTER: George Ragula, RagulaTech LLC
10:35am-11:00am	Trenchless – Evolving With the Times PRESENTER: Dennis Walsh, Public Service Electric & Gas (PSE&G)
	AM Track 2 – Sanitary/Storm Sewer Evaluation/Rehabilitation
9:00am-9:25am	Trenchless Technologies In Tidal/Beach Environments PRESENTER: Bob Drake, The BETA Group
9:30am-9:55am	Design and Installation Considerations using a Flexible Fabric Reinforced Lining Solution in Force Mains PRESENTER: Regina Costa, Raedlinger Primus Line
10:35am-11:00am	Structural Rehabilitation of Aging Sewer Interceptors in Queens, NY utilizing Geopolymer PRESENTER: Ryan Graham, Vortex

AFTERNOON TECHNICAL SESSIONS

PRESENTATIONS

TIME	**PM Track 1 - Pipe Busting/Ramming, HDD, Geotechnical**
1:30pm-1:55pm	Trenchless Methods to Facilitate Box Tunnel Installation - Connecting the Empire State Trail PRESENTER: Nick Strater, PG, Brierley Associates
2:00pm-2:25pm	Middlebury Vermont Pipe Bursting PRESENTER: Tom Loyer, ECI
2:30pm-2:55pm	Broadway Railroad Xing – Trenchless Direct Jack PRESENTER: Jay Perkins, PE, Brierley Associates
3:00pm-3:55pm	Technology Innovations for the Project Lifecycle PRESENTERS: Lis Bissonnette, Kleinfelder; James Ulrich CHMM LSRP (Kleinfelder)
	PM Track 2 - Domestic Water & Sanitary Sewer Evaluation/Rehabilitation
1:30pm-1:55pm	Condition Assessment in Brockton's Twin 24-inch Transmission Mains PRESENTERS: Ian Mead, Tighe & Bond; Pat Hill, City of Brockton
2:00pm-2:25pm	CIPP Lining of 42-inch Force Main, Stamford CT PRESENTERS: Ann Brown, City of Stamford; Dennis Dievert, Wright Pierce; Steve Soldati, Aegion Corp
2:30pm-2:55pm	Emergent Rehabilitation of a Critically Deteriorated Force Main using the IDB Approach PRESENTER: Alexandra Garcia
3:00pm-3:55pm	SIPP - A Proven Trenchless Technology PRESENTER: Roger Linder PE, Suez

IN PERSON AND READY FOR ACTION!

UMass Lowell NASTT Student Chapter

By: Violet Smith, Ryan Trinh, Dr. Raj Kumar Gondle (Faculty Advisor)

After being online for three semesters due to current pandemic, students are excited to be back on campus this fall semester. Students, faculty and staff on UMass Lowell are vaccinated and committed to maintaining a low-row risk campus environment with indoor mask mandate. Several efforts are ongoing and awareness programs are being held to reduce the spread of coronavirus and keep the campus safe and healthy. While the traditional learning style looks new for students, faculty and staff are working hard and dedicated to providing a positive learning environment and outstanding educational experience to students. Several faculty have implemented hybrid teaching methods and working creatively to help and accommodate students.

In order to enhance student's hands-on learning and to improve active participation, Prof. Raj Gondle embraced a transformative teaching model by bringing RealWear Augmented Reality (AR) technology into our online/hyflex teaching. The pedagogical initiative of RealWear AR technology in conducting engineering labs was truly innovative and a first-of-a-kind way to demonstrate the best engineering practices in a remote and hybrid/hyflex learning environment. The RealWear was used during geotechnical engineering lab course as a digital transformative educational tool to capture fundamental soil tests in real-time and walkthrough every step of the experiment by keeping students engaged as they would in a physical lab.

Our student activities have fully returned to campus and recruitments to student clubs have improved tremendously after the stunted growth we had during the pandemic. Most of our student members from previous years successfully graduated and moved on to bigger and better things in their life. Some of our student leaders had interviews and were hired by the trenchless industry. Liam Henderson, past president of our student chapter, is hiking the Appalachian Trial after graduation.

Prof. Raj Kumar Gondle is bringing RealWear Augmented Reality (AR) technology into teaching

As per the constitution of the UMass Lowell's NASTT Student Chapter, new student officers were elected and actively engaged in leadership roles. This academic year, we have a diverse panel of student leaders and student members from many different classes. Since our return to campus, the student chapter held multiple recruitment events in Fall including UML ENGAGE event. Several students from different disciplines visited the NASTT table at these engagement fairs. We have many fun events planned for the upcoming school year and look forward to learning more about the industry together.

As sad as it is to see our previous officers move on, our new officers have a lot to offer. I was elected as the new President of the Student Chapter, and I am in my senior year here at UMass Lowell. Our Vice President, Jeremiah, is a junior and has shown great initiative on getting involved with leadership and helping me out whenever he can. Our Treasurer, Ryan, is a sophomore in the engineering and has taken on the very important task of organizing our finances. Finally, our Secretary, Iverson, is a freshman, part of the Class of 2025. Our officers will bring fresh ideas to the Student Chapter. With representation from every graduation year in office, they will


Prof. Raj Gondle and Prof. Edward Hajduk with Liam Henderson up in Crawford Notch

Violet Smith, our current President of the Student Chapter, representing the NASTT at UMass Lowell's ENGAGE event and other events

be able to carry on our engagement with the university and the Trenchless industry. Both Iverson and Ryan are on campus for the first time, so while learning the ropes of being club officers, they are still getting familiar with our campus.

Our secretary Ryan shares his thoughts and experiences on transitioning from being a virtual student to coming to campus full time:

"Starting my first college experience as an online student was extremely dull and unmotivating. It was difficult waking up every morning just to sit and look at a screen for 6+ hours. Although UMass Lowell tried to make virtual learning as engaging as possible, it was not fun. But coming back to UMass Lowell at full capacity was exciting. Being on campus allows many more opportunities to fully engage in the college scene. I am able to participate in sports, school events, and different clubs. I am excited to be part of the NASTT student chapter as a treasurer. It's exciting to truly see what field of study you are going into and getting a first-person perspective. As officer role of treasurer, it is my duty to oversee the club's finances so we can continue having these learning experiences."

Ryan's frustration with being an online student is understandable. Most of our students have experiences very similar to this. In fact for most students, joining the NASTT Student Chapter or other clubs on campus this year is their first time engaging in a social group within the University. During the pandemic, the Student Chapter and other clubs attended several online engagement events, but the student turnout was very low. It is hard to encourage students to be excited about the different activities we have for them to join on campus if they have never been to campus or if they do not know when in-person activities would start again. This semester, our engagement events were in person and the student turnout was amazing. We had an engagement fair outside on the soccer fields the very first week of classes and we packed the field full of new students. This was a great introduction for the Student Chapter among these new students across the campus to any major. The Civil and Environmental Engineering (CEE) department had their own engagement fair a couple of weeks later, with several dozen CEE students attending. This is where we were able to enroll the most students in the NASTT Student Chapter.

Upcoming for the student chapter this semester, we have a field site visit to witness the microtunnel and installation of a large-diameter pipe under a levee with a part of the Amtrak system. The field site visit is possible because the strong collaborations between the student chapter and the trenchless industry. Also, this will be my first in-person trenchless demonstration, as well as the first time for all students attending a field site. We haven't had many opportunities to attend events in the past year and a half, so work and studying are the only "events" that the students have to associate with campus so far. In the past, our chapter has attended many field sites and trenchless demonstrations, as well as both regional and national No-Dig Conferences. Now, as most of our previous senior members have moved on, and I have only attended the Spring 2021 Orlando No-Dig show, the chapter has many new experiences to look forward to. The Spring 2021 Orlando No-Dig show was the highlight of my junior year during the pandemic. Being able to travel and meet with industry professionals after a year of not meeting anyone new was an amazing experience. It was my first in-person encounter with Trenchless Technologies, and it was a great first impression.

