Sixth International Symposium on Bioremediation and Sustainable Environmental Technologies

FINAL PROGRAM

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Sixth International Symposium on Bioremediation and Sustainable Environmental Technologies

Welcome to Austin! Thank you for attending the 2023 Bioremediation Symposium.

We are so grateful for your participation, especially after the 2021 Symposium cancellation due to the COVID pandemic. We are excited to gather, once again, to discuss pressing technical challenges facing our world. We believe you will find both the technical program content and the networking opportunities well worth your time!

Our daily work of environmental remediation and management requires engagement across diverse groups of stakeholders representing environmental, economic, political, and social dimensions. The 2023 technical program therefore reflects this multi-dimensional approach and includes sessions and panel discussions focused on emerging contaminants and critical considerations in bioremediation, including characterization and remediation of PFAS, innovative technologies, sustainable environmental technologies, climate change and resilient remediation, and advances in natural attenuation.

We acknowledge and appreciate the participation of the Symposium Sponsors seen to the left whose financial support is integral to Battelle's ability to organize and host the event. In addition, we recognize the efforts of the Technical Steering Committee, Session Chairs, Panel organizers, and others, who have committed their time and technical expertise to developing a high-quality technical program. Our sincere thanks are also extended to the hundreds of platform and poster presenters who are responsible for all the research, hard work, and innovation that will be shared in individual presentations over the course of this week. We are eager to see and hear all that updates and advancements in the field since we gathered last!

On Monday, May 8, the Symposium commences with two short courses and a Career KickStarter for students and young professionals. The Plenary Session, featuring Dr. Francis Wiese, will be presented at 5:30 p.m. in Waterloo Ballroom 1-2 (Level 5). All attendees, including Exhibitors, are invited to attend the Plenary Session. The Welcome Reception will be held in the Exhibit Hall (Moontower Hall, Level 2) immediately following the Plenary Session and will feature 50+ exhibit booths and an early display of Group 1 Posters.

From Tuesday, May 9, through Thursday, May 11, more than 400 platform and poster presentations will be presented in 46 breakout sessions. Five panel discussions and nine Learning Lab presentations will also be conducted. Posters will be presented in two groups on Tuesday and Wednesday evenings from 5:45-7:00 p.m. On Thursday afternoon, the Symposium will close with a Closing Panel discussion from 3:00-4:00 p.m. The Closing Panel will provide a recap of major topics and themes from each of the five technical tracks while also touching on research needs, innovative approaches, and upcoming challenges. The Symposium will conclude with a Closing Reception immediately following the Closing Panel Discussion.

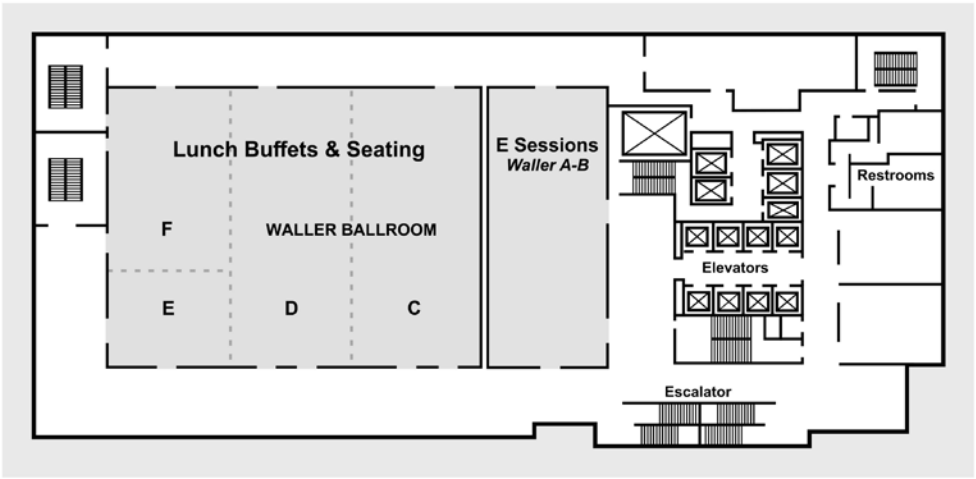
In your free time, we hope you enjoy exploring the arts, music, and cuisine that make Austin such an enticing place to visit. We are happy you are here with us and look forward to seeing old friends and colleagues, meeting new people, encouraging and mentoring students and young professionals, and learning more about this important work we do every day.

Pamela Chang and Deepti Krishnan Nair | Symposium Program Chairs (Battelle)

CONTENTS

Symposium Floor Plan

WALLER BALLROOM—LEVEL 3



WATERLOO BALLROOM—LEVEL 5

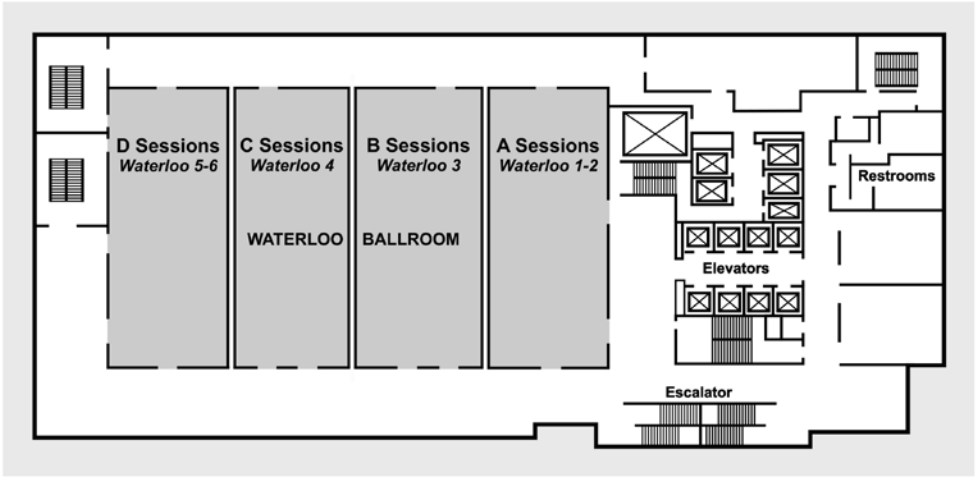


Exhibit Hall—Moontower Hall (Level 2)

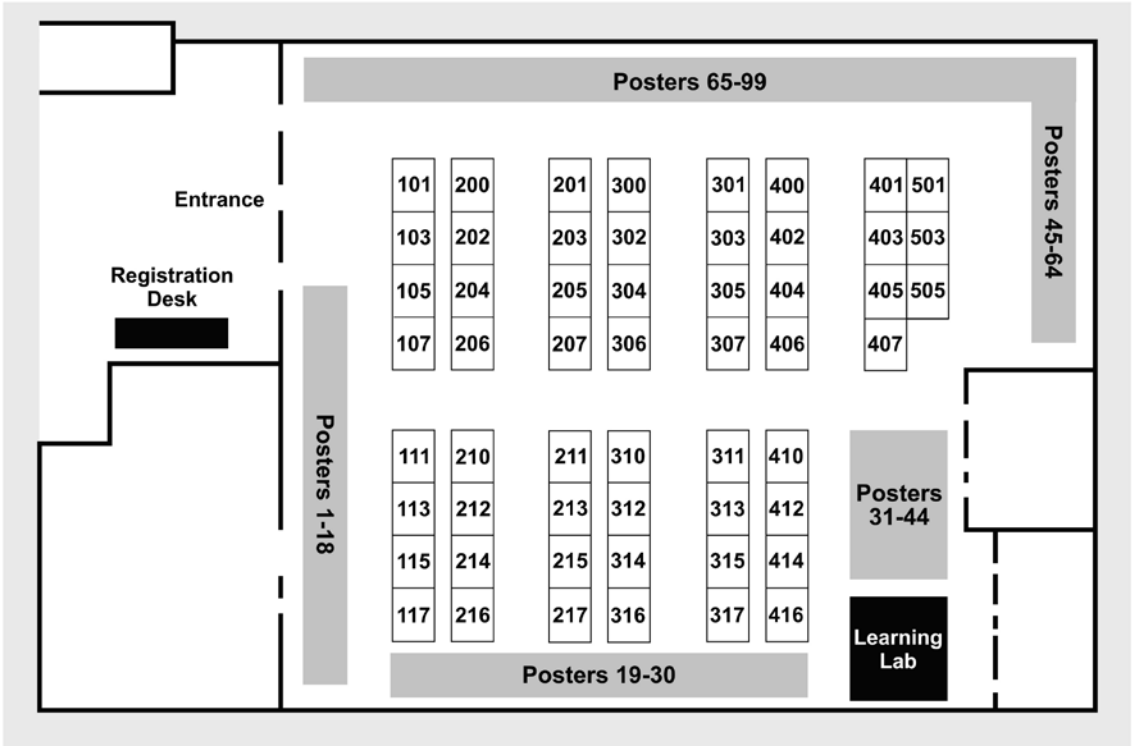


Exhibit Hours

Monday, May 8: 7:00–8:30 p.m.
Tuesday, May 9: 7:00 a.m.–7:00 p.m.
Wednesday, May 10: 7:00 a.m.–7:00 p.m.
Thursday, May 11: 7:00 a.m.–1:00 p.m.

