Pipelines N 0 2 1

Design



Papers from Sessions of the Pipelines 2021 Conference August 3-6, 2021



EDITED BY Duane Strayer, P.Eng.



NSTITUTE

PIPELINES 2021

Design

PROCEEDINGS OF SESSIONS OF THE PIPELINES 2021 CONFERENCE

August 3-6, 2021

SPONSORED BY Utility Engineering and Surveying Institute of the American Society of Civil Engineers

> EDITED BY Duane Strayer, P.Eng. C. Douglas Jenkins, P.E.





Published by the American Society of Civil Engineers

Published by American Society of Civil Engineers 1801 Alexander Bell Drive Reston, Virginia, 20191-4382 www.asce.org/publications | ascelibrary.org

Any statements expressed in these materials are those of the individual authors and do not necessarily represent the views of ASCE, which takes no responsibility for any statement made herein. No reference made in this publication to any specific method, product, process, or service constitutes or implies an endorsement, recommendation, or warranty thereof by ASCE. The materials are for general information only and do not represent a standard of ASCE, nor are they intended as a reference in purchase specifications, contracts, regulations, statutes, or any other legal document. ASCE makes no representation or warranty of any kind, whether express or implied, concerning the accuracy, completeness, suitability, or utility of any information, apparatus, product, or process discussed in this publication, and assumes no liability therefor. The information contained in these materials should not be used without first securing competent advice with respect to its suitability for any general or specific application. Anyone utilizing such information assumes all liability arising from such use, including but not limited to infringement of any patent or patents.

ASCE and American Society of Civil Engineers-Registered in U.S. Patent and Trademark Office.

Photocopies and permissions. Permission to photocopy or reproduce material from ASCE publications can be requested by sending an e-mail to permissions@asce.org or by locating a title in ASCE's Civil Engineering Database (http://cedb.asce.org) or ASCE Library (http://ascelibrary.org) and using the "Permissions" link.

Errata: Errata, if any, can be found at https://doi.org/10.1061/9780784483619

Copyright © 2021 by the American Society of Civil Engineers. All Rights Reserved. ISBN 978-0-7844-8361-9 (PDF) Manufactured in the United States of America.

Preface

Pipelines are the arteries of the modern world that convey the essence of what drives the quality of life, commerce, and public health for all of society. Whether conveying drinking water, collecting wastewater, storing and conveying storm water, or transporting energy providing fluids – pipelines are one of the most essential elements of modern infrastructure that impacts the way we live and our ability to improve the world around us.

This year's conference theme is *Building Today's Infrastructure for a Changing Tomorrow*. It focuses on the aspect that pipeline engineers must take care of today's needs while looking at the needs of tomorrow in a way that minimizes disruption with an awareness that pipelines are essential to our quality of life. As we are all aware that the outbreak of COVD-19 has disrupted modern society's way of life, how utilities operate. COVID-19 has brought attention to how important reliable pipelines are for delivering water, conveying wastewater, and providing many other services that rely on pipelines. The pipeline industry must work together to address the looming infrastructure needs to extend the life and reliability of our pipeline systems.

In coordination with the American Society of Civil Engineers, the technical program and this publication were planned and implemented by the Technical Program Committee, led by the Technical Co-Chairs. A call for abstracts was made, from which approximately 196 abstracts were submitted. These abstracts were then sorted into tracks based on the general topic areas of Planning and Design, Trenchless, Condition Assessment, Construction and Rehabilitation, Utility Engineering and Surveying/ Multidiscipline, and Technical Posters. In addition, 4 panel sessions were included with topics from Working with Indigenous Communities, Ethics, Asset Management Victories and Future Insights, and Diversity in Engineering. This resulted in an extraordinarily high-quality program containing close to 141 papers and diverse array of poster presentations.

For publication purposes, technical papers from the seven presentation tracks were consolidated into the following three volumes: *1- Pipelines 2021: Planning, 2- Pipelines 2021: Design, and 3 – Pipelines 2021: Construction and Rehabilitation.*

On behalf of the Technical Program Committee, we are pleased to offer you the Proceedings of ASCE Pipelines 2021 "*Building Today's Infrastructure for a Changing Tomorrow*".