Now that we have returned to campus, our spirits are up and we are more engaged than we have been in a while. Our Student Chapter has grown and so has our enthusiasm. We are ready to get busy and expand our knowledge through educational experiences and industry connections. We are very thankful for these opportunities.

ABOUT THE AUTHORS:

***Violet Smith** is a senior in Environmental Engineering program at UMass Lowell and currently serving as the new President of the Student Chapter. Previously, she served as the secretary of the NASTT Student Chapter. She is the recipient of Spring 2021's NASTT-NE Student Scholarship.*

***Ryan Trinh** is a sophomore in the engineering and has taken on the very important task of organizing our finances. He is acting as a Treasurer of the NASTT Student Chapter this year.*

***Dr. Raj K. Gondle** is an Assistant Teaching Professor in the Department of Civil and Environmental Engineering at the University of Massachusetts Lowell (UMass Lowell). He serves as a faculty advisor for the Student Chapter. He was recognized with the 2020 UMass Lowell Departmental Teaching Excellence Award and the 2017 ASCE ExCEEd teaching fellow. Dr. Gondle is genuinely committed to student learning, devoted to student clubs/chapters, and inspirational to UMass Lowell's student body with his optimistic and bold vision for student success.*

TOWN OF SWAMPSCOTT, MA, STACY'S BROOK COMPREHENSIVE SEWER REHABILITATION – LESSONS LEARNED FROM LATERAL RENEWAL

By: John Rahill & Dan Scott, Kleinfelder, Inc.

INTRODUCTION

Ocean front public recreational beaches are one of the most treasured resources. We are fortunate enough to have them in communities along the United States seaboards, and keeping them open for public use and enjoyment is critical. The urbanization of the land surrounding our beaches jeopardizes the water quality of this precious community resource. Close monitoring and active maintenance to preserve water quality is a priority by stakeholders.

Swampscott is a coastal community in Massachusetts approximately 12 miles north of downtown Boston with approximately 15,500 residents and numerous public beaches. The largest beach, King's Beach, spans across the Town's border into the neighboring City of Lynn, MA. King's Beach receives stormwater discharges from two adjacent outfalls from the Town and the City of Lynn, MA. The non-profit public interest harbor advocacy organization, Save the Harbor/Save the Bay, performs frequent water quality testing at Boston's regional beaches and King's Beach consistently has performed poorly in contrast with the other regional beaches. King's Beach six-year average safety rating from 2015-2020 was 79 percent which ranked 2nd worst among the 15 beaches monitored. The beach safety ratings are calculated as the percent of water samples that comply with the Massachusetts Department of Public Health single sample limit for bacteria, which is a basic method to evaluate seasonal beach water quality and potential impacts to public health.

In 2008 an Administrative Consent Order with Penalty (ACOP) between the United States and the Town of Swampscott was initiated resulting in targeted Illicit Discharge Detection and Elimination (IDDE) investigations and subsequent sewer replacement/rehabilitation between 2008 and 2013. Post construction water quality sampling at the Stacy's Brook Outfall showed improvement but the E.coli concentrations were still unacceptable. A Consent Decree between the United States and the Town of Swampscott was entered on November 23 2015, with the intention of identifying and eliminating non-stormwater discharges to the storm drain system, as required by the Clean Water Act (CWA), and all applicable federal and state regulations.

Figure 1: Swampscott and Lynn, MA Outfalls at King's Beach

FIELD PROGRAM

In the ensuing months, the Town utilized the IDDE approach prescribed by the United States Environmental Protection Agency (EPA) to recommend a Project Area for the first phase of a comprehensive sewer rehabilitation program designed to improve water quality within the Stacey's Brook drainage culvert and at the outfall to King's Beach. The Stacey's Brook Drainage Area, which consists of 123,000 linear feet (LF) of stormwater pipeline, was broken down into sub areas, based upon the results from the IDDE sampling. Kleinfelder determined the Phase 1 Project Area shown in Figure 2 below, to be the highest priority area contributing to the contamination of the Stacey's Brook Culvert based on the IDDE sampling results. The Phase 1 area is characterized by fairly dense residential development (many 5,000 square foot lots).

A field program for the Phase 1 Project Area was conducted consisting of closed-circuit television (CCTV) of all 54,000 linear feet of sewer mainline pipe, the smoke testing of all 28,000 LF stormwater pipeline, surface inspection

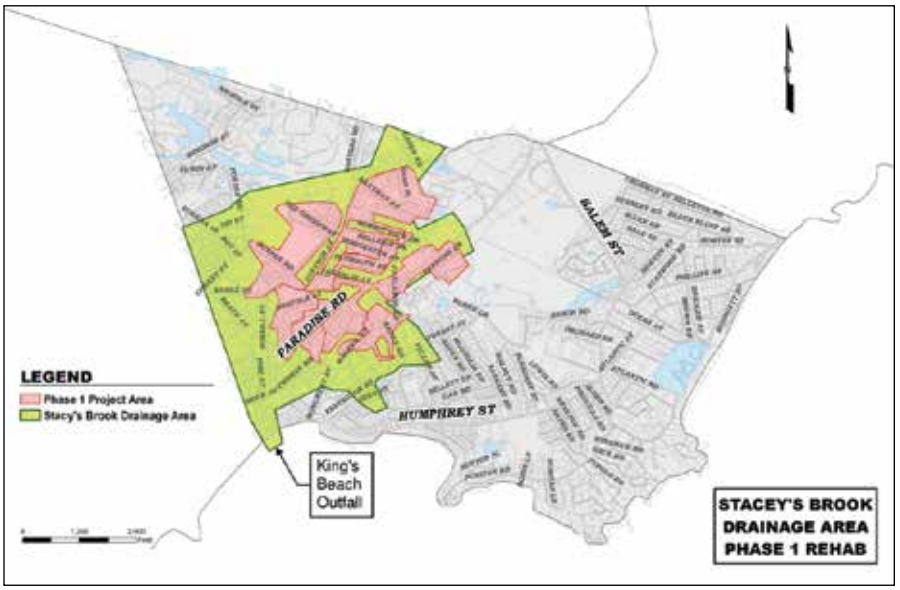

Figure 2: Stacy's Brook Drainage Area and Phase 1 Project Area Overview

of 279 sewer manholes and dye testing of the underdrain system. The CCTV of the sewer mainline pipe confirmed that collection system was comprised of predominantly 100+ year-old vitrified clay pipe (VCP) and determined that it exhibited frequent and significant structural defects, creating pathways for sewage to exfiltrate from the sewer collection system and infiltrate into the storm drain. This hypothesis was supported when the team conducted a dye-water flood test of one sewer main while simultaneously CCTV inspecting the adjacent drain. The sewer main surcharged when it was dyed and temporarily plugged. Within an hour there was green dye entering the drain manhole through joints, cracks in the pipe, and through piped connections to the drain. The dyed-water test provided evidence to support the team's hypothesis that the sewer was exfiltrating into the drain.

