ACHIEVEMENT AWARD
Coluccio’s Rene Inosanto, MWH’s Greg Raines and Contractor Ward and Burke Earn Honors

TAPPING THE UTE RESERVOIR
Nada Pacific Completes Raw Water Intake in New Mexico (pictured)

A NEW ERA IN MICRO Tunneling
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EDITOR’S MESSAGE

EVOLUTION OF THE INDUSTRY

When we first published the Microtunneling Annual in 2009, the biggest news were some of the exciting projects that were expanding the boundaries of the industry in North America. Longer drives, curved drives and the completion of projects through difficult ground conditions were among the highlights of those first few issues.

While we continue to innovate and improve, the biggest development this year has been the compilation of the ASCE’s “Standard Design and Construction Guidelines for Microtunneling,” which are on track to be published in early 2015. The document is a revision of a 2001 publication and incorporates the substantial developments in the industry over the intervening time.

Glenn Boyce of Jacobs Associates is the chairman of the committee responsible for publishing the revised guidelines. “The intent of the update is to incorporate new changes; the technology is changing and there are new procedures and adopted practices,” he said.

One recent significant development in the industry was the founding of the North American Microtunneling Association (NAMA) in 2012. NAMA represents major microtunneling contractors active in the United States and Canada. NAMA was invited to participate in the process of revising the guidelines and helped to broaden its scope through its construction experience.

The result, according to committee member Dave Bennett of Bennett Trenchless Engineers, is a useful tool for all parties involved in microtunneling. “I believe we have achieved a very practical document that has a tremendous amount of detail, yet it avoids being overly prescriptive,” he said. “It allows innovation. It allows judgment. It allows experienced practitioners the flexibility to use that experience and judgment.”

We explore this issue further beginning on page 6. We invited members of the committee to discuss the process behind creating the document, its goals and the industry in general.

On page 18 we present the Oakley Station sewer separation project in Cincinnati. While it is not technically a microtunneling project, this trenchless pipe jacking and utility tunneling project is interesting in the fact that it showcases the use of trenchless new construction in conjunction with design-build contracting. By using design-build as part of this redevelopment project, the owner – the Metropolitan Sewer District of Greater Cincinnati (MSD) – was able to save 13 months off the schedule and more than 20% from the initial construction estimate of $12.2 million – all the while helping MSD to agree to terms of its EPA consent decree to control sanitary and combined sewer overflows. What is also interesting about this project is the fact that it is one of the first to be completed in the State of Ohio to use design-build contracting, which until recently had not been permissible under Ohio’s construction laws.

As microtunneling marked its 30th anniversary in North America in 2014, there is still room for the market to grow.

Regards,

Jim Rush | Editor
The Premier Microtunneling Instructional Venue for 21 Years.

Now entering its 21st year, the Microtunneling Short Course has trained over 2,400 course students, ranging from contractors and engineers to owner agency representatives. The three-day intensive course covers the latest in emerging technologies, takes an in-depth look at subjects that can impact your job, and includes the latest technical information to ensure a successful project.

Presented by a panel of international experts and organized by Timothy Coss, President of Microtunneling Inc. and Levent Ozdemir, President, Ozdemir Engineering, the Microtunneling Short Course is a must-attend event for anyone involved with microtunneling.
This year marks the 30th anniversary of the introduction of microtunneling to the United States. Once considered a novelty application, its use has expanded throughout the years. Microtunneling is now a well-accepted trenchless method for pipeline installation throughout North America for a variety of applications and geologic conditions. But despite the fact that it is now a mature technology, education is still needed as to its capabilities and best uses.

That’s where the ASCE Microtunneling Guidelines come in. Originally published in 2001, ASCE is on the verge of releasing an updated version, officially titled “Standard Design and Construction Guidelines for Microtunneling,” that expands upon the original document, as well as provides information and commentary about developing trends and technology that have evolved in the intervening years.

The Standard was compiled by a committee of professional engineers, contractors, owners, equipment manufacturers, and material suppliers over the past several years. The committee is addressing public ballot comments before publication anticipated for early 2015.

The goal of the Standard is to provide a reference document that serves as a basis for planning, designing and constructing microtunneling projects, including a glossary of terms that assures that all parties are “speaking the same language.”

The Standard is an important step for microtunneling as it enters the next phase of its development. As such, we decided to gather a cross section of the committee involved in the writing and compilation of the document to speak about its development and goals, as well as the microtunneling industry at large.

Committee members providing their input included: Glenn Boyce, Jacobs Associates; Dennis Doherty, Haley & Aldrich; David Bennett, Bennett Trenchless Engineers; Mark Hutchinson, City of Portland; and Les Bradshaw, Bradshaw Construction.

trenchlessonline.com
WHAT WAS THE IMPETUS FOR UPDATING THE STANDARD? WHAT DO YOU HOPE TO ACCOMPLISH WITH THE PUBLICATION OF THE UPDATED DOCUMENT?

GLENN BOYCE – To be an ASCE Standard, there are certain protocols and requirements that must be met. One of them is that it needs to be updated every five years to keep current. The committee began the process of updating the original Standard in 2008, but didn’t really get going in earnest until 2010.

The intent of the update is to incorporate new changes; the technology is changing and there are new procedures and adopted practices. The process of writing the original Standard started in 1995 and took six years to complete. It didn’t go into the level of detail that some thought that it should have, but I believe we were successful in getting people’s attention and getting them started on the right path. The idea with the revision is to try to make it much more informative, much more adopted to the practices and changes that have occurred in the industry. One thing that has helped has been the involvement of the North American Microtunneling Association (NAMA), which is a group of the 15 largest microtunneling contractors in North America that formed within the last couple of years. They got involved and added their thoughts and needs and what they felt were areas that needed improvement.

So it has taken awhile, but we are hoping to create document that is up-to-date, with current technology, and will be used by everyone in the industry.

MARK HUTCHINSON – I attended training in the 1990s presented by Glenn Boyce using the old ASCE Standard. The old ASCE standard was a good introduction to microtunneling; it discussed the major subjects which were relatively new at the time.

LES BRADHSAW – There have been substantial improvements in microtunneling and the utilization of the method. With our broadened experience and equipment, we are able to complete projects in ground conditions – like rock and soft soils – that we could not do 15 years ago. We tried to address all these improvements in the Standard. I also think we did a better job of summarizing the history, the methodologies, and the lessons learned. As contractors, NAMA was reluctant to get involved initially, but we couldn’t be happier with the response from the engineering leaders of this new Standard in working with us to make things not just theoretical, but practical and usable. I think it really reflects where the industry is. It is a work in progress, however, and there are new challenges out there that are being embraced every day. The industry is moving forward in spite of the deepest recession this country has seen since the 1930s.

DAVE BENNETT – NAMA and its contractor members brought a lot of practical experience and knowledge to bear. One of the things that I am most proud of, is that I believe we have achieved a very practical document that has a tremendous amount of detail, yet it avoids being overly prescriptive. It allows innovation. It allows judgment. It allows experienced practitioners the flexibility to use that experience and judgment.

I hope the new Standard provides a framework of the best practices and raises questions owners should be asking their consultants and themselves when considering microtunneling as an option for a project. I also hope that the document can be used to educate owners’ engineers on the private and government side about the usefulness of the tool and how to have a successful project.
WHAT ARE SOME OF THE SPECIFIC AREAS THAT WERE CHANGED OR ADDED? WHY?

GLENN BOYCE – When we wrote the original Standard in the 1990s and into the early 2000s, microtunneling was used primarily in soils and generally in smaller diameters. Now the industry has migrated into larger machines with more horsepower and more torque, so we are able to go through rock conditions. We have gone from drive lengths of 200 or 500 ft to thousands of feet. The new Standard details how we deal with boulders, using modern guidance systems, using bigger machines with face access and air-locks, and using new pipe materials. It is a method that is now used in mixed face conditions in larger diameters with longer drive lengths. It is simply more reflective of what is in the industry.

LES BRADSHAW – MTBMs with cutter wheel access allow us to get in and change tooling where before they would wear out in most rock conditions before we were able to complete the drive. So what has happened is we were able to take a methodology that had severe limitations and expand out the market for it.

GLENN BOYCE – Ultimately we would like to see everyone use the Standard, and we need to spread the word that it exists. As a Standard, it represents consensus best practices, and I can see it becoming a reference document for various disputes if that is where the project ends up.

LES BRADSHAW – I absolutely think it will be used in evaluation of whether an appropriate standard of care was taken, whether it is from the engineer or contractor standpoint. It can be used as a guideline and a reference, but it shouldn’t be used as a specification. As detailed and instructive as it is, one of our greatest concerns as a contractor group was that sections should not be lifted and pasted into specifications out of context with the entire document.

DENNIS DOHERTY – It is important to note that this Standard is not presented as a specification. It is a guideline and there is specific language in the document calling out the fact that it should not be used as a specification.

DAVE BENNETT – I think all of us want to guard against this being used as a specification instead of a guideline to help craft project-specific documents. It does happen, unfortunately, that sometimes the information is put in as a technical specification. We want to make sure that doesn’t happen here. On the flip side, we had buy-in from essentially all segments of the industry, so this document cannot be ignored nor can it be argued that it doesn’t apply because it only represents one point of view. It represents a consensus that was fought over tooth and nail in many long meetings and teleconferences.

GLENN BOYCE – The result of the revisions is that we have gone from a document that was 40 pages and expanded it approximately threefold to 120 pages-plus. We have added commentary to provide readers some insight into why some of these things are important and what to look for, what can go wrong and what they should be doing to avoid problems. We have added information on earth loads and jacking forces; evaluation of jacking forces and settlement; risk evaluation; drilling fluid design; and curved alignments. We also expanded the sections related to construction, including information on types of submittals, retrievals of MTBMs, drilling fluids, lubrication, overcut, and annular space, to name a few of the changes.

DENNIS DOHERTY – The original document was referred to as “Standard Construction Guidelines for Microtunneling,” and it was realized that engineers who were perhaps not experienced were referring to the document, so with this revision we changed it to “Standard Design and Construction Guidelines for Microtunneling” so that owners and engineers can understand the details that go into making a successful project.
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ly important in creating a common language and common terminology. All of us have seen things incorrectly referred to and it happens all the time. So, while boring, it was understood by all of how important the definitions were and it was something that we kept at and refined as we went along.

LES BRADSHAW – One that struck home for NAMA was the definition of obstruction. It no longer means what the layman would think in terms of an obstruction being something that stops you; it is actually something that either stops you or prevents you from installing the pipeline within the design tolerances. If it deflects the machine and knocks the pipe off usable line and grade, then it is an obstruction.

