Pipelines 2015

Recent Advances in Underground Pipeline Engineering and Construction

Proceedings of the Pipelines 2015 Conference

Baltimore, Maryland, USA
23-26 August 2015

Volume 1 of 2

Editors:

V. Firtat Sever       Lynn Osborn

Contents

Trenchless Installation

Sugarloaf Pipeline, Kp41 Tunnel—Design and Construction.................................1
Marcus Weeks

Challenges and Rewards of a Successful Compound Curve Microtunnel Drive ..........................................................15
Dennis Shearer, John Fowler, and Jeff Anderson

Microtunneling Technology Implemented for the Replacement of an Aging One Mile PCCP 36-inch Force Main to Minimize Environmental Impacts .......................................................................................23
M. Notheis, and B. Schillo

Kaw WTP Water Transmission Main: Serving North Lawrence and Beyond ........................................................................35
Jeff Heidrick, Philip Ciesielski, Michael O’Connell, and Shawn Wilson

Permitting Requirements Drive Trenchless Design and Project Risk: An HDD Pressure Pipeline Case History ..................................................................................45
C. G. Price, M. P. Olson, and J. E. Staheli

HDD Utilized to Complete Key Crossings for Transmission Lines from New Woodbridge Energy Center .........................................................................................56
Scott Murray, Guy Dickes, and Richard (Bo) Botteicher

How to Manufacture an Endless Pipe Onsite ..........................................................................68
Mo Ehsani

Hitting the Bulls-Eye: How to Cut-In a 108" Outlet to a 108" Vertical Shaft 230' Beneath a Lake ........................................................................................................79
Glenn A. Davidenko and Gedas Grazulis

Alternative Pipe Material Choice Provides Trenchless Solution ........................................91
Craig Vandaelle and Jeffrey LeBlanc

Teamwork in Trenchless Projects: The Martha Lake Gateway Experience .........................................................................................99
Eric Schey, Ben Nelson, Michael Kucker, Matthew Pease, and Paul Richart

© ASCE
Experimental Examination of the Mathematical Model for Predicting the Borehole Pressure during Horizontal Directional Drilling

Xuanchen Yan, Sarkar Sayem, Erez Allouche, and Shaurav Alam

Victory Pipeline Duchesne County Utah Water Conservancy District

Ted Mickelsen and Dustin Langston

Big Pipe—Tight Quarters: Lessons Learned from Large Diameter Urban Pipelines

Alan C. Hutson, Russell L. Gibson, and Jared Barber

Arching Effects in Box Jacking Projects

Babak Mamaqani and Mohammad Najafi

Pipe Haunching Study Using Non-Linear Finite Element Analysis Including the Use of Soilcrete

Mark C. Webb

Trenchless Rehabilitation Saves Grottoes, VA, Culverts—and Money—Without Disrupting Traffic

W. E. Shook, R. M. Arold, and R. M. Shepherd

Trenchless Technologies Decision Support System Using Integrated Hierarchical Artificial Neural Networks and Genetic Algorithms

Amr Fathy, Soliman Abu-Samra, Mohamed Elsheikha, and Ossama Hosny

Water Pipeline from Turkey to Cyprus—1,600 mm Diameter Polyethylene 100 Pipeline and Its Flange-Technology Solution

Dragisa Dubocanin

Make Way for Progress—The Challenges of Relocating Large Diameter Water Mains for Light Rail System Expansion

Robert J. Card and David E. Hook

Under the River and through the Woods: Design and Construction of Two Large Diameter Horizontal Directional Drills for the City of Corpus Christi

Anne Carrel and Stephanie Cecil

Lessons Learned from Horizontal Directional Drilling Installation of HDPE Sewer Forcemains in Anne Arundel County, Maryland

James A. Howard

HDD River Crossing Improves Reliability of Water System and Meets Growing Demand

Chris Schuler, John Gregor, and Jeff Miller
Thermal Contraction Lesson Results in Steel Tunnel Liner Damage ..........238
B. Nash Williams

An Engineer’s Guide to Nondestructive Weld Examination ......................250
Terri Tovey

Streamlining the Submittal Process—Do’s and Don’ts ............................257
Roger Beieler and Amie Roshak