Symposium Sponsors are shown in bold.

Plenary Session—Waterloo Ballroom 1-2 (Level 5)

Climate change is undeniably affecting all of us. Dr. Wiese will review some of the drivers and socio-ecological consequences of climate change and then focus on the diverse portfolio of feasible solutions we have at our disposal to adapt to and mitigate this crisis, together.

Plenary Session Schedule

Monday, May 8, 5:30–7:00 p.m.

Welcome and Opening Remarks

Symposium Chairs:
Pamela Chang, PMP, MBA (Battelle)
Deepti Krishnan Nair (Battelle)

Presentation of Student Paper Award

Climate Change Implications and Solutions
Francis K. Wiese, Ph.D.
(Vice President, Science Director for Climate Solutions, Stantec)

Dr. Francis Wiese is a marine ecologist and Stantec's Science Director for Climate Solutions. He received his B.S. in marine biology from the University of Victoria and Ph.D. in conservation and marine biology from Memorial University of Newfoundland and brings 29 years of experience working in the coastal and marine environment throughout the world, designing, implementing, and managing large inter-disciplinary, multi-institutional science programs that address important socio-ecological issues related to climate change, the ocean, and its uses. Dr. Wiese has been active in increasing ocean sustainability and climate change awareness and providing solutions working for and with academia, government, non-profit organizations, and industry. Throughout his career, he has extensively focused on climate change and other anthropogenic stressors on the environment, system science, adaptive management, resilience, and environmental policy.

He believes that we are better together, taking inclusive approaches and fostering partnerships across non-traditional lines. He is a technical reviewer for over 20 international journals and serves on a variety of national and international committees, science panels, and working groups, including as chair of the Understanding Gulf Ocean Systems (UGOS) and member of the Gulf Research Program Division Committee.

Climate change is undeniably affecting all of us. Sea ice, land ice, and permafrost keep declining; temperate extremes are getting worse, affecting the distribution, abundance, and health of plants, animals, and people, creating food insecurity; sea level rise is eroding shorelines, compromising sensitive coastal assets such as industrial sites, power stations, and hazardous waste material deposits; salt water intrusions are affecting agriculture yields and groundwater quality; increased frequency, intensity, and duration of hurricanes and other extreme weather events are affecting the livelihood of millions of people and costing billions each year; and existing building codes are becoming obsolete. Our natural, social, and economic systems are stressed and at ever increasing risk of collapse.

We have mostly been dealing with these issues one at a time as best as possible, but these compounded and cascading effects are forcing us to rethink our approach and to design and implement system-level risk assessments and solutions. Solutions that not only address the issues at hand in terms of adaptation, but that also bring additional benefits like climate change mitigation, habitat and biodiversity restoration, and increased human well-being and economic opportunities. Solutions that need to be developed with and for people, that are sustainable, and resilient to our future projected climate.

In this presentation, Dr. Wiese will review some of the drivers and socio-ecological consequences of climate change and then focus on the diverse portfolio of feasible solutions we have at our disposal to adapt to and mitigate this crisis, together.

All attendees, including Exhibitors, are invited to attend the Plenary Session.

The Welcome Reception will be held in the Exhibit Hall (Level 2) immediately following the Plenary Session.

NOTES

General Information

All Symposium events will be held at the Marriott Austin Downtown (304 E. Cesar Chavez St, Austin, TX 78701).

See the following pages for additional information:
- Page 10: Short Courses offered on Monday
- Pages 18-21 and 26-30: Poster Sessions in each of the two poster groups.
- Page 40: Overview of the platform sessions and panels to be conducted each day. Times for exhibits, breakfasts, lunches, and receptions.

Program Overview

Monday, May 8, 2023

- **8:00 a.m.-12:00 p.m.** Morning Short Course
- **2:00-8:30 p.m.** Registration Desk Open
- **1:00-5:00 p.m.** Afternoon Short Course
- **3:00-5:00 p.m.** Career KickStarter
- **5:30-7:00 p.m.** Plenary Session
- **7:00-8:30 p.m.** Welcome Reception, Exhibits, Group 1 Poster Display

Tuesday, May 9, 2023

- **7:00 a.m.-7:00 p.m.** Registration Desk Open
- **7:00-8:00 a.m.** Continental Breakfast
- **8:00 a.m.-5:35 p.m.** Platform Presentations
- **9:30-10:15 a.m.** Morning Beverage Break
- **11:30 a.m.-1:00** p.m. General Lunch
- **3:00-3:45 p.m.** Afternoon Beverage Break
- **5:45-7:00 p.m.** Group 1 Poster Presentations and Reception

Wednesday, May 10, 2023

- **7:00 a.m.-7:00 p.m.** Registration Desk Open
- **7:00-8:00 a.m.** Continental Breakfast
- **8:00 a.m.-5:35 p.m.** Platform Presentations
- **9:30-10:15 a.m.** Morning Beverage Break
- **11:30 a.m.-1:00 p.m.** General Lunch
- **3:00-3:45 p.m.** Afternoon Beverage Break
- **5:45-7:00 p.m.** Group 2 Poster Presentations and Reception

Thursday, May 11, 2023

- **7:00 a.m.-4:00 p.m.** Registration Desk Open
- **7:00-8:00 a.m.** Continental Breakfast
- **8:00 a.m.-2:40 p.m.** Platform Presentations
- **9:30-10:15 a.m.** Morning Beverage Break
- **11:30 a.m.-1:00 p.m.** General Lunch
- **3:00-4:00 p.m.** Closing Panel Wrap-Up Discussion
- **4:00 p.m.** Closing Reception

Presentations

Late revisions in **platform presentations** (speaker changes, withdrawals) will be marked on daily lists outside each session room.

Talks are scheduled at 25-minute intervals, and each talk is to begin promptly at the time printed in the schedule, except as may be noted at the beginning of the day on the daily lists. Session Chairs will adhere strictly to the schedule, making it possible for registrants to move between session rooms to hear the talks most pertinent to them. To minimize distraction, please confine such movement to the short intervals between talks.

Posters will be presented on Tuesday and Wednesday evenings in the Exhibit Hall. During the poster sessions, presenters will be standing at their posters to discuss their work, and light refreshments will be served. See pages 18-21 and 26-30 for details on the poster presentations.

Audio, video, and still photography are prohibited in session rooms during platform presentations or panel discussions without FIRST securing the speaker(s) permission and notifying the session chair or panel moderator in advance.

Video and still photography of poster board presentations are also prohibited without FIRST securing author/speaker permission.

Professional Development Hours

General Attendance Certificate. If you would like to receive a general certificate of Symposium attendance, inquire at the Registration Desk. PDF certificates will be emailed after the Symposium.

Hours Logged Certificate. If your state licensing board accepts Symposium attendance for credit and will require documentation of hours attended during the Tuesday through Thursday technical program, a daily attendance log can be established for you. A PDF certificate will be emailed after the Symposium with the total number of hours logged.

Logged Hours Policy

To log attendance hours:

1) You are required to sign in DAILY when you arrive and out sign out DAILY before you leave (sign-in/out must be completed during Registration Desk hours);

2) You may not complete or sign a previous days' log;

3) Only those days with complete attendance logs (i.e., sign-in, sign-out, and signature) will be included on your attendance certificate.