PLEASE DESCRIBE THE PROCESS OF HOW THE DOCUMENT WAS COMPILED? HOW WAS CONSENSUS REACHED?

LES BRADSHAW – It took a willingness to listen to all sides and continually work at alternative ways until everybody said, “I think that sums it up” or “I can live with that.” Ultimately we came up with the realities of the method that we have to deal with and that we can’t ignore. It took a long time to express all the different viewpoints and good leadership to finally come up with the right terms and document these terms.

DENNIS DOHERTY – I think one of the important steps forward was a meeting that Craig Camp and I had with NAMA at the Rapid Excavation and Tunneling Conference in Washington, D.C., in 2013. We sat down with the group and were able to address their issues and get them involved with the process. I think that was when they really got involved and it was a good addition to have greater representation from the contractors.

DAVE BENNETT – Every one of us who have participated in this effort brought an agenda to the table, but in the end we also recognized the value and respected the opinions and perspective of the other parties. Getting the contractors involved was a tremendous benefit to the whole process, but within the individual sections the same kind of thing happened. We had a group of designers and we all had our specific agendas and our opinions about the best way to go about particular issues. In the end we decided that we would reference and discuss all or at least the leading philosophies and approaches and give proper reference and credits but then leave it to the judgment of the individual practitioner about how they would go about that particular task.

WHAT KIND OF FEEDBACK HAVE YOU HAD RELATED TO THE DOCUMENT SO FAR?

DAVE BENNETT – At the ACSE Pipelines Conference in Portland we hosted a workshop based on the new Standard that was well received. In fact, ASCE has approached us to do more to expand it.

SPECIAL SUPPLEMENT: NORTH AMERICAN MICROTUNNELING

BEHIND THE SCENES

The American Society of Civil Engineers (ASCE), the North American Society for Trenchless Technology (NASTT), and the North American Microtunneling Association acknowledge the work of the Microtunneling Standards Committee. This group comprises individuals from many backgrounds including: consulting engineering, the construction industry, equipment and pipe manufacturing, education, government, design, and private practice.

This Standard was prepared through the consensus standards process by balloting in compliance with procedures of ASCE’s Management Group F, Codes and Standards and NASTT. Principal authors and contributors of the Standard are:

- Glenn M. Boyce, Chair
- Robert D. Bennett
- Lester M. Bradshaw, Jr.
- Dennis J. Doherty
- D. Craig Camp
- Cal Terrasas
- Brenden D. Tippets
- Mark W. Hutchinson
- Robert Lys Jr.
- Ralph R. Carpenter
- Richard C. Turkopp

Other individuals who served on the Standards Committee are:

- Michael G. Boyle
- Mark H. Bruce
- Joseph P. Castronovo
- Daniel J. Dobbels
- D. Tom Iseley
- James K. Kwong
- Steve S. Leius
- Michael P. Murphy
- Mohammad Najafi
- Alberto G. Solana
- Richard Thomasson
- Michael G. Vitale

The committee also wishes to thank Julie McCullough and Xavier Callahan for providing technical editing of the Standard submitted to ASCE.
GLENN BOYCE – The workshop really helped provide a lot of exposure to the new Standard and we got a lot of positive feedback from it. Basically it was a 4-hour session that went through the sections of the new Standard and highlighted some of the changes that were made and the reasons behind the changes. But the document is still in progress. When it gets published and gets into people’s hands it will start to have a bigger impact.

DENNIS DOHERTY – One thing I found interesting about it was that there was a representative from the railroad at the workshop in Portland. Railroads have historically been reluctant to accept new technologies but this individual was at the conference to specifically attend the microtunneling workshop. They want to be more progressive and understand what is happening in the industry.

WHAT ABOUT THE INDUSTRY IN GENERAL? HOW DO YOU VIEW THE STATE OF THE INDUSTRY? HOW HAS IT EVOLVED?

MARK HUTCHINSON – When Portland began microtunneling in the 1990s, there were just a few engineers around with experience who could design the projects, and it was hard to get advice on what to be concerned about or specify. At that time, there were only a handful of contractors and they came with the machine they had with limited ability. Most projects ended with claims, and some projects didn’t get completed. The method was considered too risky or expensive to try from an owner’s perspective.

Today there are more options when it comes to hiring engineers, but still only a few good ones. The contractors are much more sophisticated; they bring engineers and innovative ideas. We also see contractors who are jack-and-bore contractors who sell their work as microtunneling. I think the machines, and the contractors’ people have improved. The shafts and pipe continue to be a challenge. We often have general civil/structural guys designing shafts or placing design constraints on them. We see pipe that is not properly specified requiring testing.

The social requirements also continue to increase in regard to allowed work hours, shielding operations from the public, settlement and vibration effects or perceived effects on structures, and unrealistic settlement requirements.

LES BRADSHAW – Right now the industry is significantly overcapacity from the...
the regulators don’t seem to understand the impact they are having on this industry.

LES BRADSHAW – Another area I think we need to address is the confusion that exists among some owners and engineers between slurry microtunneling and the pilot tube method budgets. I have seen estimates for microtunneling that are 30 to 40 percent of what they should be. The estimates must have been based on the pilot tube method.

DENNIS DOHERTY – The term ‘pilot tube microtunneling’ is often used today, but it is confusing. In the Standard it is referred to as the ‘pilot tube method’ to avoid confusion. The pilot tube method is not microtunneling.

DAVE BENNETT – One of the things we often fight, and lose, is unrealistically low estimates for open-cut as an alternative to microtunneling. When you start out with an unrealistically low estimate for open-cut, there is no way you are going to be able to compete with a trenchless alternative. The Owner looks at microtunneling at $2,000 per ft or $2,500 per ft, compared to unrealistically low open cut cost estimates which do not properly account for dewatering, and rule it out. But when the bids come in for open-cut with deep wells, they may understand that the trenchless option would have been competitive.

HOW DO YOU SEE THE FUTURE OF THE MARKET? WHAT CAN BE DONE TO HELP THE MICROTUNNELING INDUSTRY GROW?

MARK HUTCHINSON – I see more work in the cities due to constraints caused by streets full of utilities, ever increasing environmental issues with contaminated soil and groundwater, wetland restrictions, and requirements posed by DOTs on roadway restoration or traffic lane restrictions. I see jobs we used to specify as open-cut, requiring microtunneling now. As part of a sewer pump station we are building right now, the pipe was required to be microtunnelled, even though it was only 25 ft deep, due to zoning restrictions.

DAVE BENNETT – I believe for microtunneling – and trenchless in general to grow – we need to educate regulatory and permitting agencies that often place crippling constraints on the projects. All of us want to do the right thing and protect the environment, but we need to find a balance and move forward. We are seeing a lot of jobs that are being killed right now because of over-regulation and permit conditions that are not practical.

LES BRADSHAW – Right now we see a water crisis in the West and mandated CSO programs in the East and Midwest that are driving underground work. Most of that is related to large storage structures but in three to five years there could be some microtunneling work needed to feed the larger structures. The work is there, but it will take a while and will take continued funding.

DENNIS DOHERTY – One of the growth areas may be in the area of electrical transmission. While microtunneling has been typically used in gravity sewer systems, I am seeing it more on the power side. Microtunneling certainly gives you more options when you are working below the water table.

DAVE BENNETT – Growing the market takes efforts like the publication of the Standard, as well as the follow up education of all stakeholders. It is a slow process and it seems discouraging at times, but when we look back over 15 to 20 years we have certainly made progress. Progress is incremental, and we need to continue to educate, put together good projects with good contract documents and qualified contractors and allow them to use their innovation. It is a step-by-step process, but I still believe that is how we do it.
FEATURE STORY

MICROTUNNELING ACHIEVEMENT AWARDS
INDUSTRY LEADERS TO RECEIVE HONORS AT MICRO TUN NELING SHORT COURSE

It is often said that it takes cooperation and teamwork among all parties to complete a successful microtunneling project. Generally, this relates to the contractor, engineer and owner, but it is also true of the individual parties themselves – the contractor executives and field personnel or the project engineer and the home office. When all of these oars are rowing in the same direction, the challenges presented by Mother Nature can be overcome.

In an effort to recognize the individuals and companies that have worked toward successfully completing complicated projects and advanced the industry, the Microtunneling Achievement Awards were created. The awards are presented annually at the Microtunneling Short Course in February. This year’s awards, which were established by course organizers Tim Coss, Microtunneling Inc., and Levent Ozdemir, Ozdemir Engineering, will be bestowed at the annual banquet on Thursday, Feb. 13, 2015, in Golden, Colo.

MICROTUNNELING ACHIEVEMENT AWARD WINNERS

Past winners of the Microtunneling Achievement Award:
- Northwest Boring (2002)
- Dr. James Kwong, Yogi Kwong Engineers (2007, 2013)
- Stefan Trumpi-Althaus, Jack Control Inc. (2008)
- Matt Roberts, Kiewit (2009)
- Dennis Molvik, Northwest Boring (2011)
- Rick Turkopp, Hobas (2012)
- Gary Huber, Permalok (2012)
- James W. Fowler Co. (2014)
- Greg Raines, MWH (2015)
- Ward and Burke (2015)
The winners this year are Reynaldo (Rene) Inosanto of Frank Coluccio Construction Co., Greg Raines of MWH Global, and the contracting firm of Ward and Burke of Toronto.

RENE INOSANTO

Reynaldo (Rene) Inosanto’s involvement in the microtunneling industry pre-dates the arrival of the method to the United States. He was raised in Manila, Philippines, and earned a B.S. in civil engineering at FEATI University in Manila.

Inosanto began his career with F.F. Cruz & Co. in the Philippines as a field engineer for road and highway construction, but his career took a turn in 1983 with he got involved in microtunneling project in the congested area of Tondo in Manila. He was chosen by Mr. Kurose, the president and owner of Iseki at that time, to operate the Iseki MEPB 900 microtunnel boring machine for the Tondo sewer project. It was the following year, in 1984, that microtunneling was first used in the United States.

Following the completion of that project, Iseki brought Inosanto to Japan for additional education and training on the microtunneling method, which led to his involvement in the worldwide microtunneling industry, including working on projects in Asia, Europe, the Middle East, North America, South America and the Caribbean.

In a microtunneling career that spans over 30 years, Inosanto still gets satisfaction from a job well done. “For me, I have a good feeling when the microtunnel machine is removed from receiving pit and we were able to finish the project successfully,” he said.