Respectfully yours, Duane Strayer, P.Eng., M.ASCE, and C. Douglas Jenkins, P.E. M.ASCE Technical Co-Chairs

Acknowledgments

Technical Program Committee

Technical Program Co-Chairs

Duane Strayer, P.Eng., Associated Engineering Doug Jenkins, P.E., Jacobs

Conference Co-Chairs Jason Lueke, Ph.D., P,Eng., Associated Engineering Christine Malaka, P.Eng., ATCO Energy Solutions

Technical Program Track Chairs

Christine Ellenberger, P.E., Jacobs, Construction & Rehabilitation Amin Ganjidoost, Ph.D., P.Eng., Xylem, Condition Assessment Khalid Kaddoura, Ph.D., P.Eng., PMP, ENV SP, CLSSBB, AECOM, Condition Assessment Jeff LeBlanc, P.E., Thompson Pipe Group, Construction & Rehabilitation Shah Rahman, KCI, Planning and Design Jeffrey Shoaf, P.E., San Diego Water Authority, Planning and Design Johnathan Shirk, P.E., Black & Veatch, Multidiscipline Alan Swartz, P.E., Plummer Associates, UES Harshit Shukla, Ph.D., Clemson University, Poster Coordinator

Technical Program Advisors

Mark Poppe, P.E., Brown and Caldwell J. Felipe Pulido, P.E., OBG Part of Ramboll

Pre-Conference Workshop Leads

Workshop Co-Chair – Erin McGuire, P.E., CDM Smith Workshop Co-Chair – Renee Mayer, P.E., HDR Engineering, Inc.

John Norton, Ph.D., P.E. - Innovation in Large Diameter Pipeline Management John Jurgens – Manhole Inspection and Rehabilitation Ahmad Habibian, Ph.D., P.E. – Post-Disaster Best Practices and Lessons Learned Norman Edward Kampbell, P.E. – Design of Close-Fit Flexible Liners for Gravity Pipe Applications

ASCE Staff

Corinne Addison Cristina Charron Donna Dickert Susan Dunne Brian Foor Kevin Higgins Aaron Koepper Erin Marks Carolyn Martin Susan Reid Sean Scully Diane Swecker Trevor Williams iv

The Technical Program Co-Chairs and the Steering Committee would like to thank the over 100 professionals who volunteered their time and talents to serve as part of the 2021 Technical Committee. Everyone worked as a team to review abstracts, papers, and posters and continued to collaborate throughout the development and fine-tuning of this year's technical program, *Building Today's Infrastructure for a Changing Tomorrow*. Many of the technical committee members also served as Track Chairs and Moderators for the conference.

Anthony Aderhold Ali Alavi Ahmed Al-Bayati Ala Al-Shawwa Michael Ancell Lawrence Arcand Denis Atwood Stephanie Bache Jennifer Baldwin John Bambei Jared Barber Henry Bardakjian Juan Barrera Jesse Beaver **Roger Beieler** Graham Bell Steve Bian Allison Biggar Abdulrahman Bin Mahmoud John Blondell Matt Blythe George Bontus Monica Bramley Adam Braun William Brick Daniel Buonadonna Keith Bushdiecker Mark Bushyeager **Urso Campos** Bob Card Maureen Carlin Dave Caughlin Rajat Chakraborti Thomas Chen Scott Christensen Kyle Couture Amin Darabnoush Tehrani Mark Draper

Csaba Ekes Christine Ellenberger Kate Elliott Dan Ellison Eric Engelskirchen Murat Engindeniz John Ford Lei Fu Jeff Galloway Amin Ganjidoost Maury Gaston Matt Gaughan Shaoqing Ge Jim Geisbush Vali Ghorbanian Sam Ghosn Brandon Gorr Mike Gossett Tom Greaves John Grocki Ahmad Habibian Christopher Haeckler Masood Hajali Hunter Hanson **Cheyanne Harris** Justin Hebner Jeff Heidrick **Gregory Henry Charles Herckis** Brian Hext Tom Hill Steve Hirai Lewis Horn Amster Howard Yafei Hu David Hughes Husam Hussein Celine Hver Pat Ilasewich

Mike Jacobson Seyedmohammadsadegh Jalalediny Korky Mill Jawed Gabriel Jean Tomas Jimenez Jarred Jones Khalid Kaddoura Spyros Karamanos Vinayak Kaushal Burak Kaynak Oliver Kearns Brent Keil Josh Kercho Sooin Kim Todd King Christine Kirby Britt Klein Joel Koenig Patrick Laidlaw Chris Lamont **David Landing** Yuxin Lang Mike Larsen Cameron Lawrence Jeff LeBlanc Guohua Li Meng Liu Susanne Lockhart Karthikeyan Loganathan Paul Longo Jerome Lynch Lily Ma Steaphan MacAulay Lewis Macrae Stephanie Madara Rabia Mady Mohammadreza Malek Mohammadi