NO EXCEPTIONS ARE MADE TO THIS POLICY.

Exhibits
(Moontower Hall, Level 2)

Booths will be provided from more than 50 organizations that conduct remediation activities or supply equipment used in such work. Exhibits will be on display from 7:00 p.m. Monday evening through 1:00 p.m. Thursday afternoon. See page 5 for exhibit hours and the list of exhibitors.

Daily continental breakfasts, beverage breaks, and poster refreshments will be served in the Exhibit Hall.

Ad Hoc Meeting Rooms & Wi-Fi

Ad Hoc Meetings. Small meeting rooms are available for ad hoc meetings. Check at the Symposium Registration Desk for room details and available reservation times.

Complimentary wireless Internet access is available in the Exhibit Hall and session rooms.

Network (SSID) name: BioSymp23
Password (case-sensitive): Bio2023!

Messages, Job Postings, Lost & Found

A message board will be available near the Registration Desk. Notices about jobs available or wanted can be posted here. This board also will be used for messages taken by the registration staff for attendees. Please turn any found items into the Registration Desk. Lost items may be picked up with a detailed description of the item.

Learning Lab Schedule (Moontower Hall, Level 2)

The schedule of planned presentations is available on the Symposium mobile app and can be seen below. Each Learning Lab is scheduled twice, once on Tuesday and once on Wednesday. Look for the symbol above throughout the platform schedule grids for a reminder when a Learning Lab is scheduled.

Tuesday, May 9

- **8:50-9:15 a.m.**—Use of Passive CO_2 Traps to Quantify the Degradation Rates of Chlorinated Solvents
- **9:40-10:05 a.m.**—Sustainable and Cost-Effective Alternative for PFAS Waste Disposal
- **10:30-10:55 a.m.**—Multi-Site Trend Analysis and Remedial Design Implications of Passive Flux Data from PFAS-, CVOC- and Hydrocarbon-Contaminated Sites
- **1:00-1:25 p.m.**—Sentinel™ Passive Sampler: Lower Total Cost for PFAS Monitoring and Analysis
- **1:50-2:15 p.m.**—See Your Site in a Whole New Way: Using Soil Sense to Continuously Monitor NSZD and Hydrocarbon Plume Dynamics
- **2:40-3:05 p.m.**—Successful Sub-Slab Vapor Data Collection: Best Practices
- **3:30-3:55 p.m.**—A Non-Destructive Probe for UV-Based Monitoring: Adding Time Dependence to Fluorescence-Based HRSC Tools
- **4:20-4:45 p.m.**—Passive Sampling Methods for Time-Integrate Assessment of Bioavailable Contaminants
- **5:10-5:35 p.m.**—Web Application-Based Digital Conceptual Site Models and Their Use in Remediation Design Optimization

Wednesday, May 10

- **8:50-9:15 a.m.**—Passive Sampling Methods for Time-Integrate Assessment of Bioavailable Contaminants
- **9:40-10:05 a.m.**—Web Application-Based Digital Conceptual Site Models and Their Use in Remediation Design Optimization
- **10:30-10:55 a.m.**—Use of Passive CO_2 Traps to Quantify the Degradation Rates of Chlorinated Solvents
- **1:00-1:25 p.m.**—A Non-Destructive Probe for UV-Based Monitoring: Adding Time Dependence to Fluorescence- Based HRSC Tools
- **1:50-2:15 p.m.**—Successful Sub-Slab Vapor Data Collection: Best Practices
- **2:40-3:05 p.m.**—See Your Site in a Whole New Way: Using Soil Sense to Continuously Monitor NSZD and Hydrocarbon Plume Dynamics
- **3:30-3:55 p.m.**—Sentinel™ Passive Sampler: Lower Total Cost for PFAS Monitoring and Analysis
- **4:20-4:45 p.m.**—Multi-Site Trend Analysis and Remedial Design Implications of Passive Flux Data from PFAS-, CVOC- and Hydrocarbon-Contaminated Sites
- **5:10-5:35 p.m.**— Sustainable and Cost-Effective Alternative for PFAS Waste Disposal

Learning Lab Sponsors

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burnsmcd.com | Booth #105

ems
ems-inc.ca | Booth #200

Mobile App & Abstract Collection

Abstracts will be available only through the Symposium mobile app. Due to the size of the program—five panel discussions and more than 400 platform talks and poster presentations—it is recommended that attendees review the schedule and abstracts prior to the Symposium.

Abstracts are included for all platform and poster presentations and panel discussions. The app may be used to build a personal schedule, take notes on presentations, and highlight favorite Exhibitors. In addition, you have the option of entering your profile to enhance networking opportunities with other participants, including sending private instant messages and scheduling meetings, if enabled.

Proceedings

All presentations given at the Symposium will be represented in the proceedings. The one-page abstract will be supplemented with the slide files for platform presentations. Poster presenters have also been invited to submit PDFs of their poster presentations. After the Symposium, the proceedings will be compiled and published only online.

Meals, Breaks, & Receptions

For the convenience of Symposium participants, the following meals, breaks, and light receptions, seen to the right, will be provided at no additional cost to program registrants and exhibit booth staff during the food service times listed.

Food service for breakfasts, morning and afternoon beverage breaks, and receptions will be in the Exhibit Hall. Buffet lunches will be served in Waller Ballroom C-F (Level 3) to accommodate seating.

For other meals and refreshments not provided by the Symposium, the following additional options are available in the hotel:

- Loaf + Vine: coffee, pastries, grab & go snacks, and essentials
- Corinne: daily breakfast, lunch, dinner, and weekend brunch
- The Lobbyist: bar and lounge with classic cocktails and light bites
- Rye Bar: one of the largest rye and whiskey selections in downtown Austin
- Zanzibar: modern tiki cocktails, island-inspired bites, and unbeatable skyline views

Guest Tickets. If registrants wish to bring guests to meals or receptions, guest tickets can be purchased at the Symposium Registration Desk; guest tickets will be priced equal to the cost incurred by the Symposium for each meal.

Closing Reception

The Closing Reception will be served in Waterloo Ballroom Foyer (Level 5) immediately following the Closing Panel Discussion that will be held in Waterloo Ballrooms 1-2 (Level 5).

Closing Reception Sponsor

Food Service Times

Breaks between sessions may not directly correspond with food and beverage service times. If you wish to attend specific functions, please plan your schedule accordingly.

Continental Breakfast
Tuesday-Thursday, 7:00–8:00 a.m.

Morning Beverage Break
Tuesday-Thursday, 9:30–10:15 a.m.

Buffet Lunches
Tuesday-Thursday, 11:30 a.m.–1:00 p.m.

Afternoon Beverage Breaks
Tuesday-Wednesday, 3:00–3:45 p.m.

Welcome Reception
Monday, 7:00–8:30 p.m.

Poster Group 1 Presentations & Reception
Tuesday, 5:45–7:00 p.m.

Poster Group 2 Presentations & Reception
Wednesday, 5:45–7:00 p.m.

Closing Reception
Thursday, 4:00 p.m.

Short Course Schedule

Limited onsite Short Course registration may be available. Come to the Symposium Registration desk one hour in advance of your preferred course to see if space is available.

Short Course registrants may pick up their badge, sign in for their course, and be directed to the course room at the Symposium Registration Desk up to one hour prior to the course start time.

Monday, May 8, 8:00 a.m.-12:00 noon (morning half-day)

- Best Practices for Bioremediation and Reductive Technologies

Monday, May 8, 1:00 a.m.-5:00 p.m. (afternoon half-day)

- Application of Molecular Biological Tools to Assess Biological Processes at Contaminated Sites

Student/Young Professional Participation & Events

University students through Ph.D. candidates will find participation in the Symposium valuable to their career development. In addition to the technical information gained by attending presentations and visiting exhibits, students will be able to meet and talk with environmental professionals representing a wide range of work experience and employers. Recruitment is a major focus of many participating Exhibitors and Sponsors and the Symposium will provide enhanced networking opportunities for student jobseekers. Be sure to check the Message Board near the Registration Desk where job postings may be available from participating companies.