Inosanto has seen many changes in the market since his first project in Manila. “In the early days some of the microtunneling machines were operated inside the machine or inside the shaft, but now they are all operated from the control cabin,” he said. “The new technology also makes it easier to monitor the project. Also, with better engineering, the industry is safer than it was before.”

Some of the projects that stand out in Inosanto’s mind are the Folkstone project in the United Kingdom, part of the Channel Tunnel project in 1990 that involved the use of a 2,200-mm Iseki Crunchingmole that was converted from pipe jacking to a segmental system (now called hybrid microtunnel); the 1992 Gent, Belgium, project that used an 1,800-mm Iseki MTBM to complete the first S-curve in Belgium; and the 2002 Hickam Air Force Base project in Hawaii, which included the first underwater recovery of an MTBM in the United States (a recovery of a 1,200-mm Iseki Unclemole). Most recently, Inosanto was the operator on the 2012 Beachwalk project in Honolulu – the first S-curve completed in the United States.

“Rene has been in the micrtounneling market for 30-plus years and brings a lot of knowledge and experience to every job he is on,” said Coss on the selection of Inosanto for the award. “He is the kind of guy who comes home every day with mud on his boots. He’s the guy who is responsible for making sure all the pieces come together, and he is very good at what he does. With his involvement in projects that have expanded the industry, he is very deserving of this award.”

There are three keys to successfully completing a microtunneling project, according to Inosanto: 1) study and analyze the ground conditions, 2) choose the right equipment and manpower, and 3) focus on the job and use good judgment.

As far as improving the market, Inosanto believes that procurement that involves qualifications would be helpful, as well as increased focus and time devoted to ground investigation to aid in equipment and personnel selection. Most importantly, is teamwork.

“It’s a team effort to do a microtunneling job,” Inosanto said.

GREG RAINES

Like Inosanto, Greg Raines got involved with the underground industry early in his career. “I was in high school when I was first introduced to underground mining by a close family member,” Raines said. “He was an underground miner, and it is because of his influence that I am now working in this industry. I like to think this is why underground work is so natural for me. It was his passion and dinner table education that first got me underground, and because of this influence, I focused my education in tunneling. This initial fascination with being underground has never gone away.”

His first microtunneling experience came as a young professional as his then-firm was researching the microtunneling industry in the early 1990s; he has been involved ever since. “I enjoy the daily changes that come with a career in this field,” he said. “Every new job comes with unknowns and the challenges that inevitably arise make the work exciting. We can learn from our previous projects, but no situation will ever be exactly the same. There will always be challenges and something new to learn and apply.”

“The microtunneling industry brings the
excitement of technological advancements as well. Completing an entire project through remote control is a unique and cutting-edge. These projects put me and my team on the cusp of innovation. We are a part of the future.”

Like Inosanto, Raines has seen numerous developments in the field of microtunneling. “There have been significant changes in the industry since I first joined, from the guidance systems to the separation systems and now curved drives are finally happening in the United States,” he said. “The design of cutterhead technology is a major change also, with disk cutters for rock and systems to handle hard sticky clay, which expands the range of ground conditions we can apply the technology to.”

So what does Raines see as the keys to success? “I believe successful completion always begins with early planning and investigation,” he said. “This starts with an understanding of the geotechnical characterizations, and from there, the selection of the appropriate equipment. After planning, the key is experience and a good contract. Any difficult job is going to need flexibility and a contractual means to adjust to uncertainties, as well as a strong team with the experience to know how to handle these inevitable unknown difficulties.”

Despite its growth and maturation, microtunneling still has work to do if it is going to expand. “Our industry is using cutting-edge technology and is achieving amazing things,” he said. “However, across the tunneling industry, I think we have to be more realistic and manage expectations better with our clients. The industry tends to be too optimistic of what can be achieved within a set time and budget. I think a better understanding of the true time-tables and budgets will significantly help the industry in the future.”

“Microtunneling was hit hard by the Great Recession, because local municipalities were unable to fund much needed infrastructure projects. However, now that we are coming out of that, I expect the market to pick up as long as we deliver to our customers, as promised.”

Raines’ background and impact on the market make him an ideal candidate for the award, Coss said. “Greg has always promoted the industry with common-sense engineering,” he said. “Some engineers don’t understand what is going on in the field, but Greg understands the geology and the construction aspects – he can balance what is practical and what the owner needs.”

WARD AND BURKE

In 2011, Ward and Burke Construction, a heavy civil contracting company based in Ireland, re-introduced microtunneling to Toronto with the completion of the Gore Road project. That project involved the construction of a new 1,200-mm ID sanitary sewer pipe running directly under an existing 1,800-mm concrete pressure pipe water transmission tunnelingonline.com
line and an existing creek at Gore Road, in Brampton, Ont. Because of the presence of groundwater, cohesionless ground and the 1.5-m clearance between the two lines, settlement to the transmission line was a significant threat and traditional open-face tunneling methods were not suitable.

Due to the uniqueness of the project and limited options, Ward and Burke was able to bring microtunneling technology back to the area. The successful completion of the project then opened the door for additional projects in the area. The completion of each subsequent project then began opening the door a little wider.

“Some clients and consultants were familiar with the technology, but until somebody actually completed a project, no one was willing to specify it as microtunneling,” said John Grennan, a founding member of Ward and Burke’s Canadian operations with Robert Ward. “We started with some small, 10-m long tunnels, then 20 m, then up to 100 m and more. So the more tunnels that we did and the longer they got, everyone built up confidence, but it took a lot of jobs to build up that confidence.”

Ward and Burke was founded in Ireland in 2001 by Padraig Burke, Robert Ward and Michael Ward as a construction company engaged in heavy civil construction, including tunnels, pipelines, road and bridges. Ward and Burke expanded to the U.K. market in 2008 before entering the Canadian market in 2011.

Some of Ward and Burke’s notable projects include: the Keswick WPCP Effluent Outfall Expansion, the first-ever combined vertical and horizontal curve microtunnel constructed in North America, as well as the first curved drive in Canada and the first wet recovery of an MTBM in Canada; and the Elgin Mills Road Waterman, the longest, curved microtunnel ever constructed in North America. The project was completed in October 2013.

Grennan credits the success of Ward and Burke is attributable to a number of factors. First and foremost is a keeping the focus on doing the job right. “Our No. 1 goal is keep the client happy at all times and doing good work,” he said.

Ward and Burke is able to achieve this goal by relying on a technically led workforce. “All of our owners, directors, project managers and site managers are fully qualified civil engineers. They have graduated from some of the best universities around the world, including Massachusetts Institute of Technology (MIT),” he said. “We currently fund research programs at MIT, University of Western Ontario (UWO), and National University of Ireland Galway (NUIG) that focus on solving field problems.

“Our philosophy is to put our best people closest to the work where they are able to evaluate all the data and risk as it happens, so that they can react before a problem happens. We have also been fortunate to acquire excellent operators, technicians, mechanics and electricians, who are all important to the operation.”

Grennan credits the Microtunneling Short Course with helping the company find its direction in North America. “In 2010, Ward and Burke went to the Short Course for the first time with the aim to learn and improve from industry leaders, and we were not disappointed,” he said. “We were highly impressed by the caliber and knowledge level of the various presenters and attendees at the event. The Microtunneling Short Course set new benchmarks and targets for our company to achieve. We still believe we have a lot of work to do to reach these benchmarks. Therefore, we are honored, privileged, and humbled to receive this award from this group.”

— John Grennan, Founder of Ward and Burke

**Microtunneling Short Course:**

**THE INDUSTRY LEADER IN EDUCATION**

Established at the Colorado School of Mines in 1994, the Microtunneling Short Course is recognized as the leading instructional venue for microtunneling worldwide. Since its introduction, well over 2,000 professionals, ranging from contractors and engineers to owner agency representatives, have gone through the course.

The Microtunneling Short Course was established at a time when the method was still gaining acceptance in the utility construction industry, and has helped grow the market through education and understanding. It has continued to evolve along with the industry, offering high-level education on leading-edge technologies and topics. Since that time, the art and science of microtunneling has changed dramatically, with projects being completed in North America today that would not have been considered even a decade ago.

The 2015 Microtunneling Short Course, which will be held Feb. 10-12 with a one-day Pilot Tube seminar on offered on Feb. 9, covers the latest in emerging technologies from this growing field. With more and more demand for underground services in urban areas, the need to use minimally invasive construction techniques like microtunneling will only increase.

The Microtunneling Short Course is a three-day, intensive course presented by a panel of international experts and organized by Prof. Levent Ozdemir of Ozdemir Engineering and Timothy Coss of Microtunneling Inc. It will be held at the Green Center on the campus of the Colorado School of Mines in Golden, 40 miles west of Denver International Airport.
The course covers all aspects of microtunneling including site investigation, ground stabilization, shaft construction, pipe considerations, microtunneling and slurry equipment advances, case studies, and more. It is intended for public works and utility officials, engineers, planners, managers, contractors, and equipment manufacturers involved in any phase of trenchless technology.

Another attraction of the Microtunneling Short Course is the presentation of the Microtunneling Achievement Award winners, which are bestowed on the companies or individuals who have made a lasting impact on the microtunneling industry. This year the awards will be given to Rene Inosanto of Frank Coluccio Construction Co., Greg Raines of MWH, and the contracting firm of Ward and Burke.

The winners will be presented during an evening banquet on Thursday, Feb. 12 at the Golden Hotel. In addition to the awards presentation, the banquet includes a reception and guest speaker, and serves as a networking event to cap off the course.

If you are involved with microtunneling or are planning to be involved, the Microtunneling Short Course is a must-attend event to obtain the latest technical information to ensure a successful project. The course is presented in cooperation with Microtunneling Inc., Trenchless Technology magazine and the Colorado School of Mines’ Office of Special Programs and Continuing Education. To register for the course visit: http://csmspace.com/events/microtunnel
A RECENT PROJECT FOR THE METROPOLITAN SEWER DISTRICT OF GREATER CINCINNATI DEMONSTRATED THE BENEFITS OF COMBINING TRENCHLESS AND DESIGN-BUILD AS PART OF THE OAKLEY STATION SEWER SEPARATION PROJECT.

TEAMING UP FOR SAVINGS

DESIGN-BUILD AND TRENCHLESS A WINNER FOR CINCINNATI MSD

Trenchless technology has long been regarded for its ability to install new utilities with minimal disruption to residents and businesses. Now, when coupled with design-build contracting, it is showing that it can do in an expeditious and cost-effecting manner.