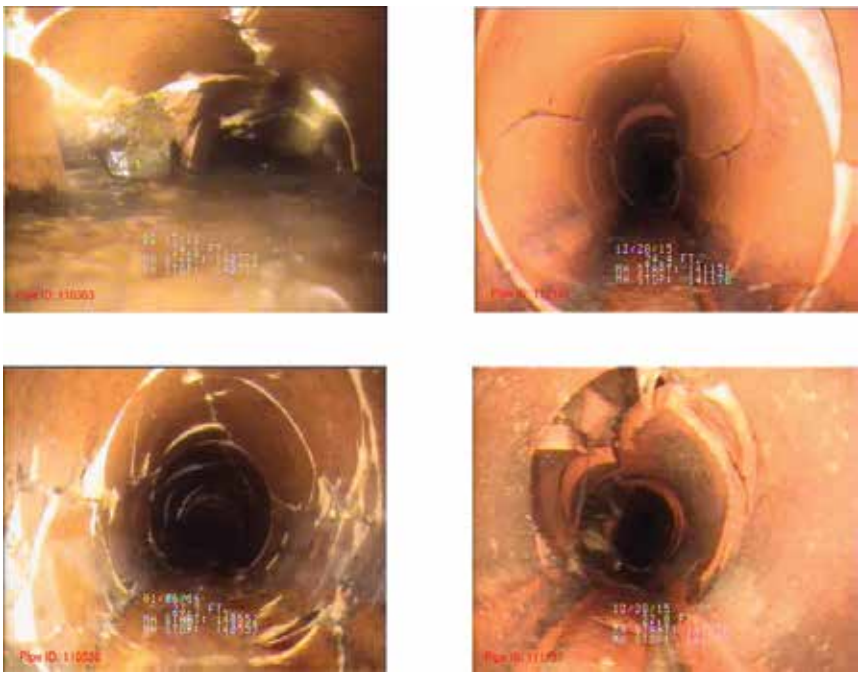

Figure 3: Severe Mainline Defects Identified in Phase 1 Project Area via CCTV

Additionally, the design team posited that, based on the CCTV data of the VCP mainlines in the Phase 1 area, the predominately VCP sewer laterals would exhibit similar structural issues, and that rehabilitating the sewer mainlines alone would not eliminate sanitary exfiltration.

The smoke testing of the stormwater system and follow up house inspections/ dye testing identified no direct illicit connections. Inspections of the manhole surfaces determined that, although they are predominantly brick, there was minimal evidence of active infiltration, and in general, the manholes were in fair condition. The dye testing of the underdrain system identified interconnectivity between the sewer collection system and the underdrain. The investigation identified locations where surcharged sewage entered the underdrain through openings in the common manhole bench or divider wall.

COMPREHENSIVE SEWER REHABILITATION DESIGN APPROACH

Based on the results of field program for the Phase 1 Project Area and record research, Kleinfelder concluded that the greatest contribution to stormwater and surface water impairment was the result of sewage exfiltrating from the sewer infrastructure and entering the storm drain, groundwater and underdrain. There are frequent instances where the sewer collection system, storm drain, and underdrain are at similar elevation and/ or in close proximity to one another in the Phase 1 Project Area. Kleinfelder and the Town recommended to US EPA to perform the renewal of all sewer mainlines and manholes, sealing of the underdrain in all common manholes and renewal of sewer laterals in close proximity to the storm drain in the Phase 1 Project Area. The comprehensive sewer rehabilitation approach has multiple benefits to the Town including renewing the 100+ year-old sewer collection system with a design life of 75+ years, and sealing the sewer to eliminate the exfiltration of sewage to the storm drain, and eliminating infiltration pathways.

Kleinfelder recommended the following renewal methodologies for the sewer/ underdrain system:

- Open cut replacement of sewer mainlines for all 6-inch diameter pipe with 8-inch diameter pipe since current standard design practice dictates the minimum gravity sewer pipe diameter should be 8 inches and reinstatement of services in a lined 6-inch pipe is typically not feasible;
- cured-in-place-pipe (CIPP) lining of all pipes greater than 6-inch in diameter with supplemental point repairs, as necessary;
- cementitious lining of all sewer manholes;
- sealing of underdrain from sewer collection system via brick bulkheads and cementitious lining;
- and CIPP lining of sewer laterals from the sewer mainline to the cast iron pipe connection at the property owner's foundation.

Kleinfelder determined that renewal of the sewer laterals in close proximity to the storm drain from the sewer mainline to the cast iron pipe connection at the property owner's foundation was the correct approach to minimize the risk of exfiltrating sewage from entering the storm drain. This determination was informed by research by the design team and conversations with the US EPA, contractors and the Town of Norwood, MA who recently completed a successful similar comprehensive sewer rehabilitation project to eliminate exfiltration.

Kleinfelder selected CIPP lining of the laterals as the preferred methodology since renewal of the entire lateral was deemed necessary to eliminate sewer exfiltration. CIPP lining the sewer lateral avoids private property access requirements aside from instances where lateral defects prohibit lining from the mainline and a spot repair is required. Open cut replacement of the entire lateral was considered, but the Town and Kleinfelder determined that the private property access and restoration required made it an undesirable approach.

Kleinfelder did not elect to perform cleaning and CCTV of the Phase 1 Project Area sewer laterals despite selecting CIPP lining from the mainline to the property owner's foundation as the preferred methodology for eliminating exfiltration from the sewer laterals. The approximately 100-year-old laterals were predominately VCP, with 3-foot pipe sections, which were assumed to be in poor structural condition with high frequencies of offset joints, root intrusion, debris accumulation and other blockages/defects which would prohibit CCTV inspection and/or be difficult to clean, resulting in high inspection/cleaning costs and incomplete information. Kleinfelder received costs in 2015 between $400 and $900 per lateral from contractors to complete light cleaning (1-2 passes of jet nozzle) and CCTV. If heavy cleaning was required, it would have been charged on an hourly basis, further increasing the cost. Additionally, pre-installation CCTV and cleaning during the construction phase would be required regardless of previous inspection information to obtain liner measurements and confirm existing conditions for proper liner installation and therefore, light cleaning and CCTV would be paid for twice.

OVERVIEW OF CONSTRUCTION PHASE

The Phase 1 comprehensive sewer rehabilitation construction began in 2017 and completion is anticipated by April 2022. The anticipated final construction quantities and costs for the project are provided in Table 1 below.

*The costs are based on the work completed to date and the anticipated costs of the remaining work in the final subphase of the project.

Item	Unit	Quantity	Estimated Cost at Substantial Completion of Construction (4/22)*
Sewer Mainline CIPP Lining (all diameters)	LF	31,110	$ 798,150.00
Sewer Mainline Replacement (8")	LF	5,900	$ 642,830.00
Mainline Spot Repairs	EA	16	$ 13,130.00
Mainline Heavy Cleaning	LF	6,610	$ 33,070.00
Lateral CIPP Lining (Avg of 60' each)	EA	460	$ 1,542,850.00
Lateral Spot Repairs	EA	110	$ 684,090.00
Lateral Heavy Cleaning	LF	7,550	$ 125,710.00
Manhole Lining	EA	250	$ 345,320.00
Underdrain Repairs/Rehabilitation	EA	65	$ 74,700.00
Other Misc. Items (Mobilization, Paving, MH F&C, Ect.)	LS	3	$ 444,600.00
TOTAL COST: $4,704,000			

Table 1: Phase 1 Project Construction Quantities and Costs

OUTCOMES OF NOT PERFORMING DESIGN PHASE CCTV AND CLEANING

There were several lessons learned that resulted from our decision to not clean and CCTV the sewer laterals in the Phase 1 Project Area, despite electing to line them from the mainline to the foundation of the home. The estimated quantities in the Phase 1 bid items for lateral heavy cleaning and spot repairs were based on input from a similar project in the Town of Norwood, MA, which completed a similar sewer lateral rehabilitation project with experienced local contractors.

Lateral heavy cleaning was included as a bid item during the Phase 1 project. An estimate of 2,250 linear feet (15 percent) of the lateral linear footage was assumed for heavy cleaning for bidding since no lateral CCTV was completed within the Phase 1 Project Area during design phase. However, during construction, significantly more heavy cleaning was required than was estimated. Overall, the total lateral heavy cleaning completed during the project was 7,550 linear feet (45 percent of total lateral linear footage).