Student Paper Winner

The winning paper is scheduled for presentation as seen below. The winner is awarded a complimentary registration and a financial award to help cover travel and related costs to attend the Symposium.

Kshitija Shah
(University of California, Los Angeles/USA)

Proteomic Insights into Fungal-Mediated PFAS Precursor Biotransformations. *K. Shah, Y. Gao, G. Nurwono, V. Pandey, A. Mayank, J.O. Park, J. Wohlschlegel, and S. Mahendra.*

(Session D4, Platform, Wednesday, 9:40 a.m.)

CONGRATULATIONS!

Career KickStarter

Monday, 3:00-5:00 p.m. (Room 501, Level 5)

Pre-registration was required to match mentors/mentees.

The Career Kickstarter is a program designed to foster networking and mentorship within the environmental sector. New professionals will be matched with an experienced professional in a mentorship relationship, which both mentee and mentor are committed to sustaining for 1 year.

Student Events Sponsors

NOTES

Program Committee, Session Chairs & Panel Moderators

Program Committee

Symposium Chairs

Pamela Chang, PMP, MBA (Battelle)
Deepti Krishnan Nair (Battelle)

Technical Steering Committee

Wendy Condit, PE (Geosyntec)
David L. Freedman, Ph.D. (Clemson University)
Kate Kucharzyk, Ph.D. (Battelle)
Carmen Lebron (Consulting Engineer)
Frank Loeffler (University of Tennessee)
Charles Newell, Ph.D., PE (GSI Environmental, Inc.)
Michael Pound (U.S. Navy/NAVFAC SW)
Michael A. Singletary, PE (U.S. Navy)
John Wilson, Ph.D. (Scissortail Environmental)

TUESDAY PLATFORM SESSIONS

A1. Advances in Amendment Formulation
Stephen Richardson (GSI Environmental)
Lydia Ross (EOS Remediation)

A2. Engineering Biogeochemical Transformation
Shandra Justicia-Leon (Arcadis)
Frank Loeffler (University of Tennessee)

A3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants
Ronnie Britto (Tetra Tech, Inc.)
Michael Lamar (CDM Smith Inc.)

A4. Phytoremediation
Heather Henry (National Institute of Environmental Health Sciences, NIH)
Timothy Mattes (University of Iowa)

B1. Fate and Transport of PFAS
David Adamson (GSI Environmental)
Ramona Iery (U.S. Navy)

B2. Innovative Treatment Technologies for PFAS In Situ
Stephen Rosansky (Battelle)
Charles Schaefer (CDM Smith Inc.)

B3. PFAS Program Management in a Rapidly Changing Regulatory Environment
Amy Dindal (Battelle)
Marc Mills (U.S. Environmental Protection Agency)

C1. Natural Source Zone Depletion
Matthew Rousseau (GHD)
Julio Zimbron (E-Flux)

C2. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites
Trevre Andrews (Jacobs)
Brant Smith (Evonik)

C3. LNAPL Bioremediation/NSZD Modeling
Greg B. Davis (CSIRO Land and Water)
Randall Sillan (AECOM)

D1. Innovative Tools for Evaluating Vapor Intrusion Risk
Loren Lund (Jacobs)
Todd McAlary (Geosyntec Consultants, Inc.)

D2. Vapor Intrusion from Non-VOC Sources (e.g., mercury, methane, PFOAs, and Radionuclides)
Bart Eklund (Haley & Aldrich, Inc.)
Mike Sequino (Directional Technologies, Inc.)

D3. HRSC and Conceptual Site Models
Junaid Sadeque (AECOM)
Rick Wice (Battelle)

E1. Best Practices in Green and Sustainable Remediation (GSR)
Alison Denn (GSI Environmental)
Richard Raymond, Jr. (Terra Systems, Inc.)

E2. Sustainable Remediation Assessment Tools
Ashley Barker (Battelle)
Wendy Condit (Geosyntec Consultants, Inc.)

E3. Robotic Technologies for Environmental Site Assessment and Monitoring
Daniel Mummert (Cedarville Engineering Group LLC)
Natahsa Sihota (Chevron Energy Technology Company)

E4. Adaptive Site Management Strategies to Mitigate Climate Change Impacts
Jana Heisler White (Battelle)
Angela Paolucci (U.S. Navy)

WEDNESDAY PLATFORM SESSIONS

A5. Optimization of Classical Bioremediation Technologies
Daniel Leigh (Evonik)
Michael Singletary (U.S. Navy)

A6. Synthetic Biology Driven Remediation
Kate Kucharzyk (Battelle)
Dayal Saran (Allonnia)

A7. In Situ Bioremediation Applications
Holly Brown (AECOM)
Will Moody (Provectus Environmental Products, Inc.)

A8. Innovative and Efficient Amendment Delivery Strategies
Todd Hanna (Legacy Remediation, Inc.)
John Haselow (Redox Tech, LLC)

B4. Activated Carbon-Based PFAS Treatment Technologies
Jack Sheldon (Antea Group)
Scott Wilson (REGENESIS)

B5. Innovative Treatment Technologies for PFAS Ex Situ
Andrew Punsoni (Allonnia)
Joseph Quinnan (Arcadis)

B6. Comparing Ex Situ Destructive Technologies
Linda Gaines (U.S. EPA)
Dung (Zoom) Nguyen (CDM Smith Inc.)

B7. PFAS in Surface Water and Storm Water
Purshotam Juriasingani (Tetra Tech, Inc.)
Eliza Kaltenberg (Battelle)

C4. Bioremediation in Complex Geological Settings
Natalie Capiro (Auburn University)
David Freedman (Clemson University)

C5. Impacts of Mixed Contaminants on Biodegradation
Robert Borden (EOS Remediation, LLC)
Sowmya Suryanarayanan (Tetra Tech, Inc.)

D4. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics
Fadime Kara Murdoch (Battelle)
Chuck Price (Allonnia)

D5. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation
Rick Cramer (Burns & McDonnell)
J. Mark Stapleton (Noblis)

D6. High-Resolution Site Characterization
Andrew Barton (Battelle)
John Sohl (Columbia Technologies, LLC)

E5. Microplastics and Nanoplastics: Degradation and Effects on the Environment
Alison Cupples (Michigan State University)
Usha Vedagiri (WSP)

E6. Bioremediation of Munitions Constituents
Rula Anselmo Deeb (Geosyntec Consultants)
Paul Erickson (REGENESIS)

E7. Treatment of Nitrate-Impacted Groundwater
Matthew Burns (WSP)
Fausto Ortiz (EOS Remediation)

THURSDAY PLATFORM SESSIONS

A9. Ex Situ and Vadose Zone Biological Treatment
Francisco Barajas-Rodriguez (AECOM)
Alan Seech (Evonik)

A10. Biobarrier Installation and Management
Arul Ayyaswami (Tetra Tech, Inc.)
Michael Lee (Terra Systems, Inc.)

A11. Challenges in Application of Bioremediation Tools
Bill Newman (RNAS Remediation Products)
Michael Pound (NAVFAC SW)

B8. Addressing Emerging Contaminants in a Regulatory Framework
Hunter Anderson (U.S. Air Force)
Christopher Hook (Tetra Tech, Inc.)

B9. Emerging Contaminants: Detection, Degradation, Fate and Transport
Jovan Popovic (Noblis)
Shalene Thomas (WSP)

B10. 1,4-Dioxane Treatment Technologies
Anthony Danko (U.S. Navy)
Kent Sorenson (Allonnia)

C6. Bioremediation Case Studies
Matthew Alexander (Leidos)
Vitthal Hosangadi (NOREAS, Inc.)

C7. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes
Fritz Krembs (Trihydro Corporation)
Troy Lizer (Provectus Environmental Products, Inc.)

D7. Chemical Fingerprinting and Forensics
Cameron Orth (Battelle)
Dora Taggart (Microbial Insights, Inc.)

D8. Improved Conceptional Site Models that Include Biodegradation Data
Charles Newell (GSI Environmental)
John Wilson (Scissortail Environmental Solutions, LLC)

D9. Tools for Site Assessment and Bioremediation Monitoring
Jay Shaw (Provectus Environmental Products, Inc.)
Tomas Will (Directional Technologies, Inc.)