Liquefaction-Induced Differential Settlement and Resulting Loading and
Structural Analysis of Buried Steel and Cast Iron Pipelines .....................267
Yogesh Prashar, Annahita Fallah, Roberts McMullin, and Xavier Irias

Guidance from Tunnel Impact Analyses for DC Clean Rivers Project:
Design Build Bidding to Protect Critical Pipelines .................................279
Jey K. Jeyapalan, Ronald B. Bizzarri, Bradley Murray, Peter Kottke,
and Eileen Test

Design and Construction I

Seismic Fragility Functions for Sewerage Pipelines .................................291
M. Liu, S. Giovinazzi, and P. Lee

Identifying Seismic Vulnerability Factors for Wastewater Pipelines after
the Canterbury (NZ) Earthquake Sequence 2010–2011 ...............................304
S. Giovinazzi, J. R. Black, M. Milke, S. Esposito, K. A. Brooks, E. K. Craigie,
and M. Liu

Shaking Table Test for Axial Behavior of Buried Inner Rehabilitated
Pipes Affected by Aging Pipes in Liquefied Ground .................................316
A. Izumi, K. Ono, S. Takahara, Y. Sawada, M. Ariyoshi, Y. Mohri,
and T. Kawabata

Design and Fabrication Requirements of a High-Pressure Steel
Pipeline ........................................................................................................325
Henry H. Bardakjian and Mark W. Bush

Analysis of a Steel Pipeline in a Seismically Active Region .....................336
Mehdi S. Zarghamee, Daniel P. Valentine, and Mark W. Bush

Analysis and Behavior of Steel Pipe Welded Lap Joints in Geohazard
Areas .........................................................................................................349
Spyros A. Karamanos, Evangelia Koritsa, Brent Keil, and Robert J. Card

Performance of Polypropylene Corrugated Pipe in North America ...........365
John M. Kurdziel

© ASCE
The Modified Use of the Rehabilitation of Water Mains Manual, AWWA M28 and ASTM F1216, to Design Large Diameter Pressure Pipes Using FRP Systems.......................................................... 374
J. D. Wise and A. J. Wagner

Why Design Engineers Do Not Follow AWWA M9 Chapter 9? Here Are Some Suggestions to Encourage Its Use................................................................. 386
Jey K. Jeyapalan

2014 Updates to ASTM C12.................................................................................. 400
Jeff Boschert and Amster Howard

Numerical Analysis of Pipe-in-Pipe Filled with Various Materials ............... 412
Shunji Kanie, Akihiro Hayashi, Yutaka Terada, and Hao Zheng

Design and Construction Case History—South Catamount Transfer Pipeline Float-Sink......................................................................................... 424
Bob Bass, Holly Link, Andrew E. Romer, and Theresa Weidmann

Improved Design and Constructability through Five Installation Methods for One HDPE Pipeline Project........................................................................ 433
Weston T. Haggen, Drew M. Hansen, Ed Gil de Rubio, and E. Alan Ambler

CSO Projects—What Is the Right Solution? A Case Study for South Bend, Indiana ................................................................. 445
Jordan C. McCormack and Kara M. Boyles

Deep Water Coastal Stormwater Outfalls: Designing for the Surf Zone........ 455
Dane R. Hancock, Eric K. Sanford, and David B. Andrews

Fast Track Relief to Midland’s Emergency Thirst.............................................. 466
John Sedbrook, Zane Edwards, and Jay Edwards

Share the Road: Challenges and Opportunities Facing Joint Pipeline and Roadway Construction Contracts.............................................................. 475
Paige Cronin, Rami Issa, Rishi Bhattacharai, and Eduardo Valerio

Challenges Associated with the Implementation of the Carlsbad Desalination Conveyance System.............................................................. 486
Jack Adam, Jeremy Crutchfield, and Jeffrey A. Shoaf

New Day, New Conflict (The Challenges of Water/Wastewater Design for a Multi-Billion Dollar Highway Design-Build Project).............................. 498
Aaron Conine, Ryan Opgenorth, Daniel Stoutenburg Jr., Robert McGee, and H. Scott Colter
Ductile Iron or Welded Steel? A Comparative Analysis between Pipe Materials for the Replacement of a Large Diameter Transmission Main.......508
M. M. Wimmer

C303—A Pipe Material in Search of a History and Searching for a Name .....518
George F. Ruchti and Robert J. Card