A recent project for the Metropolitan Sewer District of Greater Cincinnati demonstrated the benefits of combining trenchless and design-build as part of the Oakley Station sewer separation project.

Working under an EPA consent decree to reduce combined and sanitary sewer overflows, the city was in the midst of an economic development project to revitalize an abandoned industrial area. The city saw the opportunity to create a new dedicated storm sewer in the area, thereby eliminating a CSO source. By using trenchless, MSD was able to reduce impact to stakeholders, including businesses, factories and churches in the area, while addressing terms of consent decree. By using design-build, which was only recently available for use in the State of Ohio, MSD realized cost and schedule savings. The use of design-build allowed the redevelopment work to proceed concurrently without the delay of having to finalize designs. Traditional procurement could have substantially delayed the urban redevelopment efforts.

Ulliman Schutte Construction of Miamisburg, Ohio, was the design-build contractor and Midwest Mole Inc. of Indianapolis was the trenchless subcontractor selected to optimize the design and construct the majority of the scope of work that involved $5.3 million worth of deep tunneling, storm structures and utility relocation. Brown and Caldwell worked with MSD to oversee all elements of the design-build contract, including procurement assistance through development of the RFQ and RFP, technical assistance during contractor selection and negotiation, design oversight, and contractor oversight during construction.

Work included nearly a half mile of large-diameter storm sewer; 1,930 lf of 72-in. ID rib-and-board curved tunnel with a 60-in. Hobas FRP liner in a roadway; 300 ft of 72-in. RCP jacked beneath an interstate highway; 11- and 12-ft diameter 40- to 50-ft deep drilled tunnel access and manhole installation shafts; six manholes ranging from 72 to 120 in. in diameter; and an outfall structure. Midwest Mole was awarded the construction portion of the project April 16, 2013, and was substantially complete on December 19, 2013.

Trenchless construction was selected for the deep storm system due to the need minimize construction impacts to an existing highway and an active roadway with significant commercial, retail and community activity. The commercial redevelopment was well under way when the project began and the proposed tunnel and manholes had to connect to a newly constructed storm sewer system. Sanitary and water utilities had to be relocated to facilitate construction, and temporary traffic control was implemented to provide safe work zones for workers and the traveling public. All construction activities were closely coordinated with the owner, community organizations, businesses and the ongoing commercial development to assure minimal disruption and facilitate excellent communication with all stakeholders.

trenchlessonline.com
Geotechnical investigation showed that the tunnel would be constructed in relatively dry, stiff silty clays with occasional seams of perched water. Midwest Mole modified an Akkerman 720 TBM by adding self-contained hydraulics and an extended conveyor that allowed the use of three muck cars to complete one 4-ft tunnel set per muck cycle. This TBM was used to steer a radius section of tunnel that terminated where the TBM intersected the one of two deep shafts constructed using a drilled shaft lined with a 10-ft diameter grouted corrugated metal pipe. The tunnel crew navigated the 87-ft, 5-in. OD TBM through the center of a 120-in. OD manhole shaft. A standard closed-face Akkerman 720 TBM and SP 400 ton jacking system was used for the 300 ft of 72-in. RCP highway crossing.

The project included several technical challenges. The 1,930 ft of tunnel was constructed in a busy roadway with one 50-ft work shaft, two small-diameter, drilled CMP-lined deep access shafts and one 25-ft deep receiving pit. The small-diameter pits were used for the installation of precast storm manholes with 60-in. FRP lined through them. Small drilled shafts were necessary to minimize traffic disruption and utility relocation. These two manholes also had to connect to the newly constructed site drainage system that was already installed and temporarily connected to the existing combined sewer. One of these connections required jacking a 72-in. steel casing at a depth of 25 ft from inside an 11-ft diameter shaft to connect to a 48-in. storm line.

Other challenging aspects included the discovery of a buried building in the path of the proposed 72-in. RCP tunnel that was to be the system outfall. This obstruction was discovered while constructing the jacking pit and the project had to be redesigned by moving the proposed crossing within a very limited working area. The lower section of the project was redesigned while the upper end of the system continued to be constructed. Had this been a traditional design-bid-build project, the entire project would have been stopped until the changed condition was recognized and a new alignment was determined and designed, causing delays and associated costs.

Design-build contracting allowed the project to proceed while portions were redesigned with minimal cost and zero schedule impact. There were other instances where unexpected conditions posed challenges. In each case, the high degree of trust between the design-build team and the owner allowed the best solutions to be proposed and accepted rapidly.

Overall, the project proved a successful marriage of trenchless technology, design-build contracting and excellent project execution, which resulted in a very satisfied group of stakeholders who saved time and money who while proceeding with an ambitious redevelopment project while simultaneously meeting consent decrees requirements. The design-build implementation was estimated to have saved more than 20% of the construction cost of $12.2 million, and saved 13 months off of the schedule. It was named a Trenchless Technology magazine 2014 Projects of the Year Honorable Mention for the New Installation category.
At the end of April 2014, a 236-lf., 60-in. microtunneled raw water intake was completed when the microtunnel boring machine (MTBM) drilled through a concrete headwall and tremmie block before emerging into the Ute Reservoir.

Groundwater supplies for residents of Curry, Roosevelt and Quay counties in New Mexico have been dwindling in the past decade, a result of depleted supplies from local aquifers and an increase in well taps by a growing population. It became evident that current sources could not accommodate even sustained usage from the existing population in a few decades. To address these issues, the Eastern New Mexico Rural Water System (ENMRWS) was formed in 2010.

The ENMRWS was charged with finding a solution to provide a sustainable potable water source for many years to come. ENMRWS reviewed several options and chose the design of a lakeside intake structure from the Ute Reservoir as the best solution. Capitalizing on this water source is suspected to yield an annual delivery of 16,450 acre feet per year.

The Ute Reservoir was created in 1959 by damming the Canadian River in Logan, New Mexico. Today, the reservoir serves as a tourist’s destination and is flanked mostly by seasonal properties.

Major design elements for the first phase of the project include an intake structure, intake tunnel and pump forebay shaft. Future phases of the project will add pump stations, water storage tanks, 87.5 miles of 30- to 54-in. diameter transmission lines, 94.8 miles of 8- to 36-in. lateral pipelines, and communication systems. The entire project costs are $550 million and are projected for completion by 2033. The Ute Reservoir Intake Screens, Tunnel and Pump Forebay Shaft phase of the project cost $14 million.

Nada Pacific Corp. of Caruthers, California, was subcontracted for the microtunnel portion of the project. All other facets of construction were performed by ASI Constructors Inc. of Pueblo West, Colorado. Occam Engineering is the project program manager and CH2M Hill of Albuquerque, New Mexico, is project engineer. Engineering & Construction Innovations Inc., of
Oakdale, Minnesota, a sister company to ASI, provided expertise for the specialized drill-and-blast operations. ASI Marine Services, another sister company to ASI, provided professional services, personnel and equipment for the underwater construction.

ASI mobilized to the project site in late 2012. Crews began with excavation to lower and level the ground to the shaft’s top grade. The bedrock along the reservoir comprises highly saturated and fractured sandstone with an unconfined compressive strength of 10,000 psi. The 80-ft deep by 50-ft diameter forebay shaft, intended for future use as a pump station, was blasted and hollowed out in stages. After each blast, ASI lowered excavation equipment into the shaft with a 160-ton crane, spoils were transferred into a muck box and removed from the shaft via crane. Curtain grouting prevented water inflow during this process and the walls were supported with shotcrete and grouted rock anchors.

A specially designed compression ring slip form was used to mold the 18-in. thick, 4,000-psi cast-in-place walls that were installed in 11-ft increments. Next, ASI moved to drill-and-blast construction for the intake bench. A long-reach excavator, situated on a barge in the reservoir, excavated material 50 ft below the water elevation to create the intake bench. Permanent rock fall mesh was attached to the vertical rock above the intake bench by divers using 9-ft rock anchors to prevent loose rubble from falling on the equipment or intake bench. Nearly 80% of the rock fall mesh was attached underwater by the diving team.

In preparation for the MTBM’s emergence into the reservoir, a tremmie concrete block was poured and anchored to the surrounding bedrock so the MTBM would have a stable location to exit the highly fractured sandstone. The perimeter of the construction area in the reservoir was outfitted with a marine safety barrier to prevent contamination.

The MTBM was launched from the forebay shaft. The launch seal was designed to withstand the estimated groundwater pressure and consisted of multiple rubber seals and heavy-duty slide plates. Prior to launch, the seal and headwall were pressure tested to 30 psi using the MTBM and slurry system. A closure piece was welded from the seal to the pipe to ensure a watertight seal and that the water pressure from the reservoir would not push the pipe back into the launch shaft after the jacking frame and pipe clamp were removed.

Sixty-in. OD Permalok pipe in 20-ft lengths with T7 joints and Powercrete J coating on the exterior was specified for the intake tunnel. The coating protects the exterior of the pipe from the abrasive sandstone during the pipe jacking process and prevents corrosion after the microtunneling is completed.

Nada used its Akkerman SL60 MTBM,
MT460 jacking frame, control container and bentonite pump with a Derrick Flo Line Primer slurry separation plant for microtunneling operations. The MTBM was outfitted with a bulkhead to seal off the sensitive internal components of the MTBM from water damage when retrieved from the reservoir. The MTBM cutterhead was equipped with disc cutters, drag teeth, and picks to meet the 15,000-psi rock cutter baseline.

Nada mobilized on site on March 11, 2014. After a few minor delays, crews launched the MTBM on April 7, 2014, and had to contend with constant wind, sometimes as strong as 70 mph, during their six weeks onsite. They experienced an average production rate of 34 lf per 11-hour shift, and reported a peak installation rate of 52 lf in one shift.

Prior to launch, crews welded a bulkhead in the first pipe behind the MTBM. After retrieval of the MTBM, the bulkhead served as a watertight seal between the reservoir and the jacking shaft to allow for simultaneous work on both ends of the project. After the MTBM drilled through the headwall, the 5-ft space between the back end of the MTBM and the bulkhead was closed and pressure tested before the MTBM was removed from the pipe string. The bulkhead would later be removed by ASI when the complete intake system was ready for operation.

The MTBM was recovered at 50-ft depths by drivers who connected it to a sling, then hoisted it to the surface via crane. Nada completed its portion of the project on April 29, 2014.

