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BC's Magazine for Trenchless Construction

Forward

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2013

Official Publication of the North American Society for Trenchless Technology • British Columbia Chapter

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North American Society for Trenchless Technology - BC Chapter

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Y-Join NASTT BC?

THE BRITISH COLUMBIA CHAPTER OF THE NORTH AMERICAN SOCIETY FOR TRENCHLESS TECHNOLOGY (NASTT)

NASTT BRITISH COLUMBIA CHAPTER: Leaders in Innovation

Formed in 1997 as part of the original NASTT Northwest Chapter, the BC Chapter was established separately in 2005. It exists to promote the use of trenchless technology in B.C. through education and standards. NASTT-BC has worked hard over the last 8 years to have trenchless standards adopted throughout the Province. In 2008, work began by the Chapter to develop a tool for accurately determining the reduced carbon footprint that various trenchless technologies offer - the Carbon Calculator! Use this program to estimate the tons of carbon emissions that were eliminated by the trenchless construction method that you have chosen for your project. Watch for the posting of the latest version of this useful tool to enhance sustainability in British Columbia.

- In the MMCD's new Platinum book, CIPP and Pipe Bursting are included, with remaining trenchless methods to follow.
- NASTT-BC held 3 seminars last year around the province to bring local trenchless knowledge to each region. In 2013, there will be 3 more seminars on new topics in Kelowna, Burnaby and Victoria.
- NASTT-BC has worked to be a leader in promoting the use of trenchless as a low cost /low carbon method of construction.
- Since 2005, the chapter has published their annual magazine Y-DIG?
- The chapter and Y-DIG? Magazine is a great way for consultants to promote their successes, for cities to learn about the projects, methods, lessons and experiences of other cities, and for all 3 partners (owners, consultants and contractors) to share information.

WHAT IS NASTT?

Founded in 1990, NASTT is a not-for-profit educational and technical society. As the North American component of the ISTT (International Society for Trenchless Technology), NASTT is dedicated to promoting the benefits of trenchless technology through education, training and research. NASTT is the definitive resource for trenchless professionals like you, who are concerned with underground systems and the applications of trenchless technology.

Trenchless Technology

By using trenchless technology methods, you are reducing the impact of underground construction on your community. The benefits of trenchless technology are priceless:

- Minimizes surface disruption & trenching
- Reduces public inconvenience
- Cost-effective methods
- Less traffic congestion
- Widely utilized & accepted
- And this all adds up to - REDUCING CARBON FOOTPRINT BY UP TO 90%!

Membership

If you're interested or concerned in underground systems and the application of trenchless technology, then NASTT membership is right for you.

NASTT connects you to the people and businesses involved in the trenchless industry.

NASTT is your link to thousands of trenchless professionals and leaders working in regional, national and international levels. Membership is open to individuals, agencies and companies involved with providing gas, water, sewage, communications and electrical services.

Your Regional Chapter - NASTT-BC

A major contribution the NASTT-BC Chapter has made to the global trenchless effort is the promotion of trenchless technology as a low carbon option.

For more recent information on Trenchless Construction in British Columbia and BC Chapter activities, go to **www.nastt-bc.org**.

JOIN NASTT and NASTT-BC TODAY!

To become a member of NASTT-BC, contact Monica Perry at mwperry@telus.net

President's Message

Preston Creelman

Promoting Trenchless Technology in B.C.

Trenchless construction was employed on some projects in British Columbia this past year. Most citizens of B.C. were not even aware of these jobs, and that is a good thing. However, the board of NASTT BC knows that there were many more instances where one of the trenchless methods could have been utilized. With this in mind, NASTT BC will be continuing its efforts of promoting the technology of trenchless construction through education.

The one-day seminars held in 2012 were well attended, averaging over 40 at each of the three sessions. This mini "Made in B.C." roadshow format travelled to Kelowna, Parksville and Surrey. B.C. owners, designers, suppliers and contractors listened to B.C. speakers recount their recent experiences with pipe bursting, corrosion evaluation of watermains, cured-in-place-pipe technology, testing various in situ products, and culvert rehabilitation. Feedback and attendance showed that our industry wanted more presentations like this, so our board has scheduled another three events for 2013. Again, featuring five local/B.C. presenters, for one day in the Okanagan, Lower Mainland and Vancouver Island, but highlighting five other aspects of trenchless technology.

Members of the B.C. Chapter are also actively submitting papers and presentations for content of technical sessions at other organizations' conferences. The B.C. Water and Waste Association will see two papers, while submissions to No-Dig, PWA-MSA and MED-MMCD are also planned. Also, contacts at various institutions in B.C. are being initiated to begin informing students about trenchless technology; "teach 'em young!"

While we acknowledge that trenchless construction is not viable for all utility construction, certainly many more projects could be done with these methods, if only the decision makers knew of the various no-dig options. And as trenchless construction results in minimal carbon emissions to perform this infrastructure repair and/or rehab, we at NASTT BC hope that more cities choose trenchless as they realize it will also enhance their sustainability initiatives.

An Exciting Year for NASTT

DEREK POTVIN
CHAIRMAN, NASTT

This is my first opportunity to address my fellow Canadians of the British Columbia Regional Chapter as your NASTT Chairman, and I'm so proud to do so. The year 2013 is just a few months old and already so much has happened through the work of NASTT and its Regional Chapters.

The B.C. Chapter has been an integral part of NASTT since 2005, and the hard work and accomplishments of your Chapter are warmly appreciated. The B.C. Chapter has made tremendous strides in the region to spread the trenchless message to municipal owners and utilities through local outreach and educational opportunities. I am excited about your Chapter's educational program for 2013, as it takes on the topics of grouting, video and audio inspection and asset management through one-day workshops.

We recently celebrated the trenchless industry at the 2013 NASTT No-Dig Show in Sacramento, California. I hope you were able to attend this fantastic event! My thanks to the No-Dig Program Committee, led by Chair Kim Staheli, as well as the countless volunteers for such a memorable conference. I hope you were able to attend the high-quality sessions of our Technical Program and interact with the leading trenchless professionals — both are invaluable resources. Plans for the 2014 No-Dig Show in Orlando, Fla., are well under way.

I am happy to report that NASTT was able to share the 2013 No-Dig Show experience with more municipal owners this year through our Municipal Scholarship Program. This program was created to assist those owners who want to attend the No-Dig Show but do not have the financial means to do so. This was the first year of this special program, and we were pleased to provide the cost of hotel space and show entry to 85 North American municipal owners who otherwise would not have been able to attend. We look forward to growing this program to give municipal owners the opportunity to learn how trenchless technology can benefit their communities.

2013 is shaping up to be an exciting year for NASTT. Let me share a few of our key initiatives with you. We will continue to build and strengthen our relationships with associations such as APWA and AGA, allowing us to reach out to even more municipal and utility owners. The NASTT Carbon Calculator continues toward completion, and we have put together an exceptional educational lineup through our Good Practices workshops and Webinar series.

NASTT reaps its rewards through the commitment, enthusiasm and dedication of its Regional Chapters. We simply would not have the success we have without you — you are our trusted partner. I look forward to working with you to make 2013 the best year yet!

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NASTT'S 2014 NO-DIG SHOW

THE MAGIC OF TRENCHLESS

APRIL 13-17 - GAYLORD PALMS - ORLANDO, FLORIDA

WWW.NODIGSHOW.COM

The North American Society for Trenchless Technology (NASTT) is now accepting abstracts for its 2014 No-Dig Show in Orlando, Florida. The conference will take place at the Gaylord Palms on April 13-17, 2014.

Prospective authors are invited to submit a 250-word abstract outlining the scope of their paper and the principal points of benefit to the trenchless industry. The abstracts must be submitted electronically at NASTT's website by June 30, 2013: http://www.nastt.org/abstractsubmission.

NASTT's 2014 No-Dig Show Program Committee will review abstracts and notify the primary authors of acceptance in August. To ensure meaningful and commercial free technical content, all papers will be peer-reviewed. Final papers will be published in the conference proceedings.

ABSTRACTS FROM THE FOLLOWING SUBJECT AREAS ARE OF INTEREST TO THE NO-DIG SHOW PROGRAM COMMITTEE:

HDD

- Pipeline Inspection and Locating
- Condition Assessment
- Subsurface Utility Engineering
- I&I and Leak Detection

Cutting-Edge Advances in Pipeline and Manhole Rehabilitation

- Cured-in-Place Pipe Lining
- Sliplining
- Pipe Bursting
- Laterals Rehabilitation
- Grouting
- Lining Materials and Application Methods

New Installations

- New Concepts for Trenchless Equipment, Materials and Methods
- Horizontal Directional Drilling (HDD)
- Microtunneling
- New Applications for Boring Techniques (Auger Boring and Pipe Ramming)
- Pilot Tube Boring (Tunneling)

Trenchless Research and Development

- University and Industry Initiatives
- Education and Training

Environmental Incentives, Challenges and Sustainability

- Carbon Reduction
- Sustainable Construction Practices

Municipal Issues

- Selection Criteria for Contractors
- Development of Submittal Requirements
- Measuring Quality Assurance/Quality Control
- Project Budgeting and Prioritization
- Selection Criteria for Materials
- Funding for "Green" Technologies
- Lessons Learned

Industry Issues

- Social Costs and Impacts
- Carbon Footprint Reduction
- Industry Trends, Issues and Concerns

QUESTIONS? PLEASE CONTACT:

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SUBMISSION DEADLINE: JUNE 30, 2013

Measuring the Benefits of Trenchless Construction: *An Update*

David O'Sullivan
PW Trenchless Construction Inc.