E8. Advances in Tools and Techniques for Assessing MNA
Rick Gillespie (REGENESIS)
Sam Rosolina (Microbial Insights, Inc.)

E9. Groundwater/Surface Water Interactions
Stephanie Fiorenza (Arcadis)
Scott Pittenger (In-Situ Oxidative Technologies, Inc. [ISOTEC])

Panel Discussions

TUESDAY

(C Sessions Room—8:00-9:40 a.m.)
What Are the Knowledge Gaps for Fate and Transport at Complex Sites?
Moderators: Charles Newell, Ph.D., P.E. (GSI Environmental Inc.) and
John Wilson, Ph.D. (Scissortail Environmental)

(B Sessions Room—1:50-3:30 p.m.)
PFAS Program Management in a Rapidly Changing Regulatory Environment
Moderators: Frank Loeffler, Ph.D. (University of Tennessee/Oak Ridge National Laboratory) and
Rula Deeb, Ph.D., BCEEM, PMP (Geosyntec Consultants)

WEDNESDAY

(E Sessions Room—8:00-9:40 a.m.)
Opportunities and Challenges for Engineered Biology in Bioremediation
Moderator: Kent Sorenson, Ph.D., PE (Allonnia)

(C Sessions Room—1:25-3:05 p.m.)
Status of the 2015 Geology Revolution…Where Are We Now and Where Do We Go from Here?
Moderators: Rick Cramer, PG (Burns & McDonnell) and Rick Wice, PG (Battelle)

THURSDAY

(E Sessions Room—10:30 a.m.-12:10 p.m.)
Science, Application, Monitoring, and Illustrative Case Studies of Biogeochemical Remediation
Moderator: Brant Smith, P.E., Ph.D (Evonik)

Tuesday Platform Sessions—8:00–10:30 a.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
8:00	**Rhamnolipids Compositions for Hydrocarbon-Contaminated Soil Remediation: Part II.** *G. Ren, D.G. Brown, P. Ni, S. Compston, K. Ayres, and K. Wilson.* Ginger Ren (Stepan/USA)	**What is Remediation Geology and Why Should It be a Part of Every PFAS Remedial Investigation?** *R.S. Cramer, M.R. Shultz, and C.P. Plank.* Rick Cramer (Burns & McDonnell/USA)	**PANEL DISCUSSION** **What Are the Knowledge Gaps for Fate and Transport at Complex Sites?** **Moderators** Charles Newell, Ph.D., P.E. (GSI Environmental Inc.) John Wilson, Ph.D. (Scissortail Environmental) **Panelists** Tamzen Macbeth, Ph.D., PE (CDM Smith) Hunter Anderson, Ph.D. (U.S. Air Force) Curt Stanley, P.G., CPGS (GSI Environmental) Natalie Capiro, Ph.D. (Auburn University, Cornell University)	**The Best Method to Assess Whether a Vapor Intrusion Risk is Present and Requires Mitigation: The Preference for Passive Samplers.** *H. O'Neill and S. Thornley.* Harry O'Neill (Beacon Environmental/USA)	**Environmental Justice as a New Driver for Sustainable Remediation at Superfund Sites.** *R. Wice.* Rick Wice (Battelle/USA)
8:25	**The In Situ Treatment of Dissolved BTEX and Gasoline Residues Using Micro Activated Carbon.** *R. McGregor.* Rick McGregor (InSitu Remediation Services Ltd./Canada)	**Lysimeters to Evaluate PFAS Leaching at AFFF-Impacted Sites.** *C.E. Schaefer, Y. Fang, S. Shea, N. Gonda, and C.P. Higgins.* Charles Schaefer (CDM Smith Inc./USA)		**Building Pressure Cycling to Document Due Care Compliance in Brownfields Redevelopment.** *T. Gabris and S. Baushke.* Theresa Gabris (Geosyntec Consultants, Inc./USA)	**Sustainable Assessment Tool for the Selection of the Optimal Site Remediation Technologies for Contaminated Gasoline Sites.** *C. Dunlop, B. Abbassi, and R.G. Zytner.* Connor Dunlop (University of Guelph/Canada)
L 8:50	**Solid Phase Colloidal Organic Amendments Promote Sustained Biodegradation in Permeable Reactive Barriers.** *P. Erickson, S. Nguyen, J. Freim, R. Moore, and J. Parker.* Paul Erickson (REGENESIS/USA)	**PFAS Leaching Test and Soil Threshold Calculations by Means of Analytical Models.** *F. Motta, S. Verdelocco, and G. Volpi.* Francesca Motta (AECOM/Italy)		**Evaluation of Spatiotemporal Variability in Site-Specific Attenuation Factors.** *M.A. Lahvis and R.A. Ettinger.* Matthew Lahvis (Shell Global Solutions/USA)	**The Sustainable Remediation of an Agrochemical Manufacturing Facility.** *A.O. Thomas, D. Manning, L. Leclezio, and R. Pollock.* Alan Thomas (ERM/United Kingdom)
9:15	**Carbon + Nutrients = Stronger Bacteria = Faster Remediation.** *L. Ross, J.F. Ortiz-Medina, and B. Yuncu.* Lydia Ross (EOS Remediation/USA)	**Vertebrae™ Segmented Wells for Monitoring Contaminant Mass Discharge.** *K. Hasbrouck, C. Divine, B. Parker, and L. Robinson.* Kristen Hasbrouck (Tanaq Environmental LLC/USA)		**Measurement of Soil Gas to Indoor Air Attenuation Rates Using Radon as a Naturally-Occurring Tracer Gas.** *J. Sanders.* Jonathan Sanders (GeoKinetics/USA)	**Carbon Sequestration to Stabilize Legacy Alkaline Waste.** *D. Granger and M. Viganotti.* David Granger (AECOM/United Kingdom)
L 9:40	SESSION BREAK	**Regional PFAS Soil Investigation of the Air Deposition Pathway.** *C. Fath, B. Angerman, and J. Dippert.* Casy Fath (Barr Engineering Co./USA)	SESSION BREAK	**Passive and Active Soil Gas Sampling along a Sanitary Sewer Line Used for Source Area Delineation and Vapor Intrusion Assessment.** *R.H. Christensen, Jr. and J. Humphress.* Richard Christensen (Acuity Environmental Solutions, LLC/USA)	SESSION BREAK
10:05	**A2.** **Viewing the End from the Beginning: Designing for the Transition to Long-Term Passive Phases of In Situ Chlorinated Solvent Treatment.** *J.M. Tillotson, M. McCaughey, S. Justicia-Leon, and C. Divine.* Jason Tillotson (Arcadis/USA)	**Methods to Estimate Recharge to Determine Mass Discharge from Unsaturated Zone PFAS Source Areas.** *C.J. Newell, E.B. Stockwell, K.L. Walker, D.T. Adamson, J. Alanis, and R.H. Anderson.* Charles Newell (GSI Environmental/USA)	**C1.** **More Data, Less LNAPL: Insights from over 15 Years of Research on Natural Source Zone Depletion (NSZD).** *P.R. Kulkarni, K.L. Walker, C.J. Newell, K. Karimi Askarani, Y. Li, and T.E. McHugh.* Kenneth Walker (GSI Environmental/USA)	**Soil Vapor Extraction Technology Implementation for Vapor Intrusion Mitigation.** *O. Uppal, P. Bennett, A. Broughton, Y.-V. Van, A. Klopfenstein, G. Plantz, and R. Farson.* Omer Uppal (Haley & Aldrich, Inc./USA)	**E2.** **Assessing the Sociotechnical of Remediation through Humanitarian Engineering and SustainAlytics Framework.** *J. Cloninger, B. Moak, M. Harclerode, and C. Silver.* Jane Cloninger (CDM Smith Inc./USA)

A1. Advances in Amendment Formulation — **B1. Fate and Transport of PFAS** — **Panel Discussion** — **D1. Innovative Tools for Evaluating Vapor Intrusion Risk** — **E1. Best Practices in Green and Sustainable Remediation (GSR)**