Exploring Use of Large-Diameter HDPE Pipe for Water Main Applications.................................................................530
Mohammad Najafi, Ahmad Habibian, V. Firit Sever, D. Divyashree,
and Abhay Jain

It's a Blasting Good Time! Installation of a 30-inch HDPE Transmission Main in a Corrosive Environment, through Rock, under a River, and Adjacent to an Active Failing Pipe .................................................................................542
Robert J. Dudley, Susan S. Donnally, and Paul S. DiMarco

Evaluation of Corrugated HDPE Pipes Manufactured with Recycled Content underneath Railroads .......................................................................553
Michael Pluimer, Leslie McCarthy, Andrea Welker, and Eric Musselman

Survey of Water Utilities on Their Experiences with Use of Large-Diameter HDPE Pipe for Water Main Applications ............................................................564
D. Divyashree, Mohammad Najafi, V. Firit Sever,
and Alimohammad Entezarmahdi

Can a Design Engineer Rely on D/t Ratio as a Rational Indicator to Manage Stresses and Strains in Welded Steel Pipe During Handling? ...............574
Stephen Shumaker, Arul M. Britto, and Jey K. Jeyapalan

Stulling of Large Diameter Steel Water Pipe—What It Is and What It Is Not......................................................................................586
Larry Swim, Neal Kelemen, Brent Keil, Rich Mielke, and Shah Rahman

Design and Construction II

Extremely Controlled Rock Blasting Near Critical Pipes Where Mechanical Excavation Is Not Practical...............................................................594
Gordon F. Revey

Completion and Startup of Utah Lake System Pipelines.................................606
Mark Breitenbach, Nathaniel Jones, and Adam Murdock

Compacting Pipeline Embedment Soils with Saturation and Vibration........615
Matt S. Turney, Amster Howard, and John H. Bambei Jr.
Assessment and Rehabilitation I

Benefits of PACP® Version 7.0 Update NASSCO .......................................................... 878
Ted DeBoda and Jane Bayer

The Condition Assessment of a 30-inch Ductile Iron Water Line by WaterOne of Johnson County, Kansas .................................................................................. 887
Shaun Pietig

Developing an Inline Pipe Wall Screening Tool for Assessing and Managing Metallic Pipe .................................................................................................................. 900
Allison Stroebele, Travis Wagner, and Peter O. Paulson

Comprehensive Condition Assessment of Large Diameter Steel Pipe—The Next Chapter in San Diego County Water Authority’s Asset Management Program .................................................................................................. 911
Martin R. Coghill, John J. Galleher, and Christopher Kyea

The Case for Large Diameter Pipeline Condition Assessment .................................................................................................................. 923
Nathan D. Faber and Gary A. Eaton

Condition Assessment Methods for 1920s Lock-Bar Steel Pipe .................................. 931
Andi Corrao, Brian Briones, Richard VanderSchaaf, and Juan Elli Bermudo

A Look Back: Analyzing the Results of LWC’s PCCP Condition Assessment Pilot Projects ................................................................................................................ 943
Andrew F. Williams, Dennis Pike, and Tony Gathof

And the Kitchen Sink—Using a Full Toolbox to Assess a Critical Bulk Water Asset in South Africa .................................................................................................................. 954
Mike Jacobson, Londewe Xaba, and Kobus Prinsloo

Large Diameter Pipeline Asset Management for Sustaining Silicon Valley’s Water Needs .................................................................................................................. 966
Tony T. Ndah, James Stephen Crowley, Thomas Lau, Dave Mathews, and Arthur Partridge

A Repair Program to Minimize Failure Risk of Highly Distressed PCCP Circulating Water Lines ........................................................................................................ 978
Murat Engindeniz, Mehdi Zarghamee, Kevin Crosby, and Ben Cluff

Condition Assessment of Sanitary Sewer Lines Using Acoustic Inspection .................. 989
George Selembo and Ivan Howitt

© ASCE
Assessment of a Critical Raw Water Infrastructure for the City of San Diego El Monte Pipeline Inspection and Condition Assessment Project ................................................................. 1138
Kirstin Byrne, James Cathcart, Richard VanderSchaaf, and Yana Balotsky

Evaluation of Acoustic Wave Based PCCP Stiffness Testing Results .......... 1150
Rasko Ojdrovic, Peter D. Nardini, Marc Bracken, and John Marciszewski