When most people think about trenchless (should they be so deprived and have nothing else to think about), they recognize the benefits. However, in this day and age, those benefits must be measured and evidenced in a legally acceptable manner for a government to give them full consideration.

When we deal with public funds, the path of spending approvals must be clear, concise and replicable. The Supreme Court of Canada has made it very clear, in its decisions on the process of public tendering, that in order to award a contract documents must be clear and precise.

Broad and subjective clauses will be meaningless while precise and focused clauses will be upheld no matter how weird they sound. Example: Under tendering law, a city is well within its rights to require that, when you submit a tender, you wear a pink jacket. If you do not wear the pink jacket, the city is legally entitled to reject your bid, as long as they stated that requirement clearly in the "instructions to tenders." They may, however, not get many bids!

Therefore, clauses like "the owner has the right to accept tenders that are environmentally friendly" will not be enforceable unless the "environmentally friendliness" is defined clearly in a measurable way. In short, subjectivity in the tender submission process has to be removed and replaced by the objective, measurable and comparable.

NASTT-BC initially pursued the connection between reduction of carbon emissions and the promotion of trenchless construction. Our Carbon Calculator and subsequent calculators are tools to assist designers in making decisions as to which type of construction to recommend, and to guide them in designing projects. The broader promise of trenchless cannot be leveraged until we monetize the environmental value of choosing trenchless technology over the status quo.

Carbon Protocol

If we can reduce our carbon emissions using trenchless, we must go beyond calculating these reductions and on to proving them. The reduction of carbon emissions did not have a value when we started this process seven years ago, but more and more governments are assessing value on carbon emissions, and that is what we are trying to benefit from.

> "The 'carbon credit' is a difficult concept for the public to understand, and various vested interests can create uncertainty around the concept very easily."

In British Columbia in 2008, the provincial government mandated reductions in carbon emissions. The B.C. government along with all schools, universities and health authorities achieved carbon neutrality in 2010. Most municipalities in the province signed on to the Climate Action Charter, which commits them to achieve or evidence progress to carbon neutrality by 2012. Since most of the cities of B.C. are trying to achieve zero carbon emissions in their "day-to-day" operations, we have an opportunity to assist the cities to get closer to that goal.

Cities now have the choice of reducing their energy use as much as possible and then buying credits to "offset' the energy they use while serving the tax-

payer. But since the use of trenchless creates a measurable carbon benefit, we can help them get closer to carbon neutral without having to buy credits externally.

This area of the carbon market is quite new for government as well as industry, and it has to be set up very carefully. A definitive legal method must be developed to allow these savings to be turned into a saleable/tradable item. This is called the Carbon Offset Protocol.

The "carbon credit" is a difficult concept for the public to understand, and various vested interests can create uncertainty around the concept very easily. Therefore, we have to be very careful to make sure that the work we do is totally transparent and sanctioned by the various approving bodies.

The first trenchless offset protocol is something we developed a year ago, but we were ahead of government and so had to wait for the provincial government and cities to catch up. They have now caught up and thus we are moving forward again. We are working with an adjunct professor at UBC as well as three other carbon professionals to have the protocol accepted by the province as an acceptable way of creating carbon credits for use within a city's own carbon offsetting system. This will allow cities in B.C. to capture the carbon credits from their trenchless programs. The cities can then apply these credits against their emissions from regular operations.

Somebody once asked me to clarify this, and I explained it this way: "A beer parlor has a good business but is looking to increase its profits and lower its costs. One of the staff says 'What about all the beer bottles we put in the garbage each week?' Then they set up a system of collecting all the empty beer bottles and returning them for the deposit. That is the kind of saving we are talking about. Not something of a major cost benefit, but enough to make a difference and something that is the right thing to do for the environment."

With reference to the tendering process above, it now means that a major benefit of trenchless can be measured in a legally defined way, and that cost saving can be added to the project should it be constructed using trenchless rather than traditional open-cut construction. This gives us a legal route to add the benefits of trenchless in the tendering process.

Societal Good

In this day and age, where we see the effects of weather change and the devastating effects it has on society, we in the utility industry need to "do our bit" to reduce carbon emissions where we can.

To do this, we need to be innovative and come up with different ways of completing our work. That work includes the provision of clean water and sewage removal to the general population, as well as the provision of electricity, information and fuels to our businesses and homes.

One must remember that the supply of clean water and the removal of sewage are the biggest life-prolonging services that can be supplied by government. All the health care in the world only accounts for about four or five years of the average life. Clean water accounts for over 30. Leveraging carbon offsets so the trenchless construction industry can cost-effectively provide those services is clearly the right thing to do.

Trunk Sewer Relining in Whistler

JOHN KUPSKAY, P.ENG &
KIRK MCLEOD, ASCT
PARAGON ENGINEERING LTD.

Project: Whistler Alta Vista Trunk Sewer Relining

Owner: Resort Municipality of Whistler (RMOW); Project Engineer James Hallisey, P. Eng.; Project Manager Paul Bencharski, AScT; Utilities Supervisor Chris Wike

Engineer: Paragon Engineering Ltd.; Project Manager John Kupskay, P. Eng.; Project Technician Melchor Mateo III; Construction Inspector Kirk McLeod, AScT

Contractor: Mar-Tech Underground Services Ltd.; Project Manager Bob Taylor

Odour concerns voiced by local residents in the Alta Vista area of Whistler sparked an investigation by RMOW to isolate causes. Inspections revealed extensive deterioration in drop manholes, suspected to be due to H2S (hydrogen sulphide) corrosion. RMOW was concerned that deterioration would continue to the point of failure.

RMOW Utilities Supervisor Chris Wike contacted Paragon Engineering Ltd. to investigate corrosion concerns in isolated sections of 35-year-old existing concrete sanitary sewer trunk mains in the vicinity of three drop manholes along the sanitary trunk sewer, and to assess manhole and pipe condition. Hanging pipe gaskets and exposed reinforcing steel were observed in the concrete pipe and all five manholes. Aeration

Mar-Tech Underground Services was Contractor in the Whistler project

and turbulence due to heavy flows through the drop manholes were determined to be the primary source of the H2S corrosion in the manholes and main. Paragon's assessment report recommended internal reconstruction of five manholes including 600-mm-diameter concrete drop structures outside three of the manholes and 180 metres of 600-mm-diameter gravity trunk sanitary sewer main.

Due to advanced deterioration, repair works were deemed as critical, resulting in fast-track completion of design and tender documents followed by construction immediately thereafter.

Tendering

Tendering for this project took place between August 15 and 28, 2012. Due to complexity of the project and time constraints, only one tenderer, Mar-Tech Underground Services Ltd., responded. The contract was awarded to Mar-Tech for $426,655.73 (including HST).

Relining Manholes & Mains

Rehabilitation designs were based on 35-mm-thick Permacast ConMICShield manhole liner to rehabilitate manholes and 12- to 13.5-mm-thick CIPP liner to restore the sewer main.

Liner installation in the Whistler Alta Vista project

The existing main was bypassed and cleared of all roots and flushed and cleaned prior to installation of the liner. The liner was inverted under pressure and steam cured for approximately three to four hours.

After a one-hour cool-down, the ends of the cured liner were cut out at the manholes. The liner portions covering the entrance to the drop structures were then cut out by man entry. A remote-controlled lateral cutter was then placed into the new main to reinstate existing service laterals, providing minimal interruptions to the neighbouring residences. Test samples for manhole and pipe were prepared and sent for testing and evaluation to determine the tensile and flexural properties.

By using Permacast and CIPP relining technology, RMOW was able to take advantage of a quick, economical and trenchless reconstruction that could possibly provide solutions for other areas of similar condition. This option is normally selected because it is low-cost and offers a low carbon footprint and restores full structural condition while providing a 50-year service life.

Relining Drop Structures

Mar-Tech used Formadrain to line the two-metre-deep drop structures outside each manhole. Formadrain is a steam-cured system using balanced bi-directional woven fibreglass and a two-component epoxy resin that is pulled in place through existing pipes.

The Formadrain liner was inserted through the bottom of the drop structure and held in place for approximately two hours while it steam cured.

Original as-built drawings indicated two 45-degree bends within the drop structures; however, field review indicated a single 90-degree bend at the bottom of the drops. This sharp bend created an issue when curing the bladder as the material produced a fold at the bend which was deemed to be minor and accepted in place

Drop structure liner wetout

Reconstructing Manholes

Corroded steel ladder rungs were exposed down the entire depth of the manholes. Prior to reconstructing the manholes, the interior surface was pressure washed to remove all laitance and loose material.