ASI planned to remain onsite through November 2014. Doug Laub, general superintendent for ASI, reported that they are currently “completing construction on the concrete deck designed to receive a pump station building in a future contract.” Laub furthered that, “they formed and placed the intake footing 50 ft below reservoir elevation, and erected the column support structure that will hold the high and low level intake valves and support the elevated access platform, approximately 15 ft above water elevation.” The intake screens are hydro-burst actuated to keep them clean for raw water filtration before it goes into the forebay shaft. It was expected that the complete system will be in full operation in late 2014.

Laub commented on the complexities of this project noting that, “the sizeable quantity of underwater work, amount of concrete installed underwater, and technical factors made this project remarkable. The unique construction variables required careful staging and extraordinary safety considerations – factors not typically considered on a job site.” Laub stated that all the crews had to be careful to maximize their time. He added, “project regulations disallowed night shift and weekend work, so each step in the timeline was constantly assessed and reassessed during the crew’s daily meetings.”

Laub was pleased with ASI’s partnership with Nada and attributed the success of the microtunnel intake to “expertise, collaborative planning and communication.”

Laura Anderson is Director of Marketing for Akerman, a Pipe Jacking and Tunneling Equipment Manufacturer Headquartered in Brownsdale, Minnesota.
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While microtunneling is never "routine"—careful planning and attention to detail are prerequisites of every successful project—the reality is that some jobs are more difficult than others. Mixed faced conditions, abrasive rock and strict requirements for line and grade accuracy can challenge even the most seasoned professionals.

In a recent microtunneling project in Pennsylvania, the contractor faced all three of these difficulties in a single run, which also included shallow cover as it passed below the Schuylkill River in Reading.

As part of the project, crews from Bradshaw Construction of Eldersburg, Maryland, completed a 436-ft bore through mixed face conditions, including rock that measured 34,300 psi. To complicate matters, crews had to hit a small-diameter (9-ft) receiving shaft, which meant that accuracy of plus/minus 1.5 in. was needed to allow recovery of the microtunnel boring machine (MTBM). Given the potential for deflection due to the mixed face and hard rock conditions, this presented a significant challenge.

Most of the new pipeline was constructed by open-cut, but microtunneling was selected to install the 436-ft reach under the Schuylkill River. The design called for construction of shafts on either side of the river, with a 60-in. casing installed to host the 42-in. pipeline. Entech Engineering of Reading was the project designer and Hill International Inc. of Philadelphia was the project manager. Pact Construction of Riegels, New Jersey, was the general contractor.

Several challenges were associated with the construction of the jacking shaft, including: the presence of contaminated groundwater, which restricted dewatering; the deteriorated condition of the existing pipeline, which limited blasting for shaft excavation in rock; the potential for flooding due to the proximity to the river; constraints related to the keeping operations at the pump station unimpeded; and limited shaft support options due to the geologic conditions.

To minimize groundwater inflow and dewatering, a secant pile shaft 32-ft in diameter and 40 ft deep was constructed. Drilled piles were viewed as preferential to steel sheeting because of the rock conditions near the pipeline invert. Once the piles were drilled and the shaft excavated subaqueously, the plan was to install a concrete tremie plug at the shaft bottom.

During shaft construction, however, it was discovered that the top of rock was higher than expected. This was despite an extensive geotechnical investigation program that included 12 borings, nine of which were within the river, along the 436-ft bore. Due to the presence of...
rock requiring mechanical excavation, a reinforced concrete slab was constructed, which minimized the amount of rock excavation needed. A concrete thrust block was installed to accommodate the MTBM and 520-metric ton jacking frame.

Crews used a specially fabricated, 60-in. diameter MTBM with 280 mm disc cutters. The MTBM was equipped with access to the back of the cutterhead, which would allow changing of cutting tools in what was anticipated to be an abrasive environment. crews jacked in 20-ft lengths of Permalok steel casing pipe as the MTBM progressed.

The entrance eye comprised a seal and fiberglass reinforcement in the secants to allow passage of the MTBM. Challenges associated with the tunnel drive included the mixed face and hard rock ground conditions as well as the low cover (5 ft) below the bottom of the river.

Once through the seal, the MTBM encountered mixed-face conditions for the first 112 ft. In addition to mixed-face conditions on the top and bottom of the alignment, conditions also varied left and right, causing difficulty in keeping the machine on line and grade. Conventional mixed-face conditions of alluvial deposits with core stones followed over the next 84 ft. Toward the middle of the river, an area of unstable ground led to over-excavation and caused the cutter wheel to stall and cause the slurry lines and pumps to clog.

Full-face rock was encountered 196 ft into the drive and continued until the MTBM was 40 ft from the reception shaft. At this point the MTBM was stopped and jacking pressures increased, necessitating a cutterhead intervention. However, testing revealed that water was flowing from the river along the overcut annulus around the casing. Crews grouted the annulus, thereby cutting off the water flow and allowing the intervention. The intervention showed mostly nominal wear, except for one disc cutter that had a failed bearing, which was replaced. Overall, the drive had an average advance rate of approximately 12 ft per shift.

Lester Bradshaw Jr., president of Bradshaw Construction, said that there are several factors to consider when trying to keep an MTBM on line and grade in difficult conditions. “First, you need to recognize quickly when you encountered the conditions before the MTBM is deflected off course. Second, you need to slow down the MTBM advance rate,” he said. “This gives the operator time to respond and the MTBM time to cut into the harder material without significant deflection. While recognizing such situations before being deflected is sometimes easier said than done, particularly in conditions like this or with boulders, too often I hear of MTBM operators who try to push through to keep that productivity up, and in the process they sacrifice accuracy.

“Finally, it is important to use a drilling fluid thickened with bentonite and/or polymers to support the tunnel face and hopefully prevent sinkholes. The very fact that part of the face cuts slow while other parts might flush easily is challenge unto itself. While sinkholes may not cause line and grade deviation, they can have disastrous consequences, including environmental or structural damages, increasing jacking loads or, in our case, bringing river water to the face of the MTBM and making accessing the cutter chamber expensive and time consuming.”

The reception shaft was located on the south side of the Schuylkill River with ground surface 6 ft below the elevation of the jacking shaft, increasing the potential for flooding. Like the jacking shaft, blasting was not permitted due to the proximity to the existing pipeline and its condition, resulting in shaft excavation through dolomitic rock in the bottom half of the 34 ft deep shaft. According to Bradshaw, the hard dolomite with a peak UCS of 34,300 limited the shaft diameter to 9 ft, substantially smaller than a 16-ft diameter shaft that would preferably be built in that situation. The shaft was drilled using slurry and steel casing shaft supports installed to full depth and grouted in place.

The MTBM was recovered in several shifts and the 42-in. DIP force main installed and grouted in place after pressure testing. “Our crew did an exceptional job operating the MTBM on multiple shifts and achieving the goal of hitting the receiving shaft within 1.5 in., which led to a very expeditious recovery,” Bradshaw said.

This article used information from the paper “MICROTUNNELING IN MIXED FACE/MIXED REACH HARD ROCK,” by LESTER M. BRADSHAW JR., WHICH WAS PRESENTED AT THE 2014 NASTT NO-DIG SHOW IN ORLANDO, FLORIDA. THAT PAPER IS AVAILABLE FOR NASTT MEMBERS FREE OF CHARGE AND CAN BE PURCHASED BY NON-MEMBERS AT WWW.NASTT.ORG/TECHNICALPAPERS.
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MORE...
OB LOG

The project includes extremely tight work areas within existence of difficult ground condition. This $780,520 project for Pacific Gas & Electric involved a single tunnel drive of 165 ft of 16-in. OD steel casing pipe with 8-in. fusion-welded PVC carrier pipe. Shafts will be approximately 20 to 40 ft deep. Crews will use an Iskei TCZ300 16-in. ODMTBM for this $183,000 project.

The prime contractor is Blue Pacific Engineering & Construction. The engineer is Tran Engineering. Work is scheduled to be performed in February 2015.

MURRIETA

Whitewood Gravity Sewer
Vadnais Trenchless

This $2 million project for the Eastern Municipal Water District comprised four separate tunnel drives totaling 1,191 ft of 38.5-in. OD Permalok steel casing with 21.5-in. OD VCP carrier pipe. The drive lengths ranged from 155 to 545 ft. Shafts were approximately 20 ft deep. The drives were installed up to 15 ft below the groundwater table in alluvium soils with bedrock intrusions and gabbro rock. Tunneling was completed beneath Interstate 215, environmentally sensitive open areas, and residential streets that had to remain open. Difficult ground conditions required the replacement of the MTBM with a mixed face MTBM (Iskei TCC800 39.5-in. OD).

Utah Pacific Construction Co. was the prime contractor. Hunsaker & Associates was the engineer. The project was completed in late April.

NEWPORT BEACH

Newport Force Main Rehabilitation
Vadnais Trenchless

This $2.24 million project for the Orange County Sanitation District consists of two tunnel drives totaling 1,430 ft of 42-in. OD Permalok casing with 32-in. HDPE carrier pipe. Drive lengths are 410 and 1,020 ft with shafts that will be approximately 12 to 22 ft deep. The groundwater table is approximately 12 ft above the tunnel horizon. The drives are to be installed with the use of a mixed-ground cutter head in siltsand bedrock to running sands using an Iskei TCS900 42-in. OD MTBM.

The project will be constructed within a very tight work area in the center median of Highway 1 (Pacific Coast Highway), a heavily trafficked thoroughfare in Southern California. The alignment is severely congested with existing utilities. Work is scheduled to begin in November.

VISTA

Watson Way Project
James W. Fowler Co.

The Watson Way project involved the installation of 3,800 ft of approximately 20-in. diameter sewer pipeline near Watson Way in Vista, California. As designed, the project included about 2,600 ft of microtunneling, 400 ft of horizontal directional driling (HDD), and 800 ft of cut-and-cover pipeline. A series of launching and receiving pits were envisioned to keep the microtunnel drive lengths at about 400 to 500 ft. Ground conditions include artificial fill, alluvium, and highly weathered to fresh granitic rock.

Site conditions and/or construction contractor preference resulted in a variety of modifications to the design layout, including reducing the number of launching/receiving pits, lengthening the tunnel drives, substituting a pipe ram for the HDD drive, auger boring one reach, and increasing the amount of cut-and-cover construction. Jacobs Associates was contracted by M.J.S. Construction Management and the City of Vista to provide reviews of the microtunneling specifications, review of contractor submittals, construction observation, analysis of as-built geologic conditions, and evaluation of microtunneling progress and methods.