Tuesday Platform Sessions—10:30 a.m.–1:00 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
10:30	A2. Engineering Biogeochemical Transformation **Spatial and Temporal Application of Two Remedial Technologies at an Active Industrial Site Help Manage the Environmental Risks.** *R. Srirangam, F. Lakhwala, A. Kokorsky, and J. Wood.* Ravikumar Srirangam (Evonik/USA)	SESSION BREAK	C1. Natural Source Zone Depletion **Enhanced LNAPL Natural Source Zone Depletion by Solar-Powered Bioventing at the Former Guadalupe Oil Field.** *B. McAlexander, J. Eichert, C. Smith, E. Daniels, and N. Sihota.* Justin Eichert (Trihydro Corporation/USA)	SESSION BREAK	E2. Sustainable Remediation Assessment Tools **Consideration of Unintended Impacts in Sustainable Remediation Options.** *K. Waldron and G. Wolf.* Gerlinde Wolf (Ramboll/USA)
10:55	**Min-Traps for Collection and Analysis of Reactive Iron Sulfide Minerals for Abiotic CVOC Degradation.** *C. Divine, S. Justicia-Leon, J. Tilton, D. Liles, D. Taggart, and K. Clark.* Craig Divine (Arcadis/USA)	B2. Innovative Treatment Technologies for PFAS in Situ **Transformation of Per- and Poly-Fluoroalkyl Substances (PFAS) by Environmentally Relevant Co-Metabolic Organisms.** *J.A. LaFond, A. Jackson, J. Guelfo, P.B. Hatzinger, and R. Rezes.* Jessica LaFond (Texas Tech University/USA)	**Soil Gas Gradient Method for Estimating Natural Attenuation Rates of NAPL and Specific Chemicals of Concern.** *I. Verginelli, M. Lahvis, P. Jourabchi, and G. DeVaull.* Parisa Jourabchi (ARIS Environmental Ltd./Canada)	D2. Vapor Intrusion from Non-VOC Sources (e.g., mercury, methane, PFOAs, and Radionuclides) **Advancing Urban Site Remediation Using In Situ Bioaugmentation for Chlorinated Aliphatic Hydrocarbons in Groundwater.** *J.P. Yoder and E. Bishop.* Jarrod Yoder (Haley & Aldrich, Inc./USA)	**Analysis of the Economic, Environmental and Social Sustainability of Soil Remediation Technologies with AECOM's Sustainable Remediation Tool.** *F. Motta, S. Boccardo, C. Visccotti, and P. Cellie.* Francesca Motta (AECOM/Italy)
11:20	**Passive Treatment of Metals-Impacted Water Using Sulfate-Mediated Metals Reduction (SMMR).** *R. Le, J. Smith, T. Carlson, M. Williams, D. Graves, S. Cronk, K. Cracchiola, and S. Dworatzek.* Rosemary Le (SiREM/USA)	**Biodegradation of Fluorotelomer-Based PFAS by Soil Cultures Enriched with Various Carbon Sources.** *J. Kim, K. Chu, M.I. Van Meter, M.L. Kim-Fu, S.W. Leonard, and J.A. Field.* Kung-Hui (Bella) Chu (Texas A&M University/USA)	**Comparison of Thermal Methods for Quantifying NSZD Rates Overlying a Shallow Petroleum Hydrocarbon Source Zone.** *I. Hers, A. Wozney, S. Kiaalhosseini, C. McGarvey, K. Stevenson, and K.K. Askarani.* Ian Hers (Hers Environmental Consulting, Inc./Canada)	**Big Bang Theory: Evaluation of Sub-Slab Methane at Large Warehouse Sites.** *T. McHug, M. Rysz, and L. Beckley.* Thomas McHugh (GSI Environmental/USA)	**Sustainable PFAS Remediation: Comparing the Environmental Impact of Enhanced Attenuation Using Colloidal Activated Carbon to Pump and Treat.** *G. Leonard, J. Laitinen, and K. Thoreson.* Gareth Leonard (REGENESIS/United Kingdom)
11:45	SESSION BREAK	**Passive In Situ Treatment of PFAS-Impacted Groundwater Using Foam Fractionation in an Air Sparge Trench.** *D. Nguyen, C. Schaefer, J. Devon, J. Bamer, T. Holsen, J. Guelfo, and B. Chaplin.* Dung (Zoom) Nguyen (CDM Smith Inc./USA)	**Making NSZD-Related Decisions in the Context of Measurement Uncertainty: Common Sources of NSZD Rate Measurement Error.** *J.A. Zimbron.* Julio Zimbron (E-Flux/USA)	**Measurement of Soil Gas to Indoor Air Attenuation Rates Using Radon as a Naturally-Occurring Tracer Gas.** *G. Tofani and J. Sanders.* Jonathan Sanders (GeoKinetics/USA)	SESSION BREAK
12:10		**Colloidal Activated Carbon Used to Enhance Natural Attenuation of PFAS at Airports Worldwide: A Multiple Site Review.** *M. Dooley and R. Moore.* Maureen Dooley (REGENESIS/USA)	SESSION BREAK	**Use of Thoron to Identify Preferential Pathways for Vapor Intrusion.** *J. Peters and K. Dilawari.* Jay Peters (Haley & Aldrich, Inc./USA)	
12:35	A3. **Characterization and Pilot Testing to Demonstrate Innovative Amendment Emplacement for In Situ Biological/Chemical Reduction of VOCs (as DNAPL) in Bedrock.** *R.A. Wymore, E.C. Ashley, and N. Castonguay.* Ryan Wymore (CDM Smith Inc./USA)	**PFAS Source Zone Management with Novel Immobilization Methods and Materials.** *P. Erickson, S. Barnes, Y. Liu, S. Bartlett, and B. Packer.* Paul Erickson (REGENESIS/USA)		SESSION BREAK	E3. **Robotics in Environmental Site Assessment.** *J. Eichert, K. Pritchard, B. McAlexander, N. Sihota, and T. Hoelen.* Justin Eichert (Trihydro Corporation/USA)