Reconstruction of manholes began by installing a Permacast Plug and Patch quick-setting cement compound to patch leaks in holes, exposed joints, and where the newly relined main tied into the manhole. MS-10,000 Structural Liner with ConMICShield was used and applied with a high-speed, rotating, bi-directional spin-caster to reconstruct the five manholes.

MS-10,000 Structural Liner is an ultra-high-strength corrosion-resistant mortar, based on silica-modified Portland cement. As bacterial growth is neutralized, hydrogen gases released from the raw sewage cannot be metabolized and converted into sulphuric acid in concentrations sufficient to damage the impregnated concrete and mortar. A Spincaster applicator was used to provide a densely compacted liner of uniform thickness and thorough coverage.

The SpinCaster applicator was positioned within the centre of the manhole at the lowest point of the new wall. Several locations were tested and confirmed for thickness and strength. ConShield CS Identifier Seal Coat was then applied by hand spray and brush to the surface of the newly reconstructed manhole. New PVC ladder rungs were then installed in all five manholes.

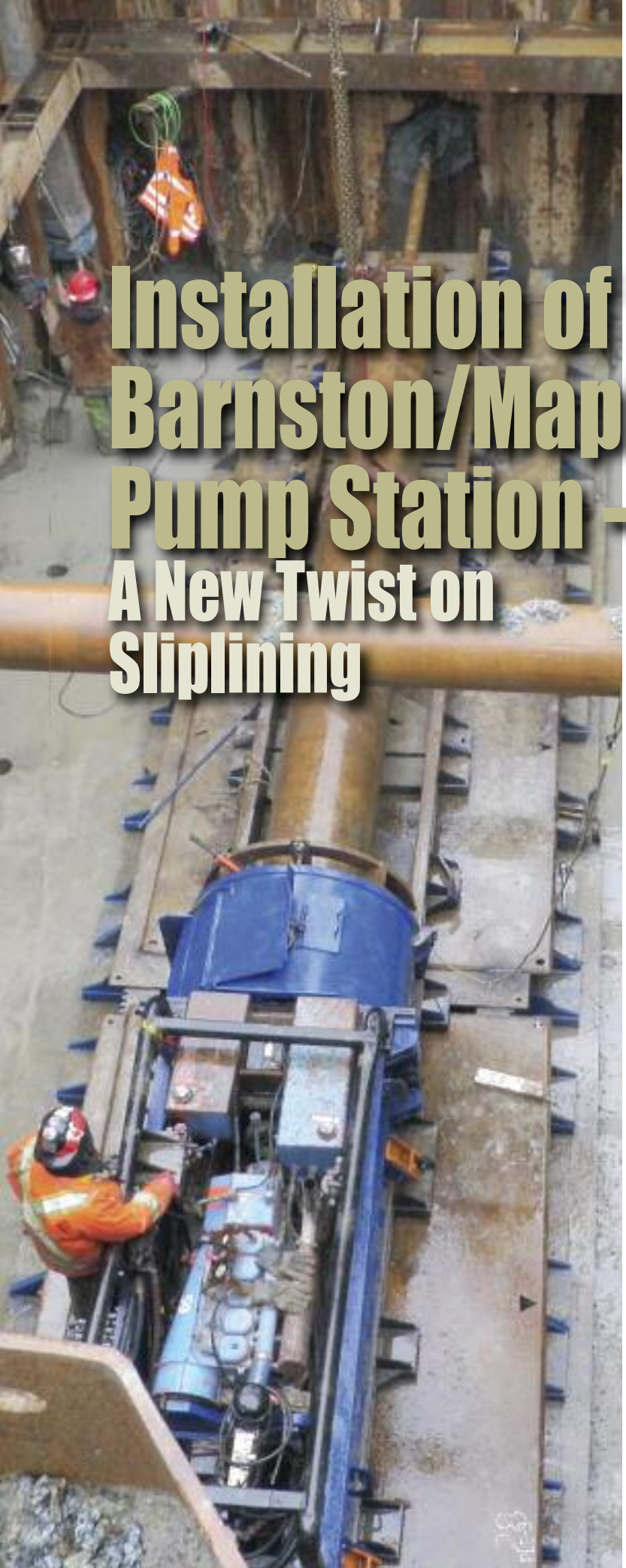
Bypass System

Five sump pumps were set into the first manhole upstream of the construction site. From each pump a 150 mm hose, was directed approximately 300 metres to the first manhole downstream not affected by construction. A crew member monitored the pumps and fuel levels at all times during their operation. Two additional pumps were on-site as backup should any of the other five become inoperable. Once proper cure requirements had been reached at the end of each day, the bypass was shut down and flows were reinstated to the main for the night. This system operated without issue during the entire project.

Ahead of Schedule

Due to the severity of the condition of the pipe and manholes, this work was considered high-priority by the RMOW and needed to be completed as soon as possible. Mar-Tech was able to schedule their crews to have the relining of the main and the drop structures completed within one working week. The following week crews completed the manhole reconstruction, and another week to install ladder rungs, demob bypass system, and site cleanup. All in all, the project was finished ahead of schedule and without any issues.

There are many articles and studies verifying the advantages of cost and time savings comparing trenchless construction to open-trench construction. This project is just another example where the time, cost, and minimal impact have proven trenchless construction to be the only reasonable option.



Installation of Barnston/Maple Ridge Pump Station - A New Twist on Sliplining

Joe Linseman
Damon Gosper
Metro Vancouver, Burnaby, B.C.

Naresh Koirala
Tom Bryski
Golder Associates Ltd., Burnaby, B.C.

Metro Vancouver (MV) is a Regional Government delivering services on behalf of 24 local authorities in the Greater Vancouver area. The Greater Vancouver Water District (GVWD) is responsible for planning, constructing and managing a network of water mains, pump stations, and reservoirs to supply water to a population of over two million people living in the region. As part of the Langley-Surrey Water Supply (LSWS) agreement, and to increase pumping capacity to Maple Ridge, Langley and South Surrey, MV is committed to construct the new Barnston/Maple Ridge Pump Station (BMRPS). A potable water pump station in the City of Pitt Meadows, the BMRPS will have many sustainable design features and be the region's largest potable water distribution pump station.

External Piping for the Station

In order to connect BMRPS to the GVWD water mains feeding Langley, Surrey, and Maple Ridge, five separate segments of piping were constructed in advance of pump station construction, as shown in yellow in Figure 1. Pipe sizes ranged from 750 millimetres to 1,350 mm, and lengths of the segments ranged from 100 metres to 250 m.

The pipe segment to the north of BMRPS is located in undeveloped land within GVWD Right-of-Way (ROW). The segment to the east is located within public ROW in a residential area. Two of the external pipe segments, known as Crossings No. 1 and 2, cross the busy six-lane Lougheed Highway, connecting the future BMRPS to existing mains on the south side of the Highway. The final pipe segment, Crossing No. 3, partially crosses the Highway to connect to an existing main roughly in the middle of the Highway.

Figure 1: External Piping Project

Geotechnical Investigation

A geotechnical site investigation completed by Golder Associates Ltd. (Golder) determined the stratigraphic sequence to consist of import road base and fill materials underlain by peat to organic silt, underlain by firm to very stiff silty clay to clay containing occasional water bearing sand seams. Based on these results, it was considered that excavation slopes steeper than 0.75 horizontal to 1 vertical would need to be shored. The ground conditions were considered suitable for tunneling, with few rocks or other obstructions expected. However, the shafts for entry and exit of the tunnel excavation equipment would require significant support.

Selecting Trenchless Technology

For the two water main segments north and east of BMRPS, open-cut installation was determined to be the most efficient in terms of reducing construction duration and impacts to local residents. For Highway Crossings No. 1 and 2, however, trenchless technology was identified as the preferred design. The benefits of using trenchless technology include: less overall noise, vibration, and dust; significantly reduced need for imported backfill; and less congestion on roads when compared to traditional pipe laying. It can also reduce the overall amount of greenhouse gas (GHG) emitted during construction compared to open-cut method. An estimate of GHG emissions was not calculated for this project.

Crossing No. 1 is 1,350 mm in diameter and 99 m in length; Crossing No. 2 is 1,350 mm in diameter and 72 m in length (Figure 2). Installation by open-cut methods would have been time-consuming and disruptive to traffic. Substantial delays to Highway traffic were not acceptable to the Ministry of Transportation and Infrastructure (MOTI). In order to mitigate these concerns, MOTI mandated that these two Highway crossings be completed using trenchless technology.

Conventional tunneling and microtunneling were identified as feasible options. Koirala et.al. (2013) provide detailed discussion on the selection of trenchless technology for this project.