The project was awarded in April 2012. the contractor began mobilization and constructed a launch shaft in late 2012, and microtunneling began in January 2013. The
microtunneling generally went smoothly, except where cobbles and an interval of strong granitic rock were encountered. In these cases, the difficulty was remedied by excavating rescue shafts. When tunneling was complete, attention turned to annular grouting of the PVC carrier pipe. Although common practice suggests that filling the carrier pipe with water will adequately dissipate heat, because of the relatively large annular space, there was a concern about excessive heat. Jacobs Associates helped resolve this issue by conducting a full-scale field test with detailed automated temperature monitoring. Test results showed a 70 to 80 degree F rise within the center of the annular grout, a 45 to 50 degree F rise at the outside wall of the carrier pipe, and a 30-degree F rise on the inside wall of the carrier pipe. The results were used to select maximum injection pressures for the annular grouting.

(Source: Jacobs Associates Blog - http://www.jacobsff.com/blog/)

FLORIDA

TAMPA

CIAC River Crossing Bradshaw Construction Corp.

Bradshaw has started construction on a microtunnel project 30 ft under the Hillsborough River. The project consists of shafts on either side of the river and a 430-ft x 60-in. steel casing containing a 36-in. water pipeline. Deep soil mixing (DSM) shafts on either side of the river and a 430-ft x 60-in. steel casing containing a 36-in. water pipeline. Deep soil mixing (DSM) shaft in Kaneohe. A conventional tunnel alignment; excavation of launching shaft (4-ft thick walls) has been completed. Current activities include microtunneling for surface pipelines, and construction of diversion and junction structures connecting to existing pipelines.

Slurry wall panels installation for 87-ft diameter launching shaft (4-ft thick walls) has been completed. Current activities include jet grouting microtunneling pipeline and conventional tunnel alignment; excavation of launching shaft in Kailua; and installation of slurry wall panels for receiving shaft in Kaneohe.

HAWAII

KANEHOE/KAILUA

Kaneohe/Kailua Sewer Tunnel Project Southland/Mole JV

This $173 million project for the City and County of Honolulu, Department of Design and Construction, Wastewater Services Division, was given NTP on Jan. 6, 2014 and has an estimated completion date of Jan. 9, 2017. The project consists of 16,338 lf of tunnel (1,388 lf conventional tunnel via Roadheader, 14,950 lf TBM tunnel) with a tunnel diameter of 13 ft. The final liner, fiberglass reinforced pipe, will have an ID of 10 ft. The project contains two slurry wall shafts: an 87-ft diameter, 95-ft deep launching shaft (Kailua Site), and a 30.5-ft diameter, 54-ft deep receiving shaft (Kaneohe Site). The predominant ground condition is basalt. The project includes microtunneling for surface pipelines, and construction of diversion and junction structures connecting to existing pipelines.

Slurry wall panels installation for 87-ft diameter launching shaft (4-ft thick walls) has been completed. Current activities include jet grouting microtunneling pipeline and conventional tunnel alignment; excavation of launching shaft in Kailua; and installation of slurry wall panels for receiving shaft in Kaneohe.

Lead Designer: Wilson Okamoto Corp.; Tunnel Designer: Jacobs Associates; Construction Manager: Bowers and Kubota Consulting; Major Subcontractors: Layne Chris-tensson Co. (slurry wall and jet grout); James W. Fowler Co. (microtunnel); Brierley Associates (Design Consultant). Hobas Pipe USA is supplying the fiberglass pipe and The Robbins Co. is supplying the TBM.

Key Project Personnel – SMJV Project Director: Tim Winn; SMJV Project Manager: Don Painter; SMJV Quality Control Manager: Craig Kolei; SMJV Senior Project Engineer: Quang D. Tran; SMJV Project Administrator: Bill Kominew; CM Director: Mike Young.

MICHIGAN

WORTH TOWNSHIP

Karegnondi Water Intake Pipeline Project L. D’Agostini & Sons

L. D’Agostini & Sons was the low bidder in February 2013 with a bid of $24.6 million for the Karegnondi Water Authority project. The intake consists of 1.5 miles of 78-in. tunnel, and is nearing completion, according to the Port Huron Times Herald. About 1,500 ft of tunnel had yet to be excavated as of late October, according to the report. Crews are using a Herrenknecht MTBM to build the tunnel. The intake is part of a larger project for the authority that involves about 74 miles of 5 to 5.5-ft pipe through Sanilac, Lapeer and Genesee counties. The new pipeline and intake will allow the authority to supply water to the county, rather than purchasing it from Detroit. The pipeline will supply untreated water to the...
municipalities of the region, industrial customers, agribusinesses, rural agriculture developments, residential commercial light and heavy manufacturers. The boundaries of the water supply encompass over 2,400 square miles and over a half a million people. This is estimated to save the county about $3 million per year.

NEBRASKA

GRAND ISLAND

Grand Island North Interceptor – Phase II (Project No. 2013-S-4)

Super Excavators

This project is still in the process of determining final scope but has an approximate microtunneling value of $1.5 million. The owner is the city of Grand Island and the prime contractor is SJ Louis with Super Excavators as the microtunneling subcontractor.

The scope of the microtunneling includes construction of approximately 730 lf of 57-in./60-in. OD Hobas pipe in two drives (212 and 520 lf). All work will be completed with Super Excavators’ Akkerman SL-60. Ground conditions consist of wet sands, silts and poorly graded silty sands. Microtunneling is expected to begin during the second quarter of 2015.

NEW HAMPSHIRE

NASHUA

CSO 005-006 Screening and Disinfection Facility

Northeast Remsco Construction Inc.

This $950,000 project for the City of Nashua involved 540 If of 60-in. RCP in a single drive beneath a U.S. Army Corps of Engineers’ flood control levee to convey CSO effluent to the river after screening and disinfection. The pipe was installed approximately 10 ft below the groundwater table through silty sand mixed with occasional cobbles.

Northeast Remsco used company-owned Herrenknecht AVN 1500T with a skin-up kit to match the 73.5-in. OD of the jacking pipe and equipped with a mixed ground cutting wheel. Northeast Remsco worked as the microtunnel sub-contractor to GC Methuen Construction Co. Inc. Hazen & Sawyer was the engineer.

Machine recovery was completed in a cofferdam built along the edge of the Merrimack River. The project was completed in August 2014.

OHIO

AKRON

Englewood Avenue – Little Cuyahoga Interceptor (LCI)

Vadnais Trenchless

This $2.295 million project for the City of Akron comprised four separate tunnel drives totaling 2,800 If of 57-in. ID Hobas primarily along Englewood Avenue. Drive lengths varied from 445 to 968 lf. Shafts were approximately 22 to 37 ft deep. The alignment was in a high groundwater table with boulders, cobbles, silts and sand. Vadnais used a Soltau RVS600AS microtunnel TB with a 61-in. OD.

RHODE ISLAND

PROVIDENCE

Narragansett Bay Commission CSO Abatement-Phase II

Northeast Remsco

Three of the five construction contracts of the Narragansett Bay Commission’s (NBC) Combined Sewer Overflow (CSO) Phase II Abatement Program have reached substantial completion. Only minor punch list items remain. The two remaining tunnel contracts are nearing completion.

Under Contract 303.03C, the Woonasquatucket CSO main contract, approximately 12,000 feet (365 m) of reinforced concrete pipe (RCP), ranging from 30 to 72 inches in diameter (760–1,830 mm), were microtunnelled and pipe jacked. In addition, a reach of 1,800 feet (550 m) of connecting adit tunnel to the Phase I Foundry shaft has been excavated by drill-and-blast methods. The adit was lined with 96-inch-diameter (2,440 mm) prestressed concrete cylinder pipe (PCCP) and the annulus filled with 50 psi LDDC (foam cement). The 96-inch pipe was transitioned down to 54-inch (1,370 mm) PCCP into the de-aeration chamber, which was formed and cast in place. The 60-inch-diameter (1,525 mm) PCPP drop shaft and the 24-inch-diameter (610 mm) mortar-lined ductile iron vent shaft were placed and encased in 20-foot (6 m) increments up to the bottom of the vortex chamber. The contract is on schedule to go into service by the end of 2014, with only minor restoration items remaining. The Barletta Heavy/Shank/Balfour Beauty Joint Venture is the general contractor for Contract 303.03C.

Under Contract 303.04C, for the Seekonk CSO Interceptor, Northeast Remsco Construction has constructed approximately 5,720 feet (1,745 m) of 48- and 60-inch-diameter (1,220 and 1,525 mm) RCP by microtunneling. Remsco is currently completing some structure work and should be demolished by October of this year. The Gilbane/Jacobs Associates JV team is providing construction management services on this Providence, Rhode Island, project to the program manager, Louis Berger.

The NBC CSO Phase II Abatement Program contractually completed in June 2015, but only minor restoration work will remain by January 2015. Depending on the weather, this work could be completed by February 2015.

(Sources: Jacobs Associates Blog – http://www.jacobssf.com/blog/)

LIVINGSTON

Livingston WTP Intake Tunnels

Bradshaw Construction Corp.

Bradshaw was selected to install twin 36-in. steel casings from a 30-ft deep pump station shaft at the shoreline of Lake Livingston Reservoir to an intake cofferdam in the lake. The 390-ft (each) casings are to be installed by microtunneling. The subsurface conditions consist of clay and sandy silt 20 ft below the water table. Project start is scheduled for October 2014. Information: Mike Wanhatalo; mwanhatalo@bradshawcc.com.

HOUSTON

Bintiff, Eppes & Frawley Forcemain Replacement

Vadnais Trenchless

This $2.35 million project for the City of Houston will consist of five tunnel drives totaling 2,180 lf of 30-in. OD Hobas and three tunnel drives totaling 839 lf of 42-in. OD Permako steel casing with 30-in. carrier pipe. Drive lengths range from 116 to 570 ft. Shafts will be approximately 20 to 30 ft deep. Tunneling is to be performed below the groundwater table in predominately stiff flat clay. Crews will use Iseki TCC600 30-in. OD and TCC900 42-in. OD MTBMs.

Huff & Mitchell Inc. is the prime contractor and CH2M Hill is the engineer. Work is scheduled to begin in early 2015.

WISCONSIN

MILWAUKEE COUNTY

Zoo IC, Zoo Interchange Phase I, State Project 1060-33-80

Super Excavators

This $3.75 million project for the Wisconsin Department of Transportation includes construction of 1,474 lf of 60-in. concrete storm sewer in five runs (282 lf, 287 lf, 532 lf, 124 lf and 249 lf). All work will be completed with our Akkerman SL-74 at an average depth of 40 v.f. Ground conditions consist primarily of clay soils, with some pockets of sands. The microtunneling subcontract also includes construction of six launching/receiving shafts. Wisconsin Constructors II, LLC (Lunda Construction Co., Michels Corp., and Edgerton Contractors) is the prime contractor.