In addition to lateral heavy cleaning, lateral spot repair quantities were difficult to estimate in the absence of lateral CCTV during design. The predominately VCP laterals were generally found to be in poor structural condition within the project area. Spot repairs were performed to repair collapsed pipes, large joint offsets, size changes, and lateral chimneys (90-degree bends at the connection to the sewer mainline). The total estimated number of lateral spot repairs in the bid was 60 (14 percent of the total laterals included in the Phase 1 Project scope), but during construction, the total number of lateral spot repairs was 110 (25 percent of the total laterals included in the Phase 1 Project scope).

Kleinfelder observed considerable geographical variability in the spot repairs required in sewer lateral of similar vintages within the Phase 1 Project Area, which demonstrated that there are a lot of factors at hand in relation to the structural condition and debris/roots accumulation in sewer laterals. In particular, we observed high rates of spot repairs required on laterals on Paradise Road, a main thoroughfare that is consistently exposed to heavy traffic and truck loading. Conditions such as age, pipe cover, material, groundwater, pipe surcharging, soil conditions, quality of construction, high-capacity loading, deferred maintenance and other contributing factors can all affect the structural deterioration of sewer laterals over time.

The difference between the lateral spot repairs completed in the Town of Swampscott and feedback we got from the Town of Norwood and local contractors, underlies the uncertainty in the structural condition of old sewer laterals.

The Town experienced unanticipated costs during construction due to the higher quantities for sewer lateral heavy cleaning and spot repairs, however, CCTV and cleaning the laterals during design would have increased the total design and construction cost and not provided much value aside from developing more accurate quantities. The CCTV inspection and light

cleaning of the 460 laterals (1 to 2 passes of the jetter nozzle) renewed as part of this project would have cost between $184,000 and $414,000 for CCTV inspection and light cleaning during design based on the pricing received from contractors. All heavy cleaning required to properly inspect the laterals would have inflated these costs higher and typically is charged at a rate of approximately $500 per crew hour.

CONCLUSIONS

In conclusion, the unique objective of this project to eliminate exfiltration via comprehensive sewer rehabilitation enabled us to evaluate the efficiency of excluding CCTV and cleaning of laterals during the design phase of the project. Our decision to not clean and CCTV the laterals resulted in lower aggregate design and construction costs in spite of the additional cleaning and spot repairs ultimately required in addition to estimated quantities.

Kleinfelder determined that excluding this step in the design process is a viable option under the circumstances of the project where sewer laterals are beyond their estimated service life and require renewal to reduce the risk of exfiltration. We recommend this approach be considered on lateral lining projects where condition assessment is not critical since it is predetermined the pipe will require renewal. Cleaning and assessment of laterals should be pursued in circumstances where the existing condition of the lateral will dictate the need for renewal and the renewal methodology.

The risk to this approach is the lack of information available to estimate the bid quantities related to lateral heavy cleaning and spot repairs. We recommend discussing this distinct risk with the client and appropriate stakeholders and ensuring the quantities included in the bid items for lateral heavy cleaning and spot repairs and the overall project contingency reflect this risk. An additional risk associated with this approach is if the awarded contractor submits a relatively high lateral heavy cleaning cost, it could potentially erode or exceed the cost savings associated with excluding lateral CCTV and cleaning of laterals during design.

Alternatively, a lateral cleaning and CCTV pilot program could be conducted in representative locations throughout the project area to calibrate the risk and reduce the uncertainty of determining the quantities for heavy cleaning and spot repairs. The localized variability we observed for required spot repairs supports the viability of a pilot program.

PHASE 1 PROJECT CLOSE OUT

After completion of the first phase of the comprehensive sewer rehabilitation program at the end of 2022, the Town will assess the water quality at King's Beach and determine if additional work is necessary. This post-construction assessment will consist of two (2) rounds of dry weather and wet weather sampling within one year from substantial completion of construction.

ABOUT THE AUTHORS:

John Rahill *holds a Bachelor of Science in Environmental Engineering from Harvard University and is an Engineer in Training. In his 3 years with the Kleinfelder water team, John has worked on a wide range of stormwater and wastewater design, construction, and planning projects in municipalities across Massachusetts.*

Dan Scott *is a Massachusetts licensed civil engineer with over 11 years of experience in the industry. As a Project Engineer and Qualified Project Manager with Kleinfelder, Dan leads complex projects involving multiple disciplines with a focus on sewer collection systems, including assessment, design, rehabilitation, I/I programs, CMOM, and risk assessment programs.*

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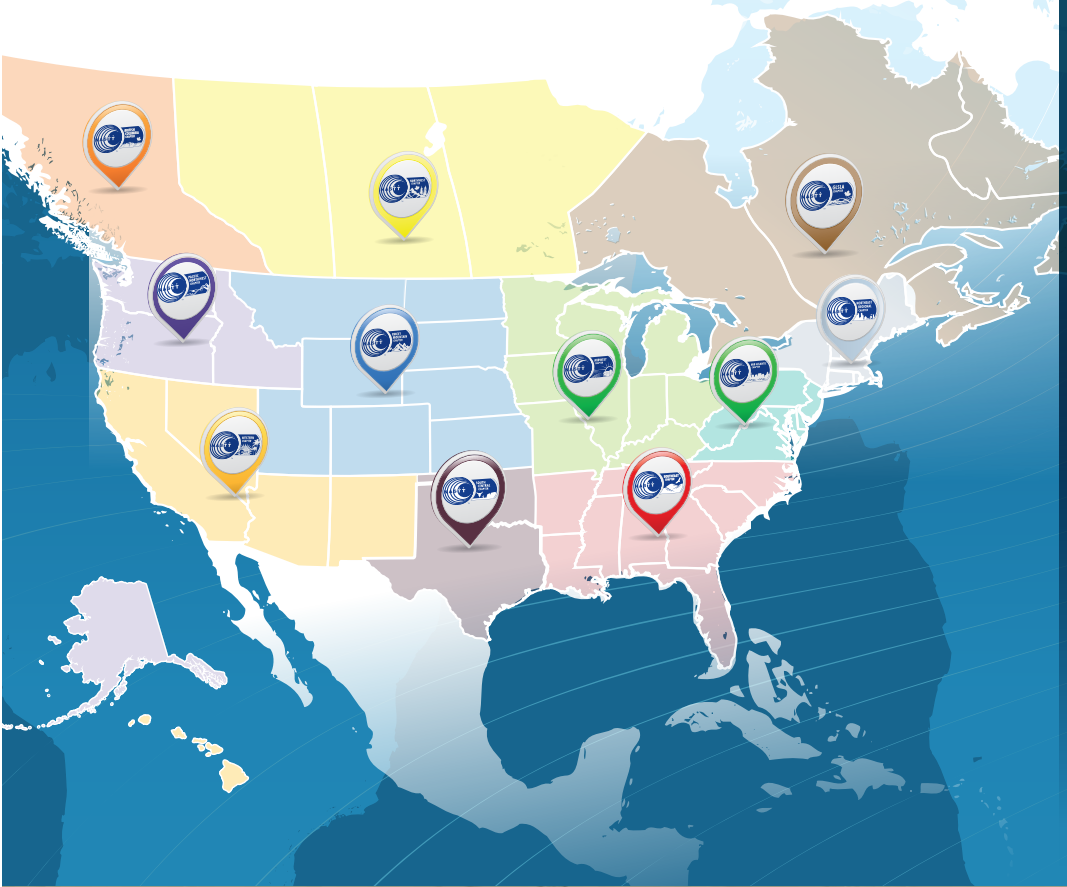

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CITY OF SYRACUSE SAVES TIME, MONEY AND DISRUPTION WITH SPRAY-IN-PLACE PIPE REHABILITATION

By: Audrey Leamy, Roger Linder, SUEZ

The Syracuse (New York) Water Department provides retail water service to the entire city, the fifth largest in the state with a 2020 population of 148,620 and a metropolitan area population totaling more than 662,000. Through wholesale and other service agreements, the Syracuse Water Department also supplies water to portions of the towns of Dewitt, Onondaga, Geddes, Camillus, Salina, and the villages of Skaneateles, and Jordan and Elbridge. For 124 years, the primary water supply for the City of Syracuse has been Skaneateles Lake, a body of water approximately 15 miles long and one mile wide.