Crossing No. 3 is 750 mm in diameter and 35 m in length, terminating at an existing main in the eastbound lanes of the Highway, as shown in Figure 3. Trenchless methods were considered for this crossing as well; however any method that required a tunnel exit shaft located within the trafficked lanes would have caused major disruptions to traffic. Due to the smaller diameter and shorter length of this crossing, and with fewer deep utilities to cross, MV engineers sought and

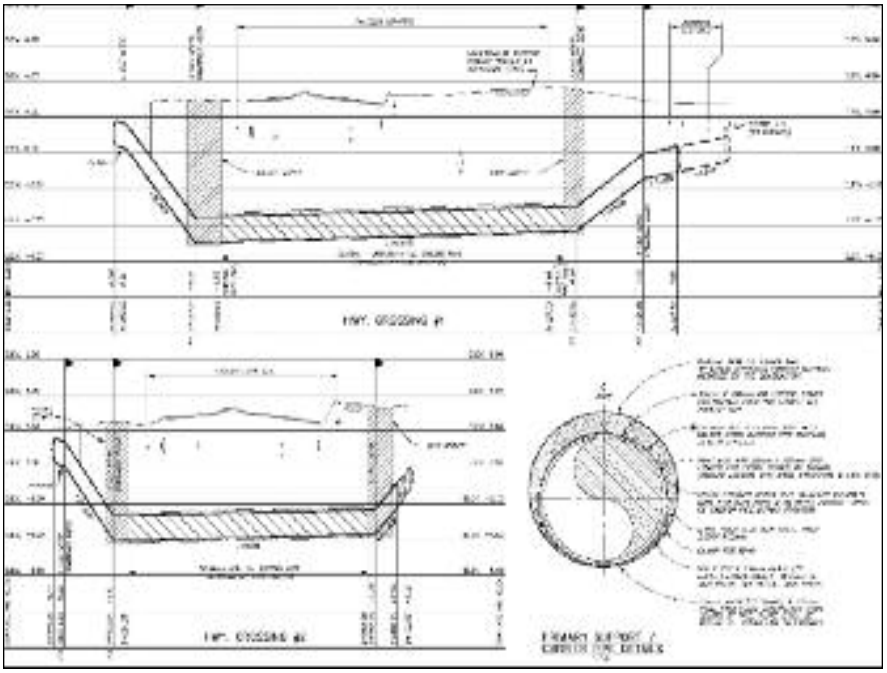


Figure 2: Trenchless Crossing Profiles

received permission from MOTI to install the water main by open-cut method over the course of a weekend.

Construction of Crossing No. 1 and Crossing No. 2 by Pilot Tube Method

The external piping general installation contract was awarded to Pedre Contractors Ltd. (Pedre). Pedre subcontracted the tunneling work to Kamloops Augering & Boring Ltd. (KAB). To install the two trenchless crossings, Pedre proposed to use Pilot Tube Method, or staged enlargement of a pilot tube bore by pipe jacking with simultaneous auger boring.

Both water mains (carrier pipes) would be housed inside larger casings to protect the integrity of their external polyurethane coatings. In Pilot Tube Method, a pipe jacking machine is set up in the Entry Shaft and a small diameter pilot bore is jacked the length of the tunnel to establish line and grade; then the bore is upsized by jacking increasingly larger pipe casings using the pilot tube bore as a guide. Based on the equipment manufacturer's recommendations, the application range for a pilot tube installation for 100-mm- to 600-mm-diameter pipes is up to 80 m in length, although a few larger-diameter installations of up to 50 m in length had been completed. The minimum casing size required to house the carrier pipe was considered to be 300 mm larger than the diameter of the 1,350 mm water mains, or 1,650 mm inside diameter. Therefore, the proposed installation by Pedre/KAB would be the largest of its kind.

Crossing No. 1

The Contractor proposed shoring the shaft excavations by sheet piles. Sheet piling for the first tunnel entry shafts began in mid-January 2012 and took approximately eight working days to complete. The depth of the proposed trenchless crossings required shafts up to 8 m deep. Pedre's shaft design subcontractor determined that 18-m sheet piles would be required to support the shafts. The additional embedment depth was required to resist lateral earth pressure and hydrostatic pressure resulting from a water table depth of 1.5 metres. Sheet piles were installed using a crane-mounted vibro hammer in order to reduce noise levels in the adjacent residential areas.

The shaft was excavated in stages as sheet piling progressed. Bracing was installed to add stability to the shafts. Due to selection of the Pilot Tube Method, the tunnel exit shafts needed to be in place very early in the tunnel-

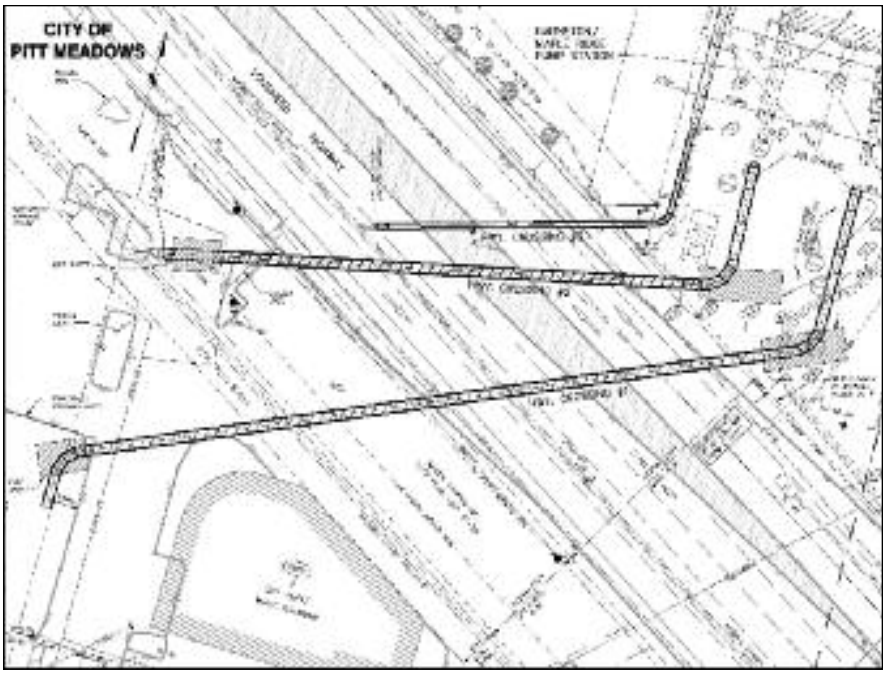


Figure 3: Highway Crossings

ing process to receive the pilot tubes. This presented a challenge because both exit shafts were located within an auto dealership. A temporary working space had been acquired within the dealership property, limiting the work duration to 180 days. Sheet pile installation for Exit Shaft No. 1 was completed in five working days in early February.

An extensive settlement monitoring program was initiated during shaft construction and tunnel excavation and used throughout the project to ensure movements were within safe tolerances on the Highway and at neighbouring residential and commercial properties.

Pedre/KAB proposed to complete each tunnel installation in three stages of upsizing using an Akkerman auger bore machine. A hole was cut in the sheet piles to allow the first pass, the 100-mm-diameter pilot tube, to enter. This hole was later upsized to accommodate the second pass using 600-mm-diameter casings, and finally 1,700-mm permanent casings (primary liner). Pedre/KAB proposed a 1,700-mm-diameter, 19-mm-pipe-wall steel casing pipe with Permalok joints. Permalok piping employs a proprietary machined joint method capable of joining two pipes without the use of welding. Pedre opted to complete a single welding pass around each joint upon installation to further ensure joint integrity in the event that pipe ramming may be required if an obstruction were encountered.

Based on the equipment manufacturer's recommendation and the expected jacking forces required to install the casings, Pedre/KAB used an Akkerman 240 pilot tube jacking system for the pilot bore and an Akkerman 84/96-1800 NG auger bore machine to install the primary liner.

After two days of machine setup and test bores, the pilot tube for the first tunnel (98 m long) was installed to full length in one 10-hour shift. Upon measurement at the exit shaft, it was discovered the pilot tube had been installed 0.5 m off alignment horizontally and within 0.04 m vertically. The 0.5-m horizontal deviation was overcome by changing the mitre angles in the piping south of the exit shaft.

Following the pilot tube bore, the contractor installed three 6-m lengths of 600-mm casing. Satisfied that line and grade had adequately been estab-

Installation of 600-mm casings following 100-mm pilot tube

Installation of 600 mm to 1700 mm expander

lished, the contractor installed the 600- to 1,700-mm expander. Finally, 6-m long 1,700-mm casings were dropped into the trench with the augers inserted for casing advancement. Soil was continually augured from inside the tunnel during installation of the 600-mm casings and the 1,700-mm casings; however, a soil plug was left at the expander face. A 16-mm outer-annulus overcut was immediately filled with a bentonite slurry via a mud line and water line welded to the outside of the casing behind a mud harness.

On the 10th day of 1,700-mm casing installation, at which time approximately 60 of 99 m had been installed, the augers began to veer towards the casing invert, owing to their accumulated weight and being 200 mm smaller diameter than the casing pipe. Tunneling crews increased the torque on the jacking machine to try to force the augers to continue, but the additional torque caused the leading augers to buckle. Fifteen metres of auger was removed while 45 m remained within the tunnel. The contractor decided to continue jacking the casings while the augers remained stationary. While this caused an increase in thrust from the jacking machine, the contractor was able to complete the casing installation in this manner. The full 99 m of casings were completed in early April after 20 working days, including five days of delay owing to the auger issues.