Sara Maloney	Kerilyn Paris	Eric Sullian
Amy Marroquin	Inshik Park	Christian Sundberg
Peter Martin	Randall Parks	Alan Swartz
Ram Mazumder	Jay Pastor	Amir Tabesh
Clinton Mcadams	Rachel Philipson	Joshua Tebbe
Benjamin McCray	Anna Pridmore	Charles Temple
Cian McDermott	Shah Rahman	Devan Thomas
Emma McGowan	Sri Rajah	Dillon Thomas
Philip Meis	Leila Ramezani	Stewart Tighe
Steven Metzler	Matthew Rennau	Eric Toffin
Richard Mielke	Fatemeh Rezaeifar	Mitsuaki Tokiyoshi
Antonio Miglio	Jon Robison	Matt Tooley
Erin Mills	Daniel Rodriguez	Logan Trifone
Numan Mizyed	Stephen Rothwell	Maggi Trimble
Alan Moon	Abhijit Roy	Michael Tupper
Juan Morales	Joe Royer	Mike Uthe
Richard Mueller	Stacie Sandmann	Luis Varela
Alois Multerer	Farid Sariosseiri	Greta Vladeanu
James Murphy	Gary Savanyu	Ophir Wainer
Paul Murray	Charles Schmidt	Bob Walker
Arne Nervik	Ramtin Serajiantehrani	Wentao Wang
Quoc Khanh Nguyen	Noel Shanahan	Stephan Weninger
Richard Nichols	Vignesh Shankar	Brad Wham
John Norton	Stephen Shaver	Andrew Williams
Stephen Nuss	Jonathan Shirk	Samuel Wilson
Olufunso Ogidan	Jeffrey Shoaf	David Winston
Yoko Ohta	Harshit Shukla	Kyle Wong
Rasko Ojdrovic	Jerry Snead	Hao Xu
Chukwuma Onuoha	Steve Soldati	Sepideh Yazdekhasti
Jaime Ordonez	Ross Standifer	Xianfei Yin
Lynn Osborn	Andrew Stanton	Xia Zhu

The Technical Program Co-Chairs also thank the authors and conference sponsors for their dedication to the industry in presenting at and supporting this conference. Without your effort and contributions, the UESI Pipelines Conference would not be possible.

And lastly, the Technical Program Co-Chairs express special thanks to Jason Lueke and Christine Malaka, Conference Co-Chairs, and the Steering Committee for their efforts and leadership during the planning and execution of Pipelines 2021 Conference.

Contents

Alternative Delivery

Alternative Delivery for Emergency Multiple Installation-Method Replacement of 30/36-in. Dual Steel Force Mains with FRP1
Gilbert Trejo, Jason Bowen, Michael Ancell, Doug Jenkins, Danny Maine, and Nancy Nuttbrock
Environmental Impact Assessment of Trenchless Cured-in-Place Pipe Renewal Method for Sanitary Sewer Applications
Together We Are Better: How Using CMAR Project Delivery for a Multijurisdictional Transmission Pipeline Benefits the Owner and the Community21 Jon Wicke, Michael D. Gossett, Steve Pool, and Keith Lemaster
Utility Coordination in Alternative Delivery Methods for Transportation Projects: Utility Responsibility Matrix and Design Development—Lessons Learned from Detailed Design Process and Construction
Critique of CANDE/AASHTO Soil Groups
An Enhanced Linear Project Resource Utilization Based on Line of Balance
Eid Alagha, Abdulrahman Bin Mahmoud, and Ayman Altuwaim
Case Study—50% Labor Reduction, 30% Time Savings, and No Damages, No Delays, No Change Orders—No Kidding! Application of 3D Subsurface Utility Engineering per ASCE 38 Standard for Puget Sound Energy's SR-510 Gas Pipeline Project
Comparison of ASCE's Unified Approach and Current Practice for Thrust Restraint Design of Continuous Pipelines—Welded Steel Pipe Example

Sewermain Design

Experimental Study of a Noncircular Corrugated Steel Culvert at Different Shallow Cover Depths		
Oliver Kearns, Ian D. Moore, and Neil A. Hoult		
Finite Element Investigation of Corrugated Steel Pipe with Extreme Corrosion under Shallow Cover		
Husam H. Hussein, Shad M. Sargand, Issam Khoury, and Fouad T. Al Rikabi		
Investigation of Dynamic Impact Factor of Metal Multipipe Culvert under Shallow Cover		
Issam Khoury, Husam H. Hussein, Shad M. Sargand, and Fouad T. Al Rikabi		
It's All True—Solid, Liquid, and Gas Don't Mix in Inverted Siphons!		
Local SSO Requires Regional Solutions		
New Alignment Diverts Near Capacity Treatment Plant to Better Serve Fastest Growing South Carolina County		
New Bonnybrook Wastewater Treatment Plant Treated Effluent Outfall—Design, Contracting, and Construction Overview247 Juan Morales and Darren Finney		
Shallow Creek Crossing—Wye Bother? Split It!		
Watermain Design		
To SURGE or Not to SURGE, That Is the Question: Is Hydraulic SURGE Analysis Needed?		
A Discussion on Pressure Standards and Its Effect on Water Distribution System Design and Operation		
Challenges with Maintaining Potable Water Quality—Designing Large Diameter Water Mains for Demands of Today and Tomorrow282 Brandon Gorr, Cian McDermott, and Joseph Ng		