Tuesday Platform Sessions—1:00–3:30 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
1:00	**Heated Water Recirculation to Enhance In Situ Abiotic and Biotic Degradation.** *F.J. Krembs, M. Olson, S. Quint, R. Hefner, M. Mercier, A. Sansom, Q. Le, N. Geibel, and M. Maxwell.* Fritz Krembs (Trihydro Corporation/USA)	SESSION BREAK	**Treating and Pretreating Hard to Access Hydrocarbon Contamination in Underground Storage Tank Basins and Utility Corridors with Colloidal Activated Carbon.** *T. Herrington and T. Harris.* Todd Herrington (REGENESIS/USA)	SESSION BREAK	**Autonomous Characterization of Chloride and Total Petroleum Hydrocarbons in Contaminated Soils Using Ground-Based Robotic Platforms.** *G.V. Lowry, A. Johnson, H. Wang, S. Wang, S. Deng, T. Hoelen, and N. Sihota.* Gregory Lowry (Carnegie Mellon University/USA)
1:25	**Biogeochemically-Enhanced Treatment of Chlorinated Organics and Metals.** *D. Leigh and A. Seech.* Daniel Leigh (Evonik/USA)	**PANEL DISCUSSION** **PFAS Program Management in a Rapidly Changing Regulatory Environment** **Moderators** Frank Loeffler, Ph.D. (University of Tennessee/Oak Ridge National Laboratory) Rula Deeb, Ph.D., BCEEM, PMP (Geosyntec Consultants) **Panelists** Heather Henry, Ph.D. (NIEHS) Richard Anderson, Ph.D. (U.S. Air Force Civil Engineer Center [AFCEC]) Charles Schaefer, Ph.D. (CDM Smith) Marc Mills, Ph.D. (U.S. EPA)	**Field Applications of Anaerobic BTX Bioaugmentation Cultures.** *J. Roberts, S. Dworatzek, J. Webb, E. Edwards, C. Toth, and N. Bawa.* Sandra Dworatzek (SiREM/Canada)	**Usage of HRSC Tools to Create More Accurate CSMs at Two Large Manufacturing Facilities.** *T. Kinney, C. Tort, and T. Fewless.* Thomas Kinney (GHD/USA)	**Drone-Based Phytoremediation Reconnaissance Using NDVI/NIR Multispectral Imagery at a Historical Waste Storage Landfill.** *C. Austin, B. Harding, A. Martin, and D. Gray.* Clara Austin (AECOM/USA)
1:50	**Bioremediation of Oil Sands Process Water (OSPW).** *D. Saran, C. Nelson, M. Albright, and K. Sorenson.* Dayal Saran (Allonnia/USA)		**Application of an All-in-One ISCO Technology for the Treatment of Hydrocarbons, BTEX and MTBE at a Former Retail Petrol Station in Italy.** *A. Leombruni, M. Mueller, and B. Smith.* Alberto Leombruni (Evonik/Italy)	**Expedited Geophysical and Drilling Site Characterization of a Karstic Gasoline Release Site to Develop a Coherent Conceptual Site Model.** *D.T. Heidlauf, D. Price, and K. Carson.* Kit Carson (Ramboll/USA)	**Long-Term Biomonitoring of Coal Ash Impoundments Using Plants and Unmanned Aerial Vehicle (UAV)-Deployed Remote Imaging Platforms.** *J.L. Davalos, J. Amos, A. Butler, N. Harms, M. Kurth, T. Rycroft, and E. Gao.* Jazmine Davalos (Oak Ridge Institute for Science and Education/USA)
2:15	**A Comparative Study of the Ability of ISCO and EISB to Treat Multiple Contaminants at a Complex Industrial Landfill Site.** *S. Dworatzek, L. Smith, K. Ashworth, M. Harkness, R. Hornung, J. Vollick, L. Streeter, C. Toth, and E. Edwards.* Sandra Dworatzek (SiREM/Canada)		**TBA Remediation Approaches at Two Distinct Sites: One Large-Scale and One with Really High Concentrations.** *A.A. Rees, F.J. Barajas, and D.M. Monson.* Assaf Rees (AECOM/USA)	**Maximizing Insight and Data Capture from Borehole Logs: The Graphical Approach to Geologic Logging and Its Benefits.** *C. Plank, J. Meyer, R. Cramer, M. Shultz, C. Newell, and D. Adamson.* Colin Plank (Burns & McDonnell/USA)	**Hyperspectral Technologies for Site Assessment and Remediation.** *I.O. Caraballo Alvarez, N. Sihota, and T. Miao.* Irma O. Caraballo Alvarez (Chevron Corporation/USA)
2:40	**Metagenomic Characterization of a Bioreactor with Polyhydroxyalkanoates and Biochar as Biomaterials to Prompt Reductive Dechlorination.** *B. Matturro, M.L. Di Franca, M.M. Rossi, L. Lorini, M. Petrangeli Papini, and S. Rossetti.* Bruna Matturro (Water Research Institute, National Research Council/Italy)		**Remediation and Management Strategies for Redevelopment of a Former MGP Site.** *J. Bergman, H. Nord, P. Elander, J. Molin, B. Smith, E. Toumie, and F. Westin.* Josephine Molin (Evonik/USA)	**High Resolution PFAS Plume Characterization in Fractured Sandstone to Support Groundwater Remedies.** *J. Ramey, K. Quinn, M. Sellwood, and M. Tofte.* Jeff Ramey (TRC/USA)	SESSION BREAK
3:05	**Fiscally Conscious DNAPL Remediation: Legacy Liability to Managed Closure.** *W.L. Brab and K.E. Thompson.* Bill Brab (AST Environmental, Inc./USA)		**Latest Developments in TPH Risk-Based Strategies.** *L. Trozzolo.* Laura Trozzolo (TRC Companies, Inc./USA)	SESSION BREAK	**Climate Change Resiliency Assessments of Two Coastal Sites in Colombia in Preparation for Resilient Remedy Selection.** *K.A. Morris and V. Kolluru.* Kevin Morris (ERM/USA)

A3. Enhanced Methods for Biodegradation/Biotransformation of Organic and Inorganic Contaminants

Panel Discussion

C2. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites

D3. HRSC and Conceptual Site Models

E3. Robotic Technologies for Environmental Site Assessment and Monitoring

E4.

Tuesday Platform Sessions—3:30–5:35 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
3:30	SESSION BREAK	SESSION BREAK	SESSION BREAK	**Changing Long-Standing Conceptual Site Models and Risk Perception with High Resolution Contaminant Distribution (HRCD).** *L.I. Robinson and W.F. Wiley.* Lance Robinson (EN Rx, Inc./USA)	**A Practical Method to Assess Groundwater Remediation System Resiliency: Groundwater Plume Stability is Your Indicator Light.** *T.O. Goist, J.A. Ricker, D. Winchell, and M. Burns.* Timothy Goist (WSP/USA)
3:55	**New Advances in Phytoremediation and Keys to Success on** *Challenging Sites. J.L. Freeman, G. O'Toole, and R. Murphy.* Galen O'Toole (Intrinsyx Environmental/USA)	**POETs for PFAS: Lessons Learned and Emerging Concerns from Monitoring >10,000 Private Drinking Water Wells.** *D. Woodward, O. Elsharnouby, and B. Malyk.* Dave Woodward (WSP/USA)	**Simulating Long-Term Trends in LNAPL NSZD.** *K. Sookhak Lari, J.L. Rayner, and G.B. Davis.* Kaveh Sookhak Lari (CSIRO/ Australia)	**High Resolution Site Characterization for Bioremediation in Fractured Rock.** *N. Thacker and B. Brab.* Nathan Thacker (AST Environmental, Inc./USA)	**Enhanced Phytotechnology as a Nature-Based Solution for Supporting Climate Resiliency.** *K. Waldron, B. Harding, C. Cohu, and J. Freeman.* Kyle Waldron (Marathon Petroleum Corporation/USA)
4:20	**Bioaugmented Phytoremediation to Treat 1,4-Dioxane Contaminated Groundwater.** *R.A. Simmer, P.J. Dixon, T.E. Mattes, and J.L. Schnoor, and L. Licht.* Reid Simmer (University of Iowa/USA)	**Treating PFAS to Near-Zero Concentrations: Life Cycle Assessment Considerations.** *D.S.-Y. Chiang, J. Gal, S. Sharma, and N. Hagelin.* Dora Chiang (WSP/USA)	**Modeling Coupled Heat Transfer and Heat Generation: Lessons for Measuring NSZD Rates Using Thermal Gradient Methods.** *J.A. Zimbron.* Julio Zimbron (E-Flux/USA)	**High-Resolution Site Characterization Methods and Applications for Evaluating LNAPL and Dissolved-Phase Plume Stability and Exposure Risk.** *W. Johnson and B. Graves.* West Johnson (Columbia Technologies, LLC/USA)	**Constructed Wetlands as a Viable Remedial Alternative Contributing to Improved Site Climate Resilience.** *M. Verbeeck, O. Vounaki, and P. Valle*. Mattias Verbeeck (ERM/Belgium)
4:45	**Stable Isotope Probing (SIP) of Rhizosphere Bacteria in 6:2 Fluorotelomer Sulfonic Acid (6:2 FTSA)-Contaminated Soil.** *S.H. Yang, L. Shan, and K.H. Chu.* Kung-Hui (Bella) Chu (Texas A&M University/USA)	**Characterizing PFAS IDW from Investigative Soil and Groundwater Data.** *J. Ramey, K. Quinn, and M. Tofte.* Jeff Ramey (TRC/USA)	**Enhancing Biodegradation of LNAPL with Bioventing.** *S. Gaito, B. Koons, and J. Smith.* Steven Gaito (AECOM/USA)	**Performing a High-Resolution Investigation to Assess Site Hydrogeology and Contaminant Migration Pathways to Update a Conceptual Site Model.** *B.L. Porter, P. Tamashiro, J. Pavlowsky, and J. Briegel.* Johanna Pavlowsky (APTIM/USA)	**Incorporating Resilience and Adaptation into the SuRF-UK Sustainable Remediation Framework.** *A.O. Thomas, R. Gill, N. Harries, and P. Bardos.* Alan Thomas (ERM/United Kingdom)
5:10	**PFAS Phytoscreening for Rapid, ad-hoc Detection of PFAS Groundwater Impacts: Initial Results from the Rastatt/Baden-Baden Site, Germany.** *A. Würth, P. Martus, M.A. Ikipinar, M. Mechler, R. Boeddinghaus, P. Blum, K. Menberg, and R. Söhlmann.* Peter Martus (AECOM/Germany)	**Fate, Transport, and Transformation of Poly- and Per-fluorinated Substances (PFAS) in Wastewater Treatment Plants.** *M. Modiri, B. Crone, P. Potter, and M. Mills.* Mahsa Modiri Gharehveran (EA Engineering, Science, and Technology, Inc., PBC/USA)	**Analytical Element Method and Soil Gas Measurements Applied to Biovent System Compositional and Rate Performance.** *A. Kirkman, J. Montoy, and M. Del Ciello.* Andrew Kirkman (BP/USA)	**Immediate Benefits from HRSC Techniques for Three PFAS Investigations.** *M. Hertz, S. Morrissette, H. Dennis, and C. Boss.* Michael Hertz (EA Engineering, Science, and Technology, Inc., PBC/ USA)	**Understanding the Impact: Evaluation of Footprint Reduction Achieved with Adaptive Site Characterization.** *J. Vidonish Aspinall, J. Gattenby, J. Quinnan, and P. Curry.* Julia Vidonish Aspinall (Arcadis/USA)