Crossing No. 2

While tunneling crews continued boring Crossing No. 1, piling crews began sheet piling for Entry Shaft No. 2. Sheet piling was completed in eight working days, followed by excavation of the shaft. For installation of this exit shaft, Pedre used a slide rail shaft support system instead of sheet piling because overhead power lines prevented the safe installation of large sheet piles. Slide rails of 2.4-m height were stacked in stages to reach the required depth of approximately 8 m. Excavation was completed in stages as slide rail installation progressed.

The slide-rail system required installation of corner posts first, which were then pushed deeper as more slide rail panels were installed. The slide rails took five days to install. Some ground loss occurred around the shaft, which was minimized by placement of rock fill. Following installation of the slide rails, the bottom panel was removed to allow for pipe entry. Two sheet piles were driven on either side of the future pipe entry to provide additional stability.

After the alignment issues encountered on the first pilot tube, the initial survey setup for the Crossing No. 2 pilot tube was checked and confirmed by MV surveyors. The full 70-m pilot tube was installed in one shift, this time within acceptable tolerances. After installing three 6-m sections of 600-mm casing, the 1,700-mm casings were installed in 10 working days, finishing at the end of April.

Water Main (Carrier Pipe) Installation within Crossings No. 1 and No. 2

Prior to being lowered into the entry shaft for installation within the tunnel casing pipe, 6-m lengths of 1,350-mm-diameter water main pipes were fitted with wood lagging. Two pipes were butt welded together in the shaft and fitted on a skid plate. The quality of each weld was confirmed by X-ray inspection. Pipes were then pulled into the casing pipe using a cable-and-pulley system set up at the exit shaft. This process was repeated until all carrier pipes had been installed.

Grouting of the pipe annulus, the area between the carrier pipe and casing pipe, was completed in one pass using “cellular” or “foamed” concrete composed of cement, water, and air cells. Test heads were installed on each

Installation of wood-lagged carrier pipes

end of the water main, which was then filled with water to prevent flotation. Grout was pumped into the annular space via a 75-mm fill port at the bottom of the pipe. Another port was installed at the top of the pipe which expelled air when the space had been filled.

The final challenge was installing the "riser pipes." These are steeply sloping pipes that connect the water main exiting the tunnel at 8 m depth to future tie-in piping at 2 to 3 m depth. First, a short length of piping was installed within the shaft. Then, the shafts were backfilled with specified fill, and the sheet piles were extracted using the vibro hammer. Finally, the contractor dug down to the test heads using a sloped excavation and installed the riser pipes via open-trench methods. Once the riser piping was installed at both ends, the entire pipe section was cleaned and hydrostatic testing was completed.

This external piping portion of the project was completed in August of 2012, on time and within budget. Final tie-ins and commissioning will occur when pump station construction is completed in the spring of 2014.

Reference:

N Koirala; T Bryski; J Linseman (2013). Installation of Large Diameter Water Mains Using Pilot Tube Method; North American Society of Trenchless Technology, Conference Proceedings, Sacramento, California, USA.

Culvert Assessment & Planning Tool Protects City Against Costly Failures

Simon Kras, E.I.T.
Project Engineer, Opus DaytonKnight Consultants Ltd.

The City of Burnaby, like many other municipalities, manages infrastructure that was largely constructed during the 1970s and '80s. The City's culverts are no exception. The City has chosen to pay attention to its culvert assets to avoid costly road failures seen elsewhere. Opus DaytonKnight Consultants (Opus DK) was retained to develop a culvert inspection, assessment and capital planning tool for the City which will streamline resources for planning repairs and rehabilitation.

Two cardinal rules of asset management stand out in relation to culverts:

1. Spend the majority of money on the highest-consequence assets.
2. Rehabilitate before replacement.

The first step in managing a City's culvert assets is to decide which assets

Road closure caused by culvert failure in Massachusetts [Photo by Massachusetts River Alliance]

1,800-mm circular concrete culvert with loss of concrete cover over steel reinforcement

to include in rehabilitation planning. Culverts which are under major roads without alternate routes, or which are located near hospitals, fire halls or other strategic locations are clearly the most critical. Any culvert larger than 600 millimetres in diameter is also considered high consequence, regardless of the location, due to the possibility of flooding.

The second step is obtaining data on the condition of the culverts by inspection. In many municipalities, no regular inspections of culverts are carried out, so the only data available for scheduling replacements is culvert age, material and design life, assuming that adequate record information is kept. Culverts of the same material can age very differently depending on the flow conditions, corrosiveness of the storm water and groundwater, and workmanship during installation. The only way to get a true assessment of a culvert's condition for planning purposes is by full inspection, which includes the approaches and the inside of the culvert. In Burnaby, inspections had been irregular and limited in nature.

Culvert Inspections

Twenty-six culverts were inspected as a test run. Three of them were found to be deteriorated to the point where relining was recommended. Identifying deterioration before excessive structural loss occurs can save the City costs for open-trench replacement of the culvert. The most rapidly deteriorating culverts are circular corrugated steel pipe (CSP), which can usually be rehabilitated by slip lining with HDPE pipe. The inspection methodology developed provides a quantitative score for each component, but differentiates between localized and overall conditions.

Assessment & Works Planning

Based on inspections, capital works can be planned for the highest-risk culverts. Opus DK's assessment tool provides a framework for the prioritization. The idea is simple: A consequence score is assigned based on roadway traffic, culvert size, depth of cover and strategic importance. A culvert condition score is determined by a technical reviewer based on the individual component scores determined at the time of inspection. The priority ranking takes into account both the consequence and condition scores.

Capital Planning

Burnaby is taking a proactive approach by developing a five-year capital plan to rehabilitate and repair aging culverts. The information base is still small — there are 131 culverts

Deteriorated 1,800 mm CSP culvert selected for slip lining with HDPE

600 mm diameter or larger in size, of which 26 have received a full inspection. Based on the known condition of 26 culverts, the condition of the entire set is predicted assuming that the culverts inspected are representative of the system.

The City has two major types of culverts – CSP culverts and concrete culverts. There are a small number of culverts of other materials such as steel and plastic, loosely grouped as "Other". All culverts of the same material were assumed to have the same probability of being in a given condition as the culverts inspected.

Although the capital plan is a poor approximation of future costs at this point, it will improve significantly as more culverts are inspected. To address replacement of low-consequence culverts as they age, Opus DK recommended that the City set aside a contingency fund.

Regular condition assessments play a pivotal role in culvert asset management. By focusing assessment efforts and maintenance on high-risk culverts, municipalities can plan future spending and minimize unforeseen costs.

Burnaby has rehabilitated several priority culverts using the results of this assessment. However, Burnaby is still reviewing the overall strategy before deciding to formally adopt the approach.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Forcemain Project in Delta

John Kupskay, P.Eng
Barry L'Heureux
Paragon Engineering Ltd.

Inverting the liner

Project: Delta Manor Phase I – Forcemain Rehabilitation

Owner: Corporation of Delta – Dale Ayers, AScT, Ryan Deernsted, AScT

Contractor: IVIS Inc., Chad Eaton (Supervisor)

Supplier: Sekisui Norditube, Steve Leffler (on-site representative)

Engineer: Paragon Engineering Ltd. – John Kupskay, P. Eng. (Project Manager and Contract Administrator), Barry L'Heureux (on-site inspector)

Phase 1 of this project was to reline 1,400 metres of 400-millimetre-diameter existing abandoned ductile iron sanitary forcemain to provide future and backup capacity to the current operating forcemain. This portion of sewer main runs from just northeast of the pump station at Linden Drive and Central to Grove Avenue, then east along Grove to 57th Street, then south along 57th Street to just south of Ladner Trunk Road.

Design

Open-cut excavation and replacement of the existing pipe was considered; however, CIPP lining was chosen due to its smaller carbon footprint, quicker construction time and minimal disruption to the residential neighbourhood.

Tender

The project was advertised for public tender between October 19 and November 8, 2011. Five tenders were received; however, due to the special-

ized procedures of CIPP pressure lining, the number of contractors with experience in this technology was limited. Tenders were evaluated with consideration given to overall company experience and track record, superintendent experience, pressure liner system technical data and liner design. The successful bid was received from Ivis Inc., which was awarded the contract for $1.45 million. On-site supervision and installation assistance from the manufacturer's representative was part of the tender award conditions.

Existing Forcemain

The existing forcemain has been dormant for approximately five years. It was abandoned when a new forcemain was installed in 2002. Highly corrosive soils and a high water table in this area led to the designated condition of the sewer main to be rehabilitated as 'Fully Deteriorated.'

Deterioration of the forcemain allowed infiltration of groundwater and also the potential for highly toxic or explosive gases to form. This condition required additional safety precautions during initial flushing and cleaning procedures.

CIPP pressure relining is a relatively new technology to the Lower Mainland, and this project was the first CIPP pressure liner for Ivis Inc. Rehabilitating the old forcemain with cured-in-place pressure pipe has provided a new structural pressure 'pipe-within-a-pipe." The Contractor installed a glass-fiber reinforced vinyl ester resin liner, manufactured by Sekisui Norditube Inc., which is designed to withstand the effects of conventional sanitary sewage and the gases produced. The Contractor field-measured the internal diameter of all pipes to determine the exact size of liner that was required so that the liner was tight to the wall of the host pipe before ordering liner.