The microtunneling for this job is part of a very large, $198 million WIDOT contract that includes coordination between several agencies and numerous contractors. The project is located over a large area that includes three cities including West Allis, Wauwatosa and Milwaukee. Challenges include a fairly aggressive schedule, uncertainties of winter weather, and microtunneling beneath highways and utilities in a highly congested area.

Shaft construction and microtunneling is scheduled to commence in early November 2014, and reach completion by early summer 2015.

TEXAS

AUSTIN

Mansfield WTP Intake Tunnel

Bradshaw Construction Corp.

Braddock was selected to install a 42-in. steel casing from a 170-ft deep pump station shaft at the shoreline of Lake Travis to an intake structure in the lake. The 530-ft casing is to be installed by microtunneling. The MTBM will be recovered underwater. The subsurface conditions consist of weak limestone transitioning to clay at the lake bottom. Project start is scheduled for December 2014. Information: Mike Wanhatalo; mwanhatalo@bradshawcc.com.

trenchlessonline.com
BOLTON
King Street Feedermain
Dibso/CRS Tunneling JV
This $12 million project (approximately $3 million for microtunneling) for the Region of Peel is being built by a joint venture of Dibso and CRS Tunneling with Gamsby and Manneros/CIMA as the engineer. The contractor is using an Akkerman SL60 slurry MTBM to complete three tunnel drives (152 m, 380 m and 320 m) at an average depth of 12-14 m through soft ground (silty-clay with boulders). Crews are using 1,200-mm ID Hanson RCP. The project is being built through the congested downtown core of Bolton with tight spaces and working areas, and restricted working hours. Mining took place during one of the coldest winters on record. Extensive settlement, vibration and noise monitoring were used due to age of downtown core. The project began Sept. 26, 2013, and reached substantial completion on Sept. 22, 2014.

GUELPH
York Sanitary Trunk Sewer and Paisley-Clythe Watermain Project
CRS Tunneling
This $1.1 million project is being constructed for the City of Guelph, with Drexler Construction Ltd. as the general contractor and is scheduled for completion (full demobilization) by mid December 2014.

Clythe Watermain Project
York Sanitary Trunk Sewer and Paisley

This $12 million project (approximately $3 million for microtunneling) for the worldwide microtunneling, horizontal directional drilling, large-diameter tunneling, slurry wall/foundation drilling, water well drilling, and various other underground construction industries. All Derrick machines, screen panels, and tanks systems are manufactured in-house at the Buffalo, New York, headquarters facility.

For information, contact Ben Clark, Derrick Equipment Company (p: 866-337-7425, em: bhc Clark@derrick.com), or Barry Sorteberg, Clean Slurry Technology (p: 661-332-9480, em: bsorteberg@cleanslurrytechnology.com).

Derrick Equipment Co. (Derrick), a leading provider of solids control equipment, announced its partnership with Clean Slurry Technology (CST). This partnership positions CST as the exclusive U.S. Civil Distributor for Derrick’s premium line of solids control products to the underground construction industry.

CST maintains a fleet of Derrick equipment for sale and rental out of its Bakersfield, California, location. CST’s inventory of Derrick solutions includes Flo-Line Primers, High “G” Linear Motion Shakers, High Speed Decanting Centrifuges, various size separation plants along with a parts, and screen panel inventory. CST offers full service solid separation system design, set-up, and operation supported by a team of fully trained technical and service personnel. The company provides additional services such as mud engineering, polymer selection testing, and polymer dosing system design – all of which are tailored to the specific needs of the project. CST has plans to expand its national presence by adding an East Coast facility in the near future.

Derrick, a family-owned company founded in 1951, has a 25-year history of offering premium solids control products to the drilling, large-diameter tunneling, slurry wall/foundation drilling, water well drilling, and various other underground construction industries. All Derrick machines, screen panels, and tanks systems are manufactured in-house at the Buffalo, New York, headquarters facility.
When planning, designing, building and overseeing a construction project, it is critically important that all parties – owner, engineer and contractor – are speaking the same language, so to speak. As part of the ASCE’s revised Standard Design and Construction Guidelines for Microtunneling, which is nearing completion, the authors included a glossary of terms so that all stakeholders are on the same page. The authors of the Guidelines, who represent a cross-section of the industry, hope that these terms will find common usage going forward. (For more information about the Guidelines, see the article beginning on page 6 of this issue.)

“We wanted to establish a common language,” said Glenn Boyce of Jacobs Associates, who served as the chairman of the committee responsible for the publication of the revised Guidelines. “We went back and forth to make sure that everything was covered, and that we formed a common language to use.”
Pipe for conveyance of water, carbon footprint: The amount of carbon the pipe is intended to transfer the jacking force from the microtunnel boring machine’s (MTBM’s) bearing area to the jacking pipe and to create a waterproof seal between the machine and the spigot of the first joint. 

Advance rate: Forward progress over a given period of time, includes penetration rate, effective advancement, and idle time; typically measured in feet or meters per shift.

Annular space: The theoretical volume between the gauge cut and the outside radius of the jacking pipe times the length of the installation, equal to \( \pi \times \text{x length of tunnel} \) annular thickness: The radial distance between the excavated radius created by the gauge cutter and the outside radius of the jacking pipe. The radial distance is equal to the overcut (gauge cut) plus the shield cut.

Annulus: The theoretical area between the gauge cut and the pipe outside diameter (OD) equal to \( \pi \times (\text{gauge cut OD} - \text{pipe OD}) \). It is the combined area created by the overcut and the shield cut.

Auger boring: A technique for forming a bore from a jacking or drive shaft to a receiving shaft by means of a rotating auger with cutting tools. The casing is jacked forward sequentially in a cyclic process while the auger is turned. Spoils are removed back to the drive shaft by helically wound auger flights rotating in the steel casing. The equipment may have limited guidance and steering capability.

Auger MTBM: A type of microtunnel boring machine that uses auger flights to remove the spoils through a separate, smaller casing placed through the jacking pipe.

Backfill grouting: Grout injected into the void space between the carrier pipe and casing after the drive is completed. Belly pans: Shims or other steel plates added to the bottom of the MTBM to adjust the diameter of the jacking pipe and to create a waterproof seal between the machine and the spigot of the first joint.

Berlin construction method: A sewer construction method developed in Berlin, Germany, whereby sewer Laterals are bored into the ground and then dropped into the sewer interceptor. This method of connecting Laterals to sewer is more commonly used with trenchless installations.

Boulder: Per ASTM D653, a rock fragment, usually rounded or semirounded, with dimensions between 3 and 12 in. (75 and 305 mm).

Cohesive soils: Earth materials containing less than 20 percent soil particles passing the No. 200 sieve. Any free-running soil, such as sand or gravel, whose strength depends on friction between particles.

Cohesive soils: Earth materials containing 20 percent or more soil particles passing the No. 200 sieve.

Compression ring: A ring fitted between the end-bearing flange of the leading pipe bell and the trailing pipe spigot to help distribute jacking forces more uniformly. A compression ring is attached to the trailing end of each pipe and is compressed between the pipe sections during jacking. The compression ring compensates for steering corrections, pipe misalignment, and pipe dimensional tolerances. It is also referred to as a packer.

Contact grouting: Grout injected into the theoretical space between the jacking pipe and the ground after the drive is completed.

Contaminated plume: The underground trace of an environmental pollutant.

Contract documents: Documents prepared by the owner and project engineer for bidding and for awarding a contract; they can include bid forms, general conditions, special conditions, technical specifications, drawings, geotechnical data reports, and geotechnical baseline reports.

Control console: An electronic unit typically inside a container located on the ground surface that controls the operation of the microtunneling machine. As the machine operator drives the tunnel from the control console, electronic information is transmitted to the control console from the MTBM. The information conveys bore position, steering angle, jacking force, penetration rates, machine-face torque, slurry feed and return flow rates and pressures, and laser position. Some control consoles are equipped with a computer that tracks and stores the data and allows real-time analysis of the tunnel drive.

Controls: Part of the microtunneling system that allows synchronized excavation, removal of spoils, and jacking of pipe to balance forward movement with excavation so that ground settlement and heave are managed.

Crossing: Pipeline installation in which the primary purpose is to provide one or more passages beneath a roadway, road, or other surface obstruction.

Crown: The highest point of the pipe or tunnel entrance seal: See launch seal.

cut and cover: See open-cut.

cutability: The capacity of rock to be splintered, rippled, chipped, and broken into smaller pieces to allow the advance of the MTBM. Key properties affecting cutability include the frequency of discontinuities, unconfined compressive strength, tensile strength, hardness, and abrasiveness of the rock.

cutter chamber access: See face access.

cutter wheel: Any rotating tool or system of tools on a common support that excavates at the face of a bore.

cuttings: See spoils.

casing: A jacked pipe in a two-pass system that supports a bore. The casing is not a carrier pipe.

cemented soils: Soils in which the particles are held together by a naturally occurring or man-made chemical agent that changes the soil’s physical and mechanical properties.

differential cut: The spiral, screwlike pattern created on the excavated surface as the gauge cutter is advanced while being rotated around the bored periphery of the cutter wheel.

differential pipe: Pipe installed in the ground and serves as the casing and carrier pipe.

discharge line: See return line.

down time: Time lost when the MTBM is unable to operate; generally associated with equipment failure.

drilling fluid: Water that may contain additives, including bentonite, polymers, soda ash, surfactants, or other materials, to enhance stability and excavatability. If the drilling fluid contains additives and is designed to have specific properties, it is considered to be an engineered drilling fluid, whether specified by the engineer or selected by the contractor. Some additives may increase the effectiveness of the drilling fluid and reduce adhesion of the spoils (cuttings). The drilling fluid is used in a closed-loop system for transporting spoils and for countering earth and groundwater pressures during microtunneling.

drive: Designation of an installation from a jacking shaft to a reception shaft.

earth pressure: The use of a tool that compresses a percussive hammer head, generally torpedo-shaped casing. The hammer may be pneumatic or hydraulic. The term is usually associated with nonsteered devices.

effective stresses: In a saturated mass of soil or rock, the total stress minus pore water pressure. Uw.

emergency recovery shaft: See rescue shaft.

Engineered drilling fluid: See drilling fluid.

Entrance seal: See launch seal.

Entry ring: See launch seal.