A4. Phytoremediation

B3. PFAS Program Management in a Rapidly Changing Regulatory Environment

C3. LNAPL Bioremediation/NSZD Modeling

D3. HRSC and Conceptual Site Models

E4. Adaptive Site Management Strategies to Mitigate Climate Change Impacts

5:45-7:00 p.m. POSTER GROUP 1 PRESENTATIONS AND RECEPTION (EXHIBIT HALL)

Group 1 Posters

Display: Monday, 7:00 p.m.–Tuesday, 7:00 p.m.
Presentations: Tuesday 5:45–7:00 p.m.

The following posters will be on display from Monday evening through Tuesday evening in the Exhibit Hall. During the Presentations/Reception period on Tuesday evening, presenters will be at their displays to discuss their work. The poster board number assigned to each presentation appears below.

A1. Advances in Amendment Formulation

1. Sulfidated Zerovalent Iron: An Innovative ISCR Technology for Discrete Source Remediation. *A. Danko, D. Fan, H. Rectanus, N. Durant, P. Tratnyek, R. Johnson, and G. Johnson.*
Dimin Fan (Geosyntec/USA)

2. Sulfidated ZVI Accelerates Bioremediation in Permeable Barriers and Source Zones. *J. Freim and S. Nguyen.*
John Freim (REGENESIS/USA)

3. Sulfidated Zerovalent Iron: Effects on Subsurface Microbial Communities and Biological Dechlorination. *P. Tratnyek, G. O'Brien Johnson, D. Fan, H. Rectanus, S. Lee, H. Girod, and A. Danko.*
Helen Girod (Geosyntec Consultants, Inc./USA)

4. Weathering of Biostimulatory Solutions Due to Surficial Interactions with Cold Region Calcareous Soils. *A. Jimmo and S.D. Siciliano.*
Amy Jimmo (University of Saskatchewan/Canada)

A2. Engineering Biogeochemical Transformation

5. Low Temperature Thermal Optimization of Source Treatment at Two Chlorinated Solvent Sites. *J. LaChance and E. Cooper.*
Eliot Cooper (Cascade Environmental/USA)

6. Application of a Combined Biological, Chemical and Biogeochemical Treatment of a Trichloroethene Plume in Northern California. *A. Chemburkar, D. Leigh, and S. Telesz.*
Daniel Leigh (Evonik/USA)

A3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants

7. Expedited Organo-Halide Destruction via Biostimulation without Augmentation Supported by Introduction of Abiotic Electron Donor. *K.C. Armstrong, K. Rapp, H. Anderson, and M.W. Fields.*
Kent Armstrong (TerraStryke Products, LLC/USA)

8. Microbial Sulfate Reduction in the Presence of Zero Valent Iron: Responses to Purity and Surface Treatment. *N. Khan and K. Millerick.*
Nofil Khan (Texas Tech University/USA)

9. A Sustainable Approach for Chlorinated Compounds Contaminated Groundwater Remediation: Raw Polyhydroxyalkanoates (PHA) from Organic Waste as Electron Donor for Biological Reductive Dechlorination Coupled with Adsorption on Biochar. *L. Lorini, M. Mariorenzi, M. Petrangeli Papini, B. Matturro, and S. Rossetti.*
Laura Lorini (La Sapienza University of Rome/Italy)

10. Ecosystem Restoration by Thermal In Situ Sustainable Remediation (TISRTM). *J. Munholland.*
Jonah Munholland (Arcadis/USA)

11. Contaminant Degradation within Colloidal Activated Carbon Treatment Zones: A Multi-Site Review to Demonstrate Complete Destruction and Reduction of CVOCs Contaminants Using Multiple Lines of Evidence. *C. Ortiz, P. Erickson, B. Griffiths, and C. Sandefur.*
Carlos Ortiz (REGENESIS/USA)

12. The Impact of Activated Carbon Grain Size on Bioremediation. *E.J. Winner.*
Ed Winner (Remediation Products, Inc./USA)

13. Living Room, Transportation, and Biofilm Community: The Overlooked Infrastructure in Subsurface Microbial Biodegradation. *E.W. Winner.*
Ed Winner (Remediation Products, Inc./USA)

A4. Phytoremediation

14. Effects of Root Exudates on 6:2 FTOH Biotransformation and Soil Microbiome. *S.H. Yang, L. Shan, and K.H. Chu.*
Kung-Hui (Bella) Chu (Texas A&M University/USA)

15. Remediation of a CVOC Plume Using TreeWell® Phytoremediation Technologies as Part of a Combined Remedies Approach. *C. Gale, B. Smith, D. Riddle, and D. Wanty.*
Christopher Gale (Applied Natural Sciences/USA)

16. Phytoremediation for Management of a Firefighter Training Site Waste Stream. *K.E. Farrington, D.F. McMillin, A.E. Lumley, R.S. McDonald, W.B. Salter, D. Bennett, E. Torres Soto, H.R. Luckarift, G.R. Johnson, and J.R. Owens.*
Glenn Johnson (Battelle/USA)

17. Retaliation of *Alstonia scholaris* (L.) R.Br. to Stable and Radioactive Cesium (^{137}Cs) and Strontium (^{90}Sr): A Sustainable Remediation Approach for Mitigation of Radionuclide-Polluted Sites. *B.S.M. Singh, N.K. Dhal, and D.K. Mohapatra.*
B.S. Manisha Singh (CSIR-Institute of Minerals and Materials Technology/India)

A5. Optimization of Classical Bioremediation Technologies

18. Site-Specific Reductive Dechlorination Designs Bundling Multiple Abiotic with Biotic Reagents: Lessons Learned. *P.M. Dombrowski, P. Kakarla, M. Lee, and D. Raymond.*
Paul Dombrowski (In-Situ Oxidative Technologies, Inc. [ISOTEC]/USA)

19. Combining ISCR and Antimethanogenic Reagents to Achieve Substantial CVOC Reduction. *T. Lizer, W. Moody, and M. Scalzi.*
Troy Lizer (Provectus Environmental Products, Inc./USA)

20. Chlorinated Solvent Plume Reduced >95% via In Situ Combined Remedy Leading to Long-Term VI Risk Reduction at State-Led Project. *J. Parker and R. Moore.*
Joel Parker (Hamp, Mathews and Associates/USA)

21. Lessons Learned from Large-Scale Bioaugmentation at a Remote Site. *S. Pittenger, P.M. Dombrowski, K. O'Neal, C. Scales, and J. Roberts.*
Scott Pittenger (In-Situ Oxidative Technologies, Inc. [ISOTEC]/USA)

22. A Comprehensive Combination of Remedial Treatment Technologies Shows Success for a Complex Site. *E. Raes, D. Busch, M. Meriney, and A. Peacock.*
Eric Raes (Engineering & Land Planning Assoc., Inc./USA)

23. Optimizing Injection and Monitoring of Bioaugmentation Cultures for In Situ Bioremediation. *C. Scales, J. Roberts, and P. Dennis.*
Corey Scales (SiREM/Canada)

24. Optimization of a Permeable Reactive Barrier for Chlorinated Solvents. *A