Installation

The Contractor initially had to confirm all depths of the pipe at the new chamber locations to determine accurate sizing of the precast chambers. Once the host pipe was flushed and cleaned, seven waterproof precast concrete access chambers were installed to provide future access for maintenance to the pipe and also to a new air-release valve. Six intermediate access pits were required between the access chamber pits to accommodate the maximum feasible lengths of the liner inversions. A new ductile iron spool piece of pipe was connected to the existing pipe at each intermediate access pit and chamber location. The liner was then inverted under pressure through the existing pipe and steam cured for approximately four hours. Once the inversion process

was completed, the pressure liner ends were prepared and Weko pressure end seals were installed. The newly lined forcemain pipe was then connected at the intermediate access points (six total) and at the maintenance chamber locations (seven) and fitted with applicable cathodic protection system. All seven precast chambers were fitted with a 400-mm flanged stainless steel tee and a 400-mm blind flange for future maintenance access. Additionally, stainless steel flanged bends were installed in three chambers to conform to existing forcemain routing.

Test samples were taken from the pipe liner, prepared and sent for third-party testing and evaluation to confirm thickness and tensile and flexural properties. All samples passed required tests. Upon completion and installation of all fittings and appurtenances, pressure testing for water tightness was performed on all pipe lining sections in this contract.

Challenges

Being the first pressure pipe installation project for Ivis Inc., many hurdles were overcome. Installation realities were quickly realized upon construction startup. A manufacturer's representative from Norditube guided and supervised wet-outs and on-site installation. As Delta is home to some of the most highly corrosive soils in the B.C. Lower Mainland, corrosion protection was maintained using a combination of individual anode protection fittings and the use of anode fields. The corrosion protection requirements were specified due to the high corrosivity of the existing soils.

Groundwater infiltration provided an issue at one location by preventing proper curing of the liner and therefore requiring a ductile iron point repair. Nearby gas mains and other existing utilities provided a challenge during excavation procedures for access pits and chamber installations. Some utilities required relocation. Shoring and stabilizing of the pits furthered complicated the situation due to adverse soil conditions which included running sand, and a high groundwater table.

Conclusions

This project did not come without its challenges and delays. However, in the end the Corporation of Delta was left with an operable backup forcemain with full access for maintenance and inspection.

As the need to repair existing utilities and infrastructure has become apparent everywhere, the requirement for trenchless technologies continues to grow. The experience gained and lessons learned on this project will be invaluable on future projects.

Chamber fittings

From Overhead to Underground

Gina Godard
Safety and Administrative Coordinator, Directional Mining & Drilling Ltd.

Project Name: Harrison River HDD Crossing

Owner: Corporation of Delta – Dale Ayers, AScT, Ryan Deernsted, AScT

General Contractor: Emil Anderson Maintenance

Drilling Contractor: Directional Mining & Drilling Ltd.

Engineering Firm: Golder Associates

What happens when all of a sudden your right-of-way is no longer "your" right-of-way? This was the situation faced by a utilities company for a section of its lines in the Harrison Mills area. In discussions with landowners to allow for continued use of their property for the lines, an offered year-by-year agreement at a substantial cost was not acceptable to the company. Therefore, the lines needed to be taken from aerial to underground. The only glitch was that the Harrison River was in the way.

Emil Anderson Maintenance (EAM) was hired as a general contractor for the project, with the expertise of well-known engineering firm Golder Associates to help with the process. With weighty considerations including environmental impact, the archeological significance of the area for First Nations people, the engineering design of the actual bore path, and pipe requirements based on particulars such as depth and ground conditions, the process took three years until it was ready to be executed.

Having done substantial works in the area, including crossing the Harrison River on other occasions, Directional Mining & Drilling Ltd. (DM&D) was one of a handful of companies approached to tender the project and was ultimately awarded the contract to complete the works.

The final design involved a 680-metre bore path with compounded curves on both entry and exit and a depth of -17m geodetic at its deepest. Due to potential interference from the steel swing bridge with the steering system, DM&D altered the original design marginally to help lower the risk of this potential interference during the all-important pilot hole drill-out. An eight-inch DR9 HDPE pipe was to be installed as the carrier for the four 1.5-inch sub-ducts. Two of these would initially hold the cables with the other two slotted for future use, thus avoiding the

DM&D performed drilling work in Harrison River crossing

First section of casing in Harrison River crossing project

disputed area.

Works began at the very end of January 2013 with mobilizing out to the site. The ground conditions at entry entailed the installation of approximately 30 m of a casing pipe to get through a known gravel zone. However, this area of the site was known to contain protected archeological deposits associated with past First Nations inhabitants. Disturbances to archeological deposits were conducted under appropriate heritage permits from the province and affected First Nations. Archaeologists from Golder Associates and First Nations assistants from Sts'ailes Nation and the Stó:lō Research and Resource Management Centre were present to monitor excavation works and inspect archeological soils for artifacts and other remains. By working hand-in-hand with these various groups, DM&D was able to mindfully excavate the required location and treat the archaeological remains respectfully. Once the excavation was complete, the casing installation was able to proceed with MT Horizontal Boring (a division of DM&D that specializes in casing installations using auger boring and pipe jacking) completing the works.

DM&D opted to bring in a larger drill for the project. While the small diameter of the pipe and the believed ground conditions did not make this necessary, the additional power this drill offered meant that if ground conditions held true to the historical boreholes, the pipe might be pulled back without an initial reaming pass. The relative ease and speed in which the pilot hole was completed (approximately 1.5 days) confirmed that a standalone reaming pass would not be required, and they were able to proceed with the plan of hooking up the eight-inch HDPE pipe for immediate installation. The slight alterations on the designed bore path allowed for successful steering with no interference from the steel bridge, and the steering head exited right on the mark.

Staging of 680 meters of pipe is no easy accomplishment, even when you are out in the country. However, luck was on their side and they were able to string the pipe through a ditch area along the highway - a dry ditch (no run-off to any storm lines), which in rainy British Columbia is hard to come by. An excavator was able to walk through the ditch to move the pipe, therefore eliminating the need for any traffic disruptions that a lane closure on the highway would have caused. The one hiccup was a rural road that had to be crossed for the last 150m of pipe. Fortunately, the road was able to be accessed from another location so DM&D

Crew members feed ducts off spools

did not have to do any "fuse on the fly." The pipe was pulled up to the road, and the final section was fused the night before pullback, and the closure was only required for 1.5 days.

Pulling pipe into a casing can be risky, so the design of the reamer was important to make sure that there was no way the pipe could become hooked on the lip once it approached the casing end. Therefore, a 14-inch custom reamer with a 60-ton swivel built directly into the back to centralize the pipe to the reamer was built to prevent this scenario from happening. The pullback of the 8-inch HDPE carrier pipe took one day total.

The depth the carrier pipe needed to be placed under the river resulted in ground pressure being a concern. Because of this, water was added to the pipe immediately following pullback so as to prevent possible collapse. The thin wall (SDR 11) of the sub-ducts meant that they too had to have water kept in them at all times to prevent collapse. During the installation this was not a problem as holes were drilled into the ducts at the pull head location to allow for them to fill with water as they were being pulled through. Ovality testing normally required a pig to be blown through with air, but instead pressurized water was used to jet it through. The only time the water will be removed is when the utilities are ready to be installed. They do not use pull strings for this anymore, but air to blow the cable through. The water will be blown out, the cable blown in and even though the cable actually takes up most all the room inside the sub-ducts, the lines will be refilled as a precautionary measure against potential collapse.

The project took less than three weeks from mobilization and site preparation to complete restoration. When asked about their experience with horizontal directional drilling, the utilities representative responded that the experience was a good one, with the staff of DM&D helpful and willing to explain the processes and what was going on or coming up. They also felt that next time they had a project such as this they would incorporate the knowledge and expertise of the drilling contractor as part of the design phase in addition to those of the engineering, geotechnical, and environmental and archeological people, as each of these groups brings a necessary solution to pieces of the puzzle.

Hay River HDD

Justin Hedemann
Business Development
Direct Horizontal Drilling

Making a connection for pilot hole – view from directional hand workstation

The horizontal directional drilling method was used to install 730 metres of NPS 48-inch carbon steel pipeline beneath the Hay River near Rainbow Lake, Alberta. NOVA Gas Transmission Ltd., a subsidiary of TransCanada PipeLines, is expanding the Northwest Pipeline System by constructing approximately 250 kilometres of new pipeline ranging in sizes from 36-inch to 48-inch. The Hay River drill was part of the Timberwolf Section, a 49-km new build of 48-inch-diameter approximately 1,200 km northwest of Calgary. Direct Horizontal Drilling was selected as the drilling contractor and casing installation started in December 2012.