Alternative Construction Methods and Pipe Material Provide Solutions for Cleveland WWTP Project ............................................................... 1160
Bernie Ashyk, Christopher Lucie, and Jeffrey LeBlanc

Padre Island Water Supply Project Minimizes Environmental Impact Using HDD Technology ................................................................. 1168
J. Douglas McMullan, Daniel Deng, Jim Williams, and Richard (Bo) Botteicher

Assessment and Rehabilitation II

Water Mains Degradation Analysis Using Log-Linear Models ............... 1181
Amin Ganjidoost, Rizwan Younis, and Mark Knight

Rehabilitation and Replacement of the East Layton Pipeline ...................... 1195
Adam Murdock, Judd Hamson, Matt Rasmussen, and Darren Hess

Validating “Fully Structural”: Development and Testing of a New Carbon Composite in situ Pressure Barrier for Trenchless Rehabilitation of Small-Diameter Pressure Pipelines .............................. 1207
N. Meyer, Scott Arnold, and G. Bontus

Integrated Technology Applications for Effective Utility Infrastructure Asset Management ................................................................. 1217
A. D. Applegate and V. L. Robinson

Beyond Water Audits into Asset Management: The Process of Non-Revenue Water Reduction and Revenue Enhancement Activities .......... 1227
Brian Skeens

Fully Structural Renewal of 39-inch PCCP Water Transmission Main with Swagelining™ and HDPE .................................................... 1237
Todd Grafenauer, Tom Hayes, James Vanderwater, Madhu Kilambi, and David Kasper

City of Baltimore SW Diversion 78-in. Diameter PCCP: 2,140 LF Continuous Carbon Fiber Pipe Rehabilitation ............................................. 1245
M. Gabbitas, K. Eysaman, A. B. Pridmore, J. Kiladis, and J. Hall
Miami-Dade Implements Hybrid FRP Trenchless Repair System
Luis Aguiar, Anna Pridmore, and Mark Geraghty

Composite versus Stand-Alone Design Methodologies for Carbon Fiber Lining Systems
Michael Gipsov, Rasko Ojdrovic, and Anna Pridmore

Better Data Equals Better Decisions: New Developments in Multi-Sensor Condition Assessment Technologies
Csaba Ékes

Application and Laboratory Tests of Stainless Steel Liner for Trenchless Rehabilitation of Water Mains in China
Wei Zhou and Baosong Ma

Non-Invasive and Remote Pipeline Rehabilitation Technology Using Reactive and Magnetic Particles
M. Makihata, B. Eovino, X. Jiang, A. Toor, K. L. Dorsey, and A. P. Pisano

Engineering Rehabilitations Based on Non-Destructive Examinations
Dan Ellison and Andy Romer

Asset Management: Performance, Sustainability, and Resiliency Model Development
Richard O. Thomasson and Sunil K. Sinha

Finite Element Modeling of Full-Scale Concrete Manholes under Soil Pressure
Elmira Riahi, Xinbao Yu, Mohammad Najafi, and Firat Sever

Comparative Analysis of Geopolymer Technology for Sewer System Rehabilitation
J. R. Royer and Dan D. Koo

An Evaluation of Trenchless Point Repair Solutions for Pipes of Varying Inner Diameter and Offset Joints
Rudy Ellgass, Jey K. Jeyapalan, Brian Gipson, Mark Biesalski, Wayne Miles, Steve Leffler, John Kurdziel, and Mark Bruce

Effective Repair of Incidental Construction Damage to 54-inch PCCP Line
A. B. Pridmore, L. Bryant, and J. Le

Repairing the World’s Largest Prestressed Concrete Pipe: A Case Study of the Central Arizona Project's Centennial Wash Siphon
Jim Geisbush
Motts Run Dam Outlet Rehabilitation—A Case Study Illustrating Design and Construction Aspects ................................................................. 1387
Chris Edwards, Owais E. Farooqi, and Ahmad Habibian

Design and Construction of a Raw River Water Welded Steel Transmission Main for a New Water Supply System in Northern Virginia ................................................................. 1396
Eric J. LaRocque

Lessons Learned in the Design, Manufacture, Shipping, and Installation of the 108-inch Integrated Pipeline (IPL) Section 15-1 ................................. 1407