The Syracuse water system is made up of over 500 miles of pipelines to deliver water from Skaneateles Lake to the City and to distribute the water throughout the City. The city's extensive water infrastructure also encompasses over 50 miles of transmission conduits, 5,500 hydrants, 7,500 valves, nine pumping stations, 19 gates houses, and two Ultraviolet Light treatment and Chlorination facilities. The water supply system also consists of water storage in Woodland and Westcott Reservoirs on the west side of the city, and water is also stored in two standpipes and in the three tanks that comprise Morningside Reservoir. Combined, the five water storage facilities accommodate a total of approximately 205 million gallons.

SIPP far less disruptive compared to traditional techniques

SOLUTIONS TO ADDRESS AGING INFRASTRUCTURE

As with many cities across the USA, the city's water infrastructure is aging. Much of it is 75 to 125 years old. In the heart of the city, the water system averages 350 main breaks a year as a result. However, city personnel have taken this issue very seriously and have begun implementing a plan to update the distribution system.

After evaluating various trenchless technologies, the project team selected SUEZ's Spray-in-Place Pipe Rehabilitation (SIPP) as the preferred solution for certain stretches of the water system. One area runs directly in front of City Hall, one of the city's busiest locations, so the solution had to provide minimal disruption both below and above ground to minimize risk. With many other utilities located in the same area, the risk of crossings and conflicts were high.

"It's an old system and very difficult to update in a dense urban setting," said Joseph Awald, Commissioner of Water, City of Syracuse.

After learning about SIPP at a lunch and learn session presented by SUEZ, the Syracuse Water Department opted to try SIPP for one stretch of pipe. It turned out to be an attractive and viable solution. With SIPP, service connections do not need to be drilled, and excavation is typically limited to a very small insertion and receiving pit making SIPP far less disruptive compared to traditional techniques.

ABOUT SIPP

SUEZ' SIPP is an efficient and long-lasting pipe rehabilitation solution that scrubs underground pipes clean and then uses a state-of-the-art, computer-controlled robotic spray rig to apply an internal epoxy pipe coating. The epoxy coating applied by SUEZ is NSF-approved for use in potable water systems across North America. Once it has cured, the epoxy lining seals the pipe, preventing leaks and water contamination, and extending the pipes' service life. This solution also minimizes future maintenance costs and increases the flow capacity for greater system efficiency and importantly, for firefighting.

As noted, SIPP eliminates the need for major road or sidewalk tear-ups, requiring only a series of small access pits along the

"WATER QUALITY IMPROVED, AND PUMPING COSTS DECREASED DUE TO THE IMPROVED FLOW OF WATER THROUGH THE RENOVATED PIPING SYSTEM."

Compact access pit

CCTV to inspect cleaning

pipeline to be rehabilitated. It can be used to rehab pipes made of different materials including cast iron, with diameters ranging from 4 inches to 36 inches.

The SUEZ SIPP rehabilitation process consists of a few key steps:

- The first step is to agree with the utility on the access point locations to be used for the SIPP process. A small access pit is excavated two feet below the host pipe. A three-foot section of the host pipe is removed to allow access to safely launch the lining equipment inside the host pipe. A CCTV inspection is performed to analyze and confirm the section of pipe to be restored.
- Next, the pipe interior is prepared for restoration by drag scraping and/or hydro-jetting to create a clean, smooth dry surface. The cleaning process is then inspected by a CCTV inspection.
- The epoxy coating is applied using computer-controlled robotic spray application rigs to ensure a more uniform coating and the desired thickness application. Once cured, this coating creates an internal seal that prevents leaks and helps protect against future corrosion and biological buildup. The two-component, 100% solid epoxy system used to coat water distribution systems exceeds ANSI/NSF 61 standards. The epoxy coating is a Zero VOC material with certified zero fish kill.
- A final CCTV inspection is performed to make sure the lining is correct. The sections of pipe that were removed at the access points can then be reinstated. The utility proceeds with the chlorination/disinfection before system restoration.

Pre Rehab Tuberculated Pipe

SIPP Pipe Relined

BENEFITS OF SIPP

SIPP can yield considerable cost savings when compared to direct replacement, where it is necessary to dig and replace the entire length of the pipe that needs attention. SIPP also saves time over traditional pipe replacement.

An important advantage of SIPP is that it minimizes inconvenience to consumers by relining water pipes instead of digging them up and replacing them. While a SIPP project does require a minimal amount of excavation limited to a very small insertion and access pit, it represents only about 3 percent of the excavation needed with traditional dig-and-replace projects. The significant cutback of excavation and backfill shortens the traditional construction schedules for this type of work and makes the work safer. Another benefit is that the epoxy lining seals the pipe, leaving no annular space for water to leak. The lining prevents corrosion, improving water quality.

SYRACUSE SIPP IN ACTION

Through its general contractor, the city signed a subcontractor agreement with SUEZ for the rehabilitation of its cast-iron water main involving 1,200 ft. of 24-inch pipe, 200 ft. of 16-inch pipe, and 500 ft. of 6-inch pipe. Due to the layout of the existing system, the project was divided into seven sections. The product applied to the existing host pipe was the Warren 301-01 coating.

As a result of this project, water capacity increased due to the removal of tuberculation. Water quality improved, and pumping costs decreased due to the improved flow of water through the renovated piping system.

The project was completed in May 2021, within both the proposed budget and timeframe. "The project was shortened by almost 30 days, and we saw approximately a 10-15 percent cost savings compared with the traditional approach," Awald said.

"Benefits included the lack of roadway disturbance and minimized disruption to traffic flow. We were able to re-open roadways quickly. We were pleasantly surprised by the quickness of the SIPP process, and we plan to use it for rehabbing other stretches of pipe in our distribution system. It's cost-effective and less invasive – a good solution to high density, high utility conflict in urban areas," he added.

ABOUT THE AUTHORS:

Audrey Leamy *is Product Manager of Spray-in-Place Pipe Services at SUEZ, where she is responsible for pipe rehabilitation and trenchless technologies nationwide.*

Roger Linder *is a Water System Consultant for the State of New York at SUEZ. Roger is a veteran of the water and wastewater industry with over 25 years of design, project management, and sales experience.*

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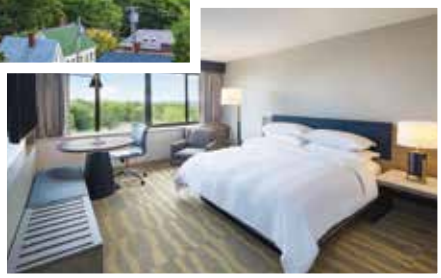

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DEVELOPMENT OF WORK ACTIVITY MATRIX FOR MICROTUNNEL QUALITY ASSURANCE, INSPECTION, AND RISK MANAGEMENT DURING CONSTRUCTION

By: Babs Marquis, CCM, McMillen Jacobs Associates,
Lisa Hamilton, PE, Massachusetts Water Resources Authority,
Jeff Passadi, PE, Metropolitan District Commission,
Ali Malick, PE, New York City Department of Design and Construction,
Patrick Hoosier, PE, AECOM Gilboa Construction Management

1. ABSTRACT

Initial microtunnel inspection reports were in the form of daily journals consisting of descriptive sentences and paragraphs with recurring but updated project-mandated information such as date, weather, temperature, equipment, and crew size. The daily journal presented a narrative of work activities performed to advance the microtunnel boring machine (MTBM) including length of tunnel excavated, number of pipes installed, observation of excavated soil material discharge at the soil separation plant, estimated units installed for schedule of values computation for monthly pay estimates, and actualized work completed for monthly construction schedule update. Except for numerical data input, daily microtunnel reports were lengthy with varying writing styles.