A geo-investigation was conducted in 2011 to confirm that HDD would be a suitable method of trenchless installation. The local geology consisted of clay deposits overlying bedrock predominantly consisting of siltstone and clay shale. After the alignment and a no-drill zone were established, the length of the bore was designed to 730 m. The alignment allowed for a typical low to high elevation drill; because of the geology on the low side (entry), temporary casing was recommended for bore stability and gravel isolation. The entry angle was designed at 16 degrees; 64 m of casing would be required to establish a seal into suitable drilling formations. Seventy-eight-inch and 72-inch steel casing were telescoped to a final depth of 65 m.

A 12.25-inch pilot hole was drilled using a mud motor configuration at an average ROP of 35 m per hour. Due to the local geology (overlaying highly reactive clays) a well-planned and thoroughly executed drilling fluid program was required to maintain planned annular pressures and achieve maximum cutting removal efficiency. A reaming schedule was

Installation of casing started in December 2012

designed using the provided engineered geo-technical report; it would consist of three passes of 30, 48 and 60 inches respectively.

A 1.1-million-pound rig (Direct 9) was selected for the project based upon many factors. Direct 9 was customized to accommodate 24-hour drilling operations in any weather conditions, especially the harsh Northern Alberta weather where it dipped below -30C throughout construction. Direct 9 is custom-built with a fully integrated steam-circulating system to allow for 24-hour all-weather operations. Direct 9 is also equipped with 110,000 pounds of rotary force and 5 m3/m pumping capacity, both a common oversight in the HDD industry as design specifications are commonly based on push and pull requirements. All three in combination need to be considered to drill and ream a large-diameter hole with maximum efficiency. A consistent rotary and high annular flow create increased ROP and decrease the amount of cleaning trips per reaming pass overall, reducing schedule. The schedule to open the 730m drill to 60-inch was 23 days, working out to an average of 96 metres per day.

The pullback operation utilized a buoyancy plan requiring the 48-inch pipeline to be filled with fresh water during pullback; by creating a neutral buoyant state within the wellbore, the pipeline experiences reduced hole drag and reduced risk to coating damage.

Direct Horizontal continues to be a leader in the HDD industry. In 2012, they installed over 15 km of 36-inch or larger diameter pipe across Canada.

The Cranberry Section - KAB Bores Holes for TransCanada Project

Harry Dickinson, AScT
Kamloops Augering & Boring Ltd.

Louisbourg Pipelines contacted Kamloops Augering & Boring Ltd. (KAB) in September 2012 to do some long trenchless installations at two locations involving road crossings and multiple pipelines. Louisbourg was awarded a contract by TransCanada PipeLines to construct 32 kilometres of 48-inch pipeline west of Manning, Alberta, known as the Tanghe Cree Lateral Loop No. 2 (Cranberry Section). The Cranberry Section will be constructed adjacent to an existing natural gas pipeline owned and operated by TransCanada. The pipeline route is located approximately 50 km northwest of Manning.

The trenchless requirement for this project was one crossing at 80 metres (262 feet) in length which had to cross one road and seven pipelines. The second crossing was 85 metres (279 feet) and had to cross one road and five pipelines. The constraints of keeping the road active, crossing existing pipelines, overall lengths and adjacent to existing pipeline required a precise installation. KAB proposed to use our Guided Bore Machine (Akkerman 240A Jacking Frame) with our American Auger 48-900 Auger Bore Machine (ABM). With the use of the Guided Bore Machine (GBM) in conjunction with a conventional ABM, long crossings that once were difficult to achieve can now be done efficiently and economically.

The length and ground conditions for pilot tubing were not as problematic as the weather conditions. Typical Canadian pipeline construction requires this work to be done during our cold winters for favorable site access conditions. The average working temperature was -30 C (-22 F), which created many difficult variables, one of which was water supply for our GBM and mud lines for lubrication during the 48-inch casing installation. KAB had to use our heated mud-shack for our water/bentonite supply during our pilot tube and casing installation.

The first stage of the slip-bore process was to use our GBM to drill the pilot tubes under the required hot lines. Stopping at view holes before each hot line, the pilot rod was surveyed to ensure the proper clearances were as designed. Utility Owner Representatives would approve the clearance and allow the pilot tubing process to proceed to the desired receptions pit.

The second step of the slip bore was attaching the four-inch pilot rod to the 48-inch casing. To reduce thrust pressure, a section of 24-inch casing was attached to the pilot rod, then it was stepped up to the 48-inch casing via an expander unit. To further reduce drag, a scrubber was welded to the expander unit and a second was welded 20 feet back on the casing – which over-cut the hole, allowing the casing to follow more easily. KAB elected to do this as we were experiencing swelling ground conditions that were making pushing and slipping difficult due to the extreme amount of squeeze. With the room available on site, we were able to bore 80-feet lengths of casing. Once the boring was completed, we set up for pulling the product pipe back through.

The final step is of the slip-bore process is to pull the product pipe back to the jacking pit. The expander unit was cut off and the 48-inch product pipe welded to the 48-inch casing. The pulling process was able to commence. Using the American Augers 48-900, the pipe was pulled back and the casing was cut off in 80-foot lengths. This process was repeated until the 48-inch product pipe was pulled through to the desired location for the tie-in. Even through the extreme cold weather of winter and swelling ground conditions, the project was completed under the estimated time schedule. Another satisfied customer was then able to complete their project.

Kamloops Augering & Boring performed slip boring in a project near Manning, Alberta.

Big Machine for Big Jobs

PTR Communications

Kamloops Augering & Boring Ltd. (KAB) is ready for the really big jobs with the world's largest auger boring machine.

The American Augers 84/96-1800 is capable of boring 96-inch-diameter holes at 1.8-million-pound thrust. Weighing about 30 tonnes, it's 17 feet long, nine feet wide and more than nine feet tall.

The standard model has a 300-horsepower Caterpillar diesel engine and a QuikTran system, exclusively from American Augers, that allows for fast return with up to 10,000 pounds of push/pull at high speed. Quik Tran "makes for easier machine operation in challenging work climates or conditions," according to the manufacturer.

The 84/96, like other American Augers machines, also has a Quik Split frame design that allows separation of the rig into sections for easier placement and removal at work areas.

KAB president Malcolm Bachand told Underground Construction magazine the 84/96 was purchased "to install culverts on a large railroad project." He was referring to repairs made in the summer of 2011 after an extreme rainfall event in the Peace River area, where KAB installed a new 72-inch-wide and 220-foot-long culvert at the Canadian National Railway's Chetwynd yard. (An article about the Chetwynd project appeared in last year's Y-Dig.)

"There is no comparison when it comes to the magnitude of its power when compared to the remainder of our fleet," KAB's Harry Dickinson said of the big machine this past March. However, he added, loading and unloading can be difficult due to its gargantuan size.

Dickinson said KAB does benefit by having the 84/96. "Installing and cleaning larger-diameter pipe has become easier. Typically, we would have to use a smaller ABM and significantly smaller auger to clean anything over 72 inches.

"The biggest benefit will be using our larger hammers with our 84/96 machine for installing up to 120-inch-diameter casings.

Established in 1976, Kamloops Augering & Boring provides comprehensive services in trenchless construction. Its services and expertise include tunneling, large-diameter pipe ramming, auger boring, rock boring, pilot tube microtunneling and horizontal pile driving.

American Augers manufactures auger boring machines, drilling rigs and related products at a 141,000-square-foot facility in West Salem, Ohio. The company proclaims on its website that its core value is "having products developed by a can-do workforce that focuses on mechanical, technological and customer-based design improvements."

The American Augers 84/96-1800 can bore 96-inch-diameter holes. (Photo courtesy American Augers Inc.)

Pipe Bursting in New Westminster

John Kupskay, P.Eng
Kirk McLeod, AScT
Paragon Engineering Ltd.

Project: New Westminster Pipe Bursting Reconstruction

Owner: Corporation of the City of New Westminster; Project Supervisor Steve Day, AScT

Engineer: Paragon Engineering Ltd.; Project Manager John Kupskay, P. Eng.; Design Technician Melchor Mateo III; Construction Inspector Kirk McLeod, AScT

Contractor: PW Trenchless Construction Ltd.; Project Manager David O'Sullivan

The City of New Westminster was founded in 1859, making it the oldest city in western Canada. An old city requires continuous maintenance of public infrastructure. New Westminster is no exception.

Much of New Westminster's sewer system operates a combined storm and sanitary system. Many of the combined sewer mains were constructed near or directly under the boulevards.

Rehabilitation Program

For the past 15 years the City of New Westminster has implemented a trenchless rehabilitation program to reconstruct deteriorated sewers and services, with the main focus being on compliance with the Metro Vancouver Liquid Waste Management Plan. The majority of the existing old pipe is vitrified clay (VC) which was used due to its reasonable price and resistance to almost all domestic and industrial sewage.

CCTV pipeline inspections of the existing sewer indicate fractured pipe, surface spalling, longitudinal cracking, deposits attached to pipe, intruding services, separated/offset joints, voids, root intrusion and root balls. Considering the many years the VC pipes have been in service, the material has performed relatively well, withstanding corrosion and degradation.