Steel Water Transmission Mains in Liquefiable Soils in Hillsboro, Oregon, Planning Considerations ......................................................... 1419
Nebojsa “Nesh” Mucibabic, Yuxin “Wolfe” Lang, and Tyler Wubbena

Addressing Rehabilitation Challenges for the Underwood Creek Force Main ....................................................................................... 1431
Bryon Livingston, Jeremy Clemmons, and Keith Kalinger

Decision-Making Guidance for Culvert Rehabilitation and Replacement Using Trenchless Techniques .................................................. 1443
He Jin, Kalyan R. Piratla, and John C. Matthews

Operations, Maintenance, Risk, and Safety

Hot Tapping and Plugging Procedures Enable Replacement of Concrete Pressure Pipelines Reaching the End of Service Life without Service Interruption ...................................................................... 1452
Charles Herckis

Evaluating Chloramine Loss in Raw Water Supply Pipelines .................. 1461
P. Greg Pope, Rob Cullwell, and Jason Gehrig

Evaluating the Effectiveness of the Sewer Root Control Program for the City of Baltimore ........................................................................... 1470
M. Driscoll, D. Calderon, and B. Harris

Performing a Condition Assessment of a 24-inch Diameter Gas Line Supplying an Important Part of a Suburban Area of a Large Midwest City ........................................................................... 1478
Charles Herckis
Influences on the Rate of Pressure Drop in Automatic Line Break Control Valves on a Natural Gas Pipeline ................................................................. 1489
Lili Zuo, Fangmei Jiang, Bin Jin, Liya Zhang, and Ting Xue

More Precise Hydro-Static Test Evaluation of High Pressure Petroleum Pipelines Using Automated Data Collection Techniques ......................... 1500
David A. Vanderpool and Stephen J. Parmentier

Maximum Transient Pressures in Batch Pipelines due to Valve Closures ................................................................................................................ 1510
Guohua Li

Electrochemical Impedance Spectroscopy: Characterizing the Performance of Corrosion Protective Pipeline Coatings ................................. 1521
S. G. Croll, K. J. Croes, and B. D. Keil

Watertightness of CFRP Liners for Distressed Pipes ........................................... 1533
Mehdi S. Zarghamee and Murat Engindeniz

Oil and Gas Pipeline Technology Finds Uses in the Water and Wastewater Industry .................................................................................... 1544
Shamus McDonnell and Chukwuma Onuoha

Strategic Management of AC Pipe in Water Systems ........................................ 1554

Pipe Bursting Asbestos Cement Pipe: The Process Is Established but What’s Next ................................................................. 1566
E. A. Ambler, J. Matthews, L. Pultz II, and R. Stowe

Management of a Pipe of High Concern for Failure: Asbestos Cement Pipes .................................................................................... 1577
F. Blaha and J. Zhang

A Comparison Study of Water Pipe Failure Prediction Models Using Weibull Distribution and Binary Logistic Regression ................................. 1590
Greta Julia Vladeanu and Dan D. Koo

Where are the Hot Zones: Prioritization with Historical Pipe Break ............. 1602
Chongyang Kate Zhao and Craig Daly

Minimizing the Risk of Catastrophic Failure of PCCP in the City of Baltimore .................................................................................... 1608
M. R. Driscoll and T. N. Hussam
Extending the Life of Existing Pipelines through the Use of a Retrofit Cathodic Protection and Internal Lining Program .......................................................... 1620
John O. Smith, Gert Van der Walt, and Andrew Fuller

Evaluating Remaining Strength of Thinning and Weakening Lined Cylinder PCCP Force Mains due to Hydrogen Sulfide Corrosion .................... 1630
Masood Hajali and Ali Alavinasab

Pipelines at Bridge Crossings: Empirical-Based Seismic Vulnerability Index ........................................................................................................... 1642
A. Rais, S. Giovinazzi, and A. Palermo

Benefits of Global Standards on the Use of Optical Fiber Sensing Systems for the Impact of Construction of New Utilities and Tunnels on Existing Utilities ........................................................................................................ 1655
Michael Iten, Zachary Spera, Jey K. Jeyapalan, Gregory Duckworth, Daniele Inaudi, Xiaoyi Bao, Nils Noether, Assaf Klar, Alec Marshall, Branko Glisic, Massimo Facchini, Johan Jason, Mohammed Elshafie, Cedric Kechavarzi, Wayne Miles, Sri Rajah, Bruce Johnston, John Allen, Hugh Lee, Steve Leffler, Avi Zadok, Peter Hayward, Kendall Waterman, and Olivier Artieres