The introduction of desktop computers in the early 1990s alleviated many of the challenges associated with handwritten reports. The inspection record keeping for microtunneling construction projects has evolved into a quality management and risk management tool based on lessons learned and the need for tracking additional parameters.

This paper presents the development of a microtunnel inspection management plan for documenting quality assurance, tracking progress, resolving challenges, and following up on nonconforming work to ensure the project is completed in accordance with the contract documents. The focus herein is on the evolution of this microtunnel inspection management plan, reporting processes, and procedures into a standardized reporting template to capture relevant project data. This template serves as a training module for developing a work activity matrix (WAM) for microtunneling inspection and risk management applicable to small, medium, and large-diameter pipeline installation in different ground conditions.

2. INTRODUCTION

As trenchless construction methods become more widely accepted and used for infrastructure project development, construction oversight and records keeping for quality assurance and quality control (QA/QC) have typically been left to the field engineering staff who are assigned to the projects during construction. To address the needs of this evolving use of trenchless methods, a work activity matrix (WAM) was developed for microtunneling projects through progressive advancement application of lessons learned to the need for developing an efficient and effective project reporting documentation format and meaningful data acquisition. This paper focus on that process.

Project	Total Length (LF)	Soil Type	Casing Diameter (in.)	Comment
Battery Park Emergency Tunnel Project – Richmond, VA (2005–2006)	2,900	Glacial till and clay	144 in. steel and lagging with CCFRP lining and 48-in. concrete jacking pipe	Design-build with SEM and microtunneling. First inspection daily report (IDR) was developed to manage work at multiple site locations with different tunnel construction methods for different diameter pipelines.
East Boston Branch Sewer – Boston, MA (2006–2010)	13,200	Glaciomarine clay and glacial till	36-in. PVC, 44-48 in. concrete jacking pipe and 66-in. Hobas® pipe	Design-bid-build microtunneling project in densely populated urban area. IDR revised to capture project-specific criteria to include graphics and delays tracking commentary.
MDC Granby Street 2/5 Street project – Hartford, CT (2010-2012)	2,490	Varved clay and glaciofluvial deposits	48 in., 60 in., and 72-in. concrete jacking pipes	Design-bid-build project. IDR developed into a template with data-focused reporting for progress charts.
DC Clean Rivers Project Long Term CSO Control Plan Washington, DC (2012–2016)	5,025	Fill and alluvial deposit	48 in., 54 in., and 72 in. concrete jacking pipes 42 in. slip lined with 24 in. Hobas® pipe 84 in. slip lined with Hobas pipe	Retrospective trenchless projects review and evaluation of previously completed projects including challenges and change orders, with forward-looking recommendations for future trenchless success based on findings and lessons learned. This led to the development of the WAM for Microtunneling projects.
New 20-inch Subaqueous Water main Extension to Randall's Island – Bronx, NY (2015–2019)	1,900	Fill, glacial till, and fine sand	Two 60 in. Permalok® steel pipe for tunnels bored for gas and water transmission	The first draft of the IDR template with data-focused reporting with graphics and chart capabilities and downtime annotations was initiated for use on the Randall's Island.
Schoharie Low Level Outlet – Gilboa, NY (2015–2019)	2,160	Rock (Sandstone), glacial till, and glaciomarine deposits	108 in. Permalok® steel pipe	Fully developed and deployed WAM and IDR format with data-driven reporting and chart options to track work activities, MTBM and mining-related systems efficacy, and down times.

Table 1 – Microtunnel Inspection Reporting and Work Activity Matrix Development

The effort and time devoted towards the microtunneling WAM development span several years and projects in the form of successive building blocks, add-ons and contributing modifications, and input from the various project owners based on their needs and interest in what they would like to track and see on the project reports. The development of the microtunneling WAM evolved through the following select projects listed in Table 1 and are discussed in subsequent sections in the order they are listed in the table:

3. BATTERY PARK TUNNEL PROJECT, CITY OF RICHMOND, RICHMOND, VA

The Battery Park Tunnel Project was awarded as a design-build contract for an emergency tunnel construction to bypass a failed sewer system with a construction value of $25 million. The construction management oversight and daily coordination for ongoing work activities for the emergency sewer construction involved coordination and supervision of multiple teams of field inspectors working with the design-build contractor's crew at multiple site operations employing two tunneling construction methods (sequential excavation and pipe jacking) to concurrently construct:

- 1,800 linear feet of 144-inch-diameter tunnel construction in soft ground by sequential excavation method (SEM);
- 1,100 linear feet of 48-inch-diameter single drive precast concrete pipe installation by pipe jacking using an Akkerman MTBM in stiff clay, which included installation of three intermediate jacking stations;
- A junction chamber to make flow connection from the new tunnel to tie-in to the existing trunk sewer; and
- A 100-foot receiving and connecting tunnel, excavated in stiff clay using the New Austrian Tunneling Method (NATM) with steel panel ground support to connect the existing 60-inch sewer to the new 12-foot-diameter tunnel.

The Battery Park Emergency Tunnel project involved construction operations at four different locations and two 50-foot-deep shafts. The12-foot-diameter tunnel was excavated with an open face shield tunnel boring machine (TBM) and a road-header, with steel sets and wood lagging for ground support. The tunnel was slip lined with centrifugally cast fiber-reinforced pipe (CCFRP), and the annulus between the liner and the ground support was backfilled from the surface with very flowable fill grout. As part of the design-builder submittal workshop, it was necessary to develop the resident engineering inspection work plan in concert with the submittal development to facilitate QA/QC field inspection, documentation, and reporting protocols for the different tunnel construction methods deployed concurrently in order to maintain the aggressive emergency construction schedule. The inspector daily report (IDR) form, developed to manage work at multiple site locations with different tunnel construction methods was intended to be a simple form, applicable for use with the various ongoing work activities at the project site.

4. EAST BOSTON BRANCH SEWER (EBBS) INTERCEPTOR RELIEF PROJECT, MASSACHUSETTS WATER RESOURCES AUTHORITY (MWRA)

The Massachusetts Water Resources Authority's (MWRA) East Boston Branch Sewer (EBBS) Relief Project was a Federal Court mandated construction contract with a construction value of $62 million. The project included microtunneling to install new interceptor relief sewers in varying soft ground conditions that consisted of soils with cobbles and boulders, marine clay, and glaciomarine and glacial till deposits in a highly urbanized, densely populated community next to Logan International Airport in East Boston. A slurry MTBM was required for the construction. Relief sewer pipes were installed, with diameters of 36, 48 and 66 inches. The tunnel alignment was

constructed via 19 jacking and receiving shafts through East Boston to the existing Caruso Pump Station sending flows to the Deer Island Wastewater Treatment Plant in Winthrop, MA.

Day-to-day oversight of the resident engineering team of inspectors and field engineers involved working around the clock with three 8-hour shifts required to cover the contractor's 13,200 linear feet of microtunneling operations at multiple locations. With MWRA requiring frequent construction progress updates, the IDR form underwent several revisions to meet the project coordinator's request to capture specific information that could be easily extracted from the IDR on a daily basis with very brief annotations. With desktop computing capability, Microsoft Office (Word and Excel), and email gaining traction, the need for high priority project reporting at the end of each shift escalated the need to develop and generate smart construction progress reporting formats with graphics to meet the fast turnaround for preparing and submitting construction progress reports.