EPB machine: Earth pressure balance tunneling machine, by which mechanical pressure is applied to the material at the face and controlled to provide the correct counterbalance to earth and groundwater pressures in order to prevent heave or subsidence. The term is not applicable to microtunneling systems for which the primary counterbalance of earth and groundwater pressures is supplied by pressurized slurry.

Exit seal: Same as a launch seal except for the retrieval of the machine at the reception shaft. Used in high groundwater and unstable soils to prevent loss of ground.

Exit shaft: See reception shaft.

Eye: The opening in the shaft wall through which the MTBM is launched.

Face: The location where excavation is taking place. Face access: Access to the location where ground water is encountered.
excavation is taking place, typically through the cutting chamber. MTBM configuration may only allow limited personnel access to the back of the cutter wheel from within the pipe string. An air lock may also be required in the rear of the MTBM to maintain air pressure for counterbalancing earth and groundwater pressures.

**face pressure:** Earth and groundwater pressures applied against the cross-sectional area of the microtunnel face.

**factor of safety:** The ratio of the structural capacity of a system to expected or actual loads on the system.

**feed line:** Pipeline that transports drilling fluid from the slurry separation plant to the face of the MTBM.

**filter cake:** A thin layer of clay or polymer from the slurry at the face and perimeter of the formation being excavated. The filter cake is formed through filtrate loss. A liquid that has passed through a filter.

**fines:** Particles of soil finer than a No. 200 (75 mm) US standard sieve.

**fracture:** See inadvertent return and hydrofracture.

**Gg**

**gauge cut:** The outermost projection of the excavation, measured as a diameter. The gauge cut is subject to cutter wear and to the differential cut.

**gel:** Per ASTM D653, the condition of a liquid that has begun to exhibit measurable shear strength.

**gravel:** The measured time interval between the point when the slurry mix is in a fluid state and the point when it begins to form a gel.

**ground cover:** Distance between the ground surface and the crown of the pipe.

**groundwater:** All subsurface water, as distinct from water on the surface.

**grouting:** The process of filling voids or of modifying or improving ground conditions. Grouting materials may be cementitious, chemical, or composed of other mixtures.

**guidance system:** System that locates the actual position of the MTBM relative to the laser or other device. The laser or other device should be referenced to the design line and grade.

**guided boring method:** Another term for the pilot tube method, in which an auger boring power unit is used with a pilot tube’s guidance and steering system.

**Hh**

**heave:** Measurable upward movement of the ground or structure as the result of the excavation process.

**horizontal directional drilling (HDD):** A surface-launched trenchless technology for the installation of pipes, conduits, and cables. HDD creates a pilot bore along the design pathway and reams the pilot bore in one or more passes. The bore is then enlarged and shaped to the size of the outer pipe string that is pulled into the prepared bore in the final step of the process.

**HQ:** A diamond core wire line tube drill bit size where the hole diameter is 96 mm and the outer pipe diameter is 116 mm.

**hydracture:** A special form of inadvertent return in which drilling fluid reaches the surface or waterway. Also called a frac-out.

**idle time:** Lost time when the MTBM is not in operation, not including makeup time or downtime.

**special supplement:** NORTH AMERICAN MICROTUNNELLING
cable. The excavation is then backfilled, and the site is restored.

open-face: Term referring to one mode of operation of a traditional TBM.

overcut: The theoretical difference between the radial measurement of the gauge cut and the MTBM (gauge cut OD - MTBM OD)/2. Actual overcut is reduced as the gauge cutter is worn because of the differential cut.

over excavation: Apportioning excavating more material than the theoretical volume of the tunnel-based on diameter and advanced distance. Over excavation can lead to ground settlement and the formation of voids.

packer: See compression ring.

penetration rate: Instantaneous excavation distance per time while the MTBM is operating, typically measured in inches per minute or millimeters per minute.

perched water: An accumulation of groundwater that is above the regional groundwater table in an unsaturated zone.

performance specification: A document that establishes the performance criteria the constructed product must meet. A performance specification leaves the selection of suitable methods to the contractor.

piecing tools: See earth piercing.

piezometer: A specialized monitoring well that provides discrete screens and underground seals to produce a measurement of the groundwater pressure at specific intervals below ground. The groundwater pressure may be measured using open standpipes or vibrating wire transducers.

pilot tube method: A multistage method of accurately installing a product pipe to line and grade by use of a guided pilot tube followed by upsizing to install the product pipe. The pilot tube method does not fit within the definition of microtunneling.

pipe brake: A mechanical device designed to prevent the MTBM and pipe string from moving back into the shaft.

pipe eating: See in-line microtunneling.

pipe jacking: A system of using hydraulic jacking from a drive shaft to directly install pipes behind a shield machine so that they form a continuous lining in the ground.

pipe lubricant: See lubrication.

pipe ramming: A trenchless installation whereby a percussive hammer is attached, via an adapter, to an open-end casing, which is then driven through the ground. The excavation, the spoils within the casing are removed after the drive is completed, or periodically during the drive.

pipe string: The succession of joined individual pipes being used to advance and support the excavation.

pitch: The upward or downward angle of the MTBM, measured from a theoretical horizontal plane passing through the longitudinal axis of the MTBM.

plastic viscosity: A measure of the internal resistance to fluid flow, expressed as the tangential shear stress in excess of the yield stress divided by the resulting rate of shear.

plowing: A condition where the MTBM is being steered in one direction, yet continues along an unintended path.

pore water pressure: The pressure of the groundwater held within a soil or rock in gaps (pores) between particles.

portholing: Carefully dug, nonmechanized excavation, used to locate a utility or other subsurface feature.

product pipe: See carrier pipe.

pumping adapter: Mechanical component mounted on the thrust ring to prevent the thrust ring from coming into contact with and damaging the pipe collar.

Rr: receiving shaft: See reception shaft.

reception shaft: Excavation into which the microtunneling equipment is driven and recovered.

rescue shaft: An unplanned additional shaft required to remove obstacles/obstructions and/or retrieve or repair the MTBM. The rescue shaft may need to function as a jacking shaft to complete the drive.

return line: Pipeline that transports slurry from the face of the MTBM to the slurry separation plant. Also known as discharge line.

rider: A shallow collection line that runs along the microtunneled trunk sewer to a draw manhole.

rock: Per ASTM D653 and ISRM, any naturally formed aggregate of mineral matter occurring in large masses or fragments.

roll: The angle of rotation about the theoretical longitudinal centerline of the MTBM, measured from the 12 o’clock position.

SS: settlement: Measurable downward movement of the ground or of an overlying utility or other structure as the result of excavation or dewatering.

settlement point or marker: An instrument to sense vertical ground movement driven into the ground to monitor vertical ground deformations before, during, and after construction.

shield cut: The theoretical difference between the radial measurement of the MTBM shield and the jacking pipe equal to (MTBM OD - pipe OD)/2.

skinning: The act of fitting a steel cylinder over the MTBM shield body to increase the diameter of an existing MTBM with the use of an appropriately upsized cutter wheel. Also referred to as upsizing.

slurry: A mixture of drilling fluid and spoils.

slurry chamber: A chamber in which excavated material is mixed with slurry for transport through the return line to the separation plant at the surface. The slurry chamber is located behind the cutter wheel of a slurry microtunneling machine.

slurry lines: Parallel hoses or pipes that transport spoils and slurry from the face of a slurry microtunneling machine through the return line to the ground surface for separation, and then return the slurry to the face for reuse through the feed line (the feed line is also known as a chiple line).

slurry separation: A process in which excavated material is separated from the circulation slurry. Mechanical separation is typical, although gravity separation in pits or tanks is possible with coarse-grained soils.

spacers: Mechanical structures used to transfer the jacking force from the jacking thrust ring to the pipe and to accommodate lengths of pipe that are longer than the stroke length of the jacks.

specials: Pipe sections immediately ahead of and behind the US. Specials have ends that are specifically manufactured to physically accommodate the US.

spoil: Earth, rock, and other materials excavated during the installation process. Also referred to as cuttings.

sump pump: A device placed at the base of a shaft or in an MTBM to collect and remove fluids incidental to the construction process and result from shaft leakage, and to prevent the excavation equipment from flooding.

surface water: Any water encountered or collected from the face of an MTBM to collect and remove fluids incidental to the construction process and result from shaft leakage, and to prevent the excavation equipment from flooding.

Tt: thrust block: An engineered structure, located between the jacking frame and the shaft wall, that distributes the jacking force developed by the hydraulic jacking frame over a large surface area to the ground behind the back wall of the shaft.

thrust ring: A fabricated ring that is mounted on the face of the jacking frame. It is intended to transfer the jacking force from the jacking frame to the thrust-bearing area of the pipe section being jacked.

tooling: Ground-engaging elements of the cutter wheel designed to excavate and penetrate the ground.

top hat: A steel can with a faceplate bolted to a reception shaft wall to receive the arriving MTBM.

trailing can: A principal module that is part of a shield machine such as an MTBM or tunnel boring machine (TBMs); its use depends on the installation dimensions required and the presence of an articulated joint to facilitate removal.

trenching: See open-cut.

trenchless technology: A family of construction techniques for installing or rehabilitating underground infrastructure with minimal disruption to surface traffic, businesses, and residents. Also includes technologies for inspection, leak location, and leak detection with minimal disruption and minimal excavation from the ground surface.

tunnel horizon: The vertical band within the ground where the tunnel is excavated. Includes one tunnel diameter above the crown and one tunnel diameter below the invert.

two-pass: A procedure by which the carrier pipe is installed within a jacked casing.

UU: unanticipated return: See inadvertent return.

upsizing: Process of creating a larger diameter MTBM than a machine with the original factory configuration. Also referred to as skinning. Also, any method that increases the cross-sectional area of an existing pipeline, replacing it with a larger cross-sectional area pipe.

utility monitoring point (UMP): An instrument designed to measure movement of an individual utility when exposed to construction activities.

utility tunneling: A construction method for excavating an opening beneath the ground without continuous disturbance of the ground surface. The excavation is of sufficient diameter to permit personnel access, and allow excavation, transport of spoils, and erection of a ground support system.

WW: water: Beam used within a braced excavation as support to control wall deflections.

water jetting: Process of using the internal cleansing mechanism of the cutter head, by which high-pressure water is sprayed from nozzles to help remove cohesive soils.

Yy: yaw: The angle of the MTBM to the left or right of a theoretical vertical plane passing through the MTBM’s longitudinal axis.

ZZ: zone of influence: Volume of ground that could possibly be affected by settlement or heave from tunnel mining, shaft excavation, pile driving, or other construction activities.
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