Integrated Fiber Optic Sensing System for Pipeline Corrosion Monitoring ............................................................................................................. 1667
Ying Huang, Xiao Liang, Sahar Abualigaledari Galedar, and Fardad Azarmi

Effects of Ultraviolet (UV) and Thermal Cycling on Polyurethane (PUR) Coated Water Transmission Pipelines ................................................................................................................... 1677
S. Smith, L. Caillouette, J. Jourdan, W. White, K. Gust, and D. Phelps

Development of Constrained Soil Modulus Values for Buried Pipe Design ........................................................................................................... 1695
Mark C. Webb

Planning and Analysis

The Value of Value Engineering—Functionality without Breaking the Bank on a Raw Water Transmission Project in Texas ................................. 1711
Matt Gaughan, Janis Murphy, William L. Wallace, and Ed Weaver

Triple Bottom-Line Assessment of Alternatives for a Large-Diameter Transmission Main from a Congested 280-MGD Water Treatment Plant Site .......................................................................................................................... 1723
Gregory Welter, Adebola Fashokun, Kim Six, Bob Dudley, Narayan Venkatesan, and Jason Jennings

© ASCE
Value Engineering of Conveyance System Projects on a Large Wet Weather Program ................................................................. 1730
Jennifer D. Baldwin, Heather S. Layrisson, and Adam M. Smith

Tools for Successful Risk Management of Your Next Underground Project .................................................................................... 1740
Steven R. Kramer

Assessing the Condition and Consequence of Failure of Pipes Crossing Major Transportation Corridors ................................................ 1750
Jeremiah Hess

Risk Model for Large-Diameter Transmission Pipeline Replacement Program ......................................................................................... 1762
Raffi Moughamian and Marshall McLeod

Understanding Risk and Resilience to Better Manage Water Transmission Systems ........................................................................ 1772
David J. Kerr, Amanvir Singh, and Imran Motala

Shifting the Paradigm from Replacement to Management ......................... 1786
J. Steffens and J. Lamica

Baltimore’s First Step towards Advanced Pipeline Management .............. 1797
Brian P. Ball, Madeleine Driscoll, and Michael Mazurek

Driving the Industry Forward Again: WSSC’s Pipeline Management System .......................................................................................... 1809
Gregory Fick, Mike Woodcock, Muhammad Tak, and Jorge Rodriguez

Asset Management Mixing Bowl: Idea Sharing Amongst Owners ............. 1817
Susan S. Donnally and Paul S. DiMarco

Smart Pipeline Infrastructure Network for Energy and Water (SPINE) ...... 1825
Sunil Sinha, Preet Singh, Irving Oppenhiem, David Iseley, Anne Khademian, Marc Edwards, Jose Perdomo, and Walter Graf

Developing Design Standards for a New Multi-Agency Regional Water Supply System ................................................................. 1835
Matthew Duffy, Mike Britch, Tyler Wubbena, and John R. Plattsmier

What Pipeline Management Can Do for You—a Review of the Costs and Benefits .................................................................................... 1844
Travis Wagner and Erin Culbertson
Developing a Pre-Certification Process for Using ISI Envision during the Planning Phase of a Pipeline Project ................................................................. 1857
Jeffrey Fuchs, Todd Perimon, Niki Iverson, Ronan Igloria, and Joelle L. Bennett

Picking a Pipeline Route through a Densely Developed Urban Environment: The Challenges Are Not Technical.............................................................. 1868
Joelle L. Bennett, Mike Britch, Tyler Wubbena, and John R. Plattsmier

DC Water Uses 3D FEM in Assessing Century Old Trunk Sewer ................. 1879
Steve Bian and Satish Soni

Wilburton Sewer Improvements—No Problems, Just Opportunities to Provide a Toolbox of Engineering Solutions ...................................................... 1890
James Chae, Brandon Cole, and Josh Finley

Potts Ditch: Rerouting the Impossible................................................................. 1901
Derek C. Urban, Joseph W. Grinstead, and Karla D. Vincent