Completed concurrently with the EBBS microtunneling construction contract was a pipe bursting contract with a rehabilitation and renewal construction value of $8.8 million. The pipe bursting effort was part of the court- mandated project that included upsizing 12-inch and 15-inch

Work Activities Matrix for Area 3 - Pre-requisit for Microtunneling
Bottom Shaft, Breakout, Thrust Blocks, Jack & MTBM Assembly, Slurry

Planned work activities Bottom shaft finish amd preperation
Breakout walls and launch seals for LL/WL tunnels
Thrust blocks for LL/WL Tunnels
MTBM assembly
Slurry separation plant assembly
Bottom shaft power, utility lines and connection to operator annex
MTBM launch and minning with pipe installation

Hold Points if any 1.11.E (Quality assurance) Microtunneling shall not be performed unless items 1.11.C & D are satisfied-

Objective: Conduct WAM task specific workshop and readiness review coordination for microtunneling
Hold Point:

Facilitator: B. Marquis

Column1	Column2	Column3	Column42	Column6	Column7	Column8	Column9	Column10	Column11
Detailed Specification			Specification Title	Action Item Required		Dates			
Item #	No.	Section	Description		Assigned Lead	Due	Follow up	Complete	Comment
1	02901		Microtunneling	Verify relevant submittal compliance	P. Hoosier				
	02950	1.07	General tunnel requirement						
	02974		Pipe in tunnel		K. schutty				
	02950		General tunnel requirement						
	01356		EH&S Plan	Related Contract drawings	B. Marquis				
	01357		Tunnel and safety requirement	EH&S Plan submittal compliance					
	02990		Tunnel & Shaft Grouting						
2	Related Drawings			Scheduled activity duration start/end date	J. Diamante				
4				Related RFI and disposition if applicable	J. Diamante				
	Related Risk								
5				Inspection check off, hold points and restric	C. Frasier				
	Related Issues								
6				Close-out data requirement	J. Diamante				
7				Other(s)					

Figure 1. Work Activities Matrix Development Plan for Area 3 – Microtunneling for LLO

vitrified clay pipe to 16-inch and 20-inch high-density polyethylene (HDPE) pipe on the upstream side of the EBBS relief alignment. The construction contract included 24 pipe bursting insertion and reception shafts of mostly steel frame, with wood sheeting, soldier piles, and wood lagging. A total 5,200 linear feet of pipeline rehabilitation were completed by pipe bursting using pneumatic and static pipe bursting systems. The project management and reporting protocol required a separate resident inspection team providing construction oversight for the pipe bursting operation under the umbrella and supervision of the construction manager (CM) for both the microtunnel and pipe bursting contracts.

5. GRANBY STREET PROJECT NO. 2 AND 5 CONSTRUCTION PHASE SERVICES, METROPOLITAN DISTRICT COMMISSION (MDC), HARTFORD, CT

The Granby 2/5 is a sewer separation project undertaken by MDC as part of the Hartford MDC sewer separation project for Phase I CSO reduction. The project included microtunneling to install 2,490 linear feet of 48- and 60- inch-diameter reinforced concrete jacking pipes on a major and busy roadway in Hartford, CT. The construction management and oversight for the microtunneling portion of the project was engaged through a staff augmentation contract with a narrow scope and responsibility strictly for the microtunneling, pipe jacking, and the jacking and receiving shafts. The IDR reporting protocol and record keeping protocol from the Battery Park Emergency Tunnel Project were modified to include the MDC project-specific parameter, which the design engineer and MDC's Program Manager approved and adopted.

6. DC CLEAN RIVERS LONG-TERM CONTROL PLAN, DC WATER, WASHINGTON, DC

The DC Clean Rivers Project (DCCR) is a $2.6 billion system of storage tunnels, conveyance pipelines, and a pump station to divert combined sewage overflows from the Anacostia River, Rock Creek, and Potomac River. The program includes the design and construction of five major storage tunnels comprising over 20 miles of 20- to 23- foot finished diameter tunnels (Blue Plains: 24,300 LF; First Street: 2,700 LF; Anacostia River: 12,500 LF; Northeast Boundary: 27,000 LF; and Potomac River Tunnels: 29,000 LF) using pressurized faced TBMs, and 22 deep shafts ranging from 15 to 132 feet in diameter.

In addition to the large-diameter tunnels, four contract packages included conveyance tunnels constructed by microtunneling and pipe jacking mined through fill and alluvium strata with cobbles and boulders:

- The Tingey Street Sewer Diversion Tunnel: This 1,120-linear-foot, 72-inch-diameter tunnel was installed by microtunneling with the jacking shaft in close proximity to the Washington National Stadium. Ground modification was required to stabilize areas of very soft soils.
- The CSO 007 Diversion Sewer: This 380-linear-foot, 54-inch-diameter sewer was installed by microtunneling near the

2016 CAT-212C SITE SPECIFIC TRAINING/WORKSHOP

WIP

Year	No	Site Specific Training/Work Shop	Expected Training Date (Approx. 30 days prior to the beginning of the Activity)	Proposed Date	Date Completed	Trainee
2016	00	Field Inspection Report - CAT212C e-Builder's IDR Format	Wednesday, January 13, 2016	Wednesday, January 13, 2016	Wednesday, January 13, 2016	
2016	01	Valve Chamber - Land Based Test Borings	Thursday, January 14, 2016	Thursday, January 14, 2016	Thursday, January 14, 2016	
2016	02	Valve Chamber- Packer Testing	Thursday, March 10, 2016	Friday, March 11, 2016	Thursday, March 10, 2016	
2016	03	Valve Chamber - Geotechnical Instrumentation	Thursday, March 10, 2016	Thursday, March 10, 2016	Thursday, March 10, 2016	
2016	04	Gate Shaft - Geotechnical Instrumentation	Thursday, March 10, 2016	Thursday, March 10, 2016	Thursday, March 10, 2016	
2016	05	General - Concrete Pre-Construction Meeting	Tuesday, March 15, 2016	Tuesday, March 15, 2016	Tuesday, March 15, 2016	
2016	06	Valve Chamber - Wing Wall Construction	Thursday, March 17, 2016	Thursday, March 17, 2016		
2016	07	Schedule - CAT212C Scope of Work	Thursday, March 24, 2016	Thursday, March 24, 2016		
2016	08	Schedule - 2016 CAT212C Schedule	Thursday, March 24, 2016	Thursday, March 24, 2016		
2016	09	Metro-E	Thursday, March 31, 2016	Thursday, March 31, 2016		
2016	10	Emergency Control Center - West Access Road Building	Thursday, March 31, 2016	Thursday, March 31, 2016		
2016	11	Tunnel & Intake - Water Based Test Borings	Thursday, April 07, 2016			
2016	12	General - SWPP Inspection	Thursday, April 14, 2016			
2016	13	Administration - eBuilder Reports	Thursday, April 21, 2016			
2016	14	Tunnel & Intake - Shaft Excavation	Thursday, April 28, 2016			
2016	15	General - Open	Thursday, May 05, 2016			
2016	16	Tunnel & Intake - Dredging	Thursday, May 19, 2016			
2016	17	Tunnel & Intake - Blasting	Thursday, July 07, 2016			
2016	18	Tunnel & Intake - Tremie Concrete	Thursday, July 14, 2016			
2016	19	Miscellaneous - Dam masonry rehabilitation	Thursday, August 11, 2016			
2016	20	Tunnel & Intake - Land Leg	Thursday, September 29, 2016			
2016	21	Tunnel - Blasting Pre-Con Survey	TBD			
2016	22	Special Inspections - Welding	TBD			
2016	23	Special Inspections - Bolting	TBD			
2016	24					

Trainee: Ewald Schwarzinger, John Gerlach, Joko Diamante, Charlie Frasier, Robin Sabbati, Dennis Escott, Jr., Scott Early, Justin LaSasso, Blake Marquis, Patrick Hoosier, Michel Lhomart, Jason LaSasso, Aaron Letterly, Michael Camadine, Kim Scotty

Please consider additional subsections
1. Concrete rebar inspection
2. Concrete form work inspection
3. Concrete placement inspection
4. Concrete testing and acceptance

Figure 2. Planned Site-Specific Training/Workshop Schedule

11th Street Bridge and passed beneath a 96-inch sewer force main.

- The M Street Diversion Sewer: This sewer consists of 48-inch and 108-inch diameter pipes, 1,025 linear feet and 1,325 linear feet, respectively constructed using the two-pass pipe jacking method.
- Two Trenchless Installations (60-inch and 24-inch sewers): These installations were constructed as part of the Poplar Point Pumping Station works. The 800-linear-foot, 60-inch-diameter sewer was installed using a two-pass tunnel system. The first pass was an 84-inch tunnel into which the 60-inch sewer pipe was installed. The second pass was a 375 linear-foot, 24-inch-diameter sewer installed in a 42-inch casing constructed using microtunneling methods.

Based on the challenges and setbacks on previously completed trenchless

construction projects, a retrospective trenchless project review and evaluation was undertaken to identify root causes of those challenging project experiences and provide forward-looking recommendations for future trenchless success based on the findings and lessons learned. This effort led to the development of the WAM for Microtunneling as an approach for good practices for trenchless project development from concept through construction, which was adopted for the four trenchless contract packages discussed above.

7. RANDALL'S ISLAND MICROTUNNEL CROSSING, NYC DEPARTMENT OF DESIGN AND CONSTRUCTION, BRONX, NY

The Randall's Island Microtunnel Crossing is a construction contract for two 950-foot-long, 60-inch-diameter tunnels to extend water and gas utilities from the South Bronx to Randall's Island in New York. The two tunnels are constructed using microtunneling trenchless construction methods to cross under the Bronx Kill and CSX railroad tracks, with two jacking shafts from Randall's Island to two receiving shafts on the Bronx side. Because of unresolved easement issues on the Bronx side, the two receiving shafts at that location had to be relocated by extending the alignment end locations by 300 feet to within the public right-of-way. The original receiving shafts were 14 feet in diameter; one was modified to a 10.5-foot by 17-foot elliptical shaft to mitigate utility conflicts.

This modification complicated receiving shaft excavation and MTBM retrieval at the end of the microtunnel drive.

Because of the similarity between the Randall's Island Microtunnel Crossing project and the previously discussed projects, the IDR format and reporting protocol were adopted, with the resident engineer and inspection (REI) team making modifications to suit the project and client requested project data, with the option to utilize the data-focused reporting format with or without the graphics and chart plotting capability.

8. SCHOHARIE LOW LEVEL OUTLET (LLO) MICROTUNNEL CONSTRUCTION, NYC DEPARTMENT OF ENVIRONMENTAL PROTECTION, GILBOA, NY

To ensure the long-term performance and reliability of the Gilboa Dam over the next 100 hundred years, the New York City Department of Environmental Protection (NYCDEP) embarked on a Capital Improvement Program that includes dam stabilization with the installation of high-capacity multistrand rock anchors, placement of over 100,000 cubic yards of mass concrete, installation of automated geotechnical monitoring systems, and more recently, the construction of a Low Level Outlet (LLO) to allow NYCDEP to drain the reservoir and meet proposed water conservation releases.

The Schoharie LLO involved the construction of two 108-inch-diameter tunnels predominantly in bedrock with a combined length of 2,158 feet. Both

tunnels (land and water leg) are lined with Permalok® steel casing pipe. Both tunnel legs were constructed from a single jacking shaft 185 feet deep in hard rock. The water leg is 950 feet long and transitions from rock into glaciofluvial deposit at the bottom of the reservoir where the MTBM was recovered from a cofferdam via wet retrieval method under 150 feet of water. The Gilboa LLO project represents one of the largest MTBM project installations in the United States fitted with hyperbaric intervention capability with wet retrieval. Because of the "potentially gassy" classification of the site, the MTBM and tunnel support equipment are the first of their kind manufactured by Herrenknecht with explosion-proof characteristics to meet OSHA 1926.407 Class I Division II requirements.

The size and complexity of the LLO tunnel construction via microtunneling was well understood by the project owner, the project design engineer, and the construction management team. A specialty firm with the credentials, technical expertise, and proven track record for this type of underground construction was engaged to provide construction oversight and resident engineering services for the LLO shaft and tunnel construction under a staff augmentation contract. With a narrowly defined scope of work, McMillen Jacobs Associates reviewed the "Conformed Construction Contract Document" and developed its work plan, which is detailed in the "Microtunnel Construction Quality Management Plan for the Schoharie Low Level Outlet." A key component of the quality management plan was the use of the WAM as a quality control tool to plan quality management, perform quality assurance, and provide documentation to control quality. In addition to quality management, the process of following the WAM protocol provided an added benefit to construction risk management as it served as a checklist for each task and subtask work activity, which were taken directly from the work breakdown structure (WBS) in the baseline construction schedule, the Schedule of Values, the technical specifications, and the contract drawings, in the order and construction sequence provided in the baseline schedule.

9. WORK ACTIVITY MATRIX AND PROJECT QUALITY MANAGEMENT

This section describes and elaborates on how the WAM is developed and used as a quality management tool. The WAM is a simple at-a-glance tool for project work planning, reporting, and record keeping. It is most effective when components of the quality management plans and training modules are kept to one page and used for discussion between the project manager and the project staff who will be directly involved in completing any of the given activity. The objective is to establish expectations, identify what needs to be done, who is doing what and when it needs to be done; what resources are required, what stands in the way of

getting the task done, and what can go wrong. For the LLO microtunneling WAM development, the construction manager and the tunnel engineer initiated and facilitated the construction quality matrix development and workshops with key participants from the CM team, the design engineer field staff, the microtunneling contractor, and the owner's representative on site. The project management approach of inclusion allowed for cooperative collaboration of the project team working towards a common project objective of getting the project built. Examples of a WAM development plan (Figure 1) and a training workshop schedule (Figure 2) are presented on page 32 and page 34.

9.1. WAM Record Documentation and Project Reporting

The tunnel engineer developed the inspection work plan and inspection documentation required for each component of the work associated with the LLO construction. The inspection work plan included applicable constraints, restrictions, mandated specification submittal review, quality assurance, and qualifications; materials, testing, approved modifications, deviations, and nonconformances; and as-built documentation, deliverables, and project close-out data. The IDR was designed to capture factual, accurate, and timely reporting of the progress of the work. The IDR is structured and formatted for the shift inspectors to record specific work activities such as make-up times to include durations for coupling pipes, slurry and utilities connections, rock cutting tool inspections and replacement frequency, material output at the slurry separation plant, mining system down times, weather delays, safety-related trainings and stand-downs, random MTBM data, all matched to each pipe advanced. In addition, the form could be amended to include additional information and data of interest. With the robust data accumulated through the IDR, the LLO weekly and monthly construction progress reporting included a variety of charts presenting graphic representation of work activities in progress on a single page or PowerPoint screen. Examples of reporting progress charts include daily and weekly production rates, mining system availability and down times, cutting tool inspection and replacement frequency with mined distance interval, jacking forces, and cutter RPM. The development and use of the WAM for microtunneling projects in the construction phase present the inspectors and field engineers with a uniform format for recording and populating the IDR form as it requires continuous interaction and involvement with the microtunneling-related construction activities and work crew for the duration of each shift.

9.2 WAM Project Value Summary

The use of the WAM for managing microtunneling projects served as a good process and procedure quality checklist for the review of the specifications, submittals, contract drawings, RFIs, and approved deviations to ensure conformance and quality in construction.

The process of developing the WAM and site-specific training workshop served as a valuable project communication and training tool to ensure the project team's understanding of the project objective, allowing the team to work collaboratively in planning, executing, and maintaining project records to support the Project Quality and Construction Management Plan.

With the level of effort involved in the development of the WAM for each required WBS activity, the project team was able to identify challenges early in the submittal review stage and work together to resolve or develop contingencies before the actual work begins. The ability of the team to respond to anticipated challenges in a timely manner and have the resources in place to minimize and control the impact of the challenges proved to be valuable risk management tool with significant schedule and cost benefit.

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