The City established annual relining and pipe-bursting programs. Pipe bursting provides a trenchless solution which replaces existing sewer pipe with the same or larger sizes. This technique also reduces the need for costly excavation, removal of trees, and reinstatement of infrastructure, resulting in lower construction cost. Benefits of pipe bursting also include a reduced carbon footprint, faster construction time and less inconvenience to the travelling public. Service laterals and catchbasin leads are fully reconstructed to the proper-

Multiple fractures


Bursting mains

Bursting service lateral

Fusing HDPE pipe

ty line using trenchless methods (pipe bursting or relining) where possible; otherwise they were replaced by open-cut excavation.

Pipe Bursting Procedure

Two pits are excavated, one at each manhole, one for the placement of the bursting machine, and one for the pipe entry. Excavations are done along the main for reconnection of each service lateral and catchbasin lead.

PW Trenchless Construction (PWT), the Lower Mainland's pioneer and leader in pipe bursting, used a TT Technologies 800 for static bursting operations for the 2012 project. The quick-lock bursting rods were inserted through the existing pipe to the entrance pit. The pipe-bursting tool generates sufficient force to burst the pipe by fragmenting and compressing the old pipe sections into the surrounding soil as it progresses.

All sections of sewer were reconstructed with fused HDPE DR17 pipe. The HDPE pipe is fused to the required length with a McElroy Fusion Machine. The strength of the fused HDPE pipe joints is designed to withstand the forces produced by bursting operations.

Service Tie-In & Bursting

Once the new main was installed, service laterals and catchbasin leads were reconstructed to the property line and tied into the new HDPE main. A new inspection chamber was installed or replaced at each service. A smaller TT Technologies Grundo Service Tugger was used to burst 100-mm HDPE for longer services. Upon completion of the sewer main bursting, new service connections were cored into the new HDPE main and fitted with either an electro-fusion saddle or an Inserta Tee (complete with steel shear band coupling) to provide a smooth, uniform, watertight joint.

A total of four sewer mains were upgraded from 150 mm to 200 mm diameter and one main upgraded from a 200-mm pipe to a 250-mm pipe as part of the 2012 project. The remaining 16 sewer mains were rehabilitated to their existing size, ranging from 200 mm to 300 mm diameter. A total of 1,750 metres on 21 sewer mains and 126 services were reconstructed from the main to the property line.

'Spreading the Word'

Chair Says Chapters Are Heart of NASTT

PTR Communications

If you've been to the NASTT No-Dig Shows in the last 15 years, you've probably met Derek Potvin. NASTT's new Chair has been a regular at No-Digs, including the 2013 edition in Sacramento, California.

Potvin, previously Vice-Chair of NASTT, has been an active member for more than 15 years. He's President of Ottawa-based Robinson Consultants Inc. and also Treasurer of NASTT's Great Lakes, St. Lawrence and Atlantic (GLSLA) Chapter. No-Dig Show veterans may recall one or more of the many papers he has authored for the annual event, including one that won an award for Outstanding Paper.

He has seen trenchless technology progress considerably since attending his first No-Dig Show in 1995. "Initially, trenchless was seen as revolutionary and unique," he recently told Trenchless International magazine. "However, it is now viewed as a responsible and progressive approach to infrastructure construction and renewal. In my area, almost all clients are now using trenchless technology in their everyday work programs."

We spoke with him briefly in Sacramento and later exchanged emails to get the new Chair's views on NASTT, its Chapters and the future of trenchless.

First up: What motivates Derek Potvin to stay active within the NASTT organization and the GLSLA Chapter? The first source of motivation he mentioned is "the belief that trenchless technologies benefit society by minimizing disruption to residents and businesses, limiting impact to the natural environment, offering potential cost savings and reducing greenhouse gas emissions." He also mentioned the "overall dedication and volunteer spirit of the organization," and said it is "exciting to be part of an organization that is supporting something we are truly passionate about. The spirit of the organization makes it easy to volunteer time."

"We are pushing forward in educating people about trenchless technology," he added. "Seeing the success and advances over the years is very rewarding and motivating. Now that I am Chair, I am privileged to have the chance to guide something I have been a part of for so long. This too, is very rewarding. "

Asked about his objectives as NASTT Chair, he pointed out that assistance from Regional Chapters is vitally important. Among his key objectives is advancement of NASTT's "exceptional educational lineup," including the Webinar series [see page 42 of this magazine], Good Practices seminars and Trenchless Technology Short Courses. He wants to see NASTT expand the Trenchless Bookstore and pledges NASTT's support of Chapters by offering local training.

Potvin wants to see awareness of trenchless technology increased by developing relationships with other industries. "We are already committed to providing training to the American Public Works Association, the American Gas Association, the Alberta Water and Wastewater Operators Association, the Atlantic Canada Water and Wastewater Association and the Association of Equipment Manufacturers, and we are currently discussing training opportunities with other associations," he noted.

He also mentioned a desire to further the success of the Municipal and Utility Scholarships and said NASTT encour-

Derek Potvin is Chair of the North American Society for Trenchless Technology.

ages its members in Regional Chapters to talk to non-member colleagues about the benefits of joining. Having more members will improve NASTT's ability "to reach out to even more municipal and utility owners and an even broader audience," he said.

"NASTT's Carbon Calculator is nearing completion of Phase II, which will offer a web-based user-friendly version of the software," he remarked. "This is a standalone NASTT initiative, and a Phase III training module is being contemplated."

Asked to describe the relationship between NASTT and its Chapters, he emphasized that "Chapters are the driving vehicles of NASTT's mission to provide trenchless technology education and training." The Chapters and NASTT – the organization as a whole – must work together for the key objective of increasing awareness of trenchless technology. Potvin said the Chapters have shown dedication to that objective with their successful work in education and training.

"Chapters' assistance at the grassroots level is vitally important, and it is their enthusiasm and dedication which really makes NASTT a successful organization," Potvin declared. "Chapters encourage peers, colleagues, members and non-members to participate in NASTT, whether it is at Regional Chapter events, with the student chapters, or via a subcommittee."

The Chapters' work is mainly about "spreading the word," he said, and they're "already doing a tremendous job promoting trenchless technology. Many Chapters have a great lineup of seminars and workshops available. Our Chapter functions reach out at the grassroots level to our members and potential members. The future of our industry involves each of us doing our part in educating people about the benefits and capabilities of trenchless technology."

It's important that trenchless technology education and training be accessible, and Chapters help with accessibility by holding local and regional events that people can get to. In a similar vein, Potvin said "NASTT has found that our complimentary Webinars are a great success because the participants have no travelling cost. It allows more members and prospective members to participate in our education initiatives."

NASTT and its chapters are in a partnership to advance understanding and awareness of trenchless technology.

NASTT is always looking to grow the benefits of membership, which in turn enhances benefits for all members. "NASTT is continually updating and improving existing courses, developing new courses, preparing new publications and offering courses in new formats such as webinars," Potvin said. "These education initiatives greatly benefit the joint NASTT and Regional Chapter mission to educate and promote the benefits of trenchless technologies. New initiatives such as the Municipal and Public Utility Scholarship program will allow more Chapter members to attend the annual NASTT No-Dig Show."

NASTT Executive Director Mike Willmets, Communications and Training Manager Michelle Hill and Board members will attend Chapter functions and events to support education initiatives or to discuss what NASTT has to offer its membership, he said.

Potvin said Regional Chapter magazines such as this one are "a place to show new technology and share the successes of trenchless technology. They also promote local and national education seminars, webinars, conferences, etc. They are a great outlet of education and information for the trenchless community and even those interested in learning about trenchless technology. They also allow for the showcasing of regional trenchless projects and local industry champions."

The Chapters those magazines serve are hubs where people "share ideas, network with colleagues and find solutions to trenchless questions," he said. "The great thing about the Chapters is that everyone is so passionate about trenchless technology and is very willing to share their knowledge and inform others about the benefits of the technologies. NASTT really profits from all of the Chapters' contributions."

He underscored the importance of Regional Chapters when he was asked for concluding thoughts in our conversation: "We must thank our Chapters as NASTT's strength evolves from a Chapter-based level, and it is that volunteer spirit that really makes it a successful organization."

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Rehabilitation

Trenchless Rehabilitation Part 1

Presenter: Derek Potvin, Robinson Consultants Inc.

- Cured in Place Pipe (CIPP) Lining
- Lateral Lining
- Spray-on Systems
- Tight Fit Lining Systems

Trenchless Rehabilitation Part 2

Presenters: Ian Doherty, Trenchless Design and Jennifer Glynn, RMC Water and Environment

- Pipe Bursting
- Sliplining
- Spiral Liners
- Spot Repairs
- Grout in Place Lining Systems
- Manhole Rehabilitation

New Installation

Trenchless New Installations Part 1

Presenters: Sam Ariaratnam, Arizona State University and Dave Bennett, Bennett Trenchless Engineers

- Horizontal Directional Drilling (HDD)
- Microtunneling
- Open Shield Pipe Jacking

Trenchless New Installations Part 2

Presenters: Don Del Nero, CH2M HILL and Kim Staheli, Staheli Trenchless Consultants Inc.

- Auger Boring
- Pipe Ramming
- Moling / Piercing
- Pilot Tube
- Guided Boring

View our archives at: www.nastt.org/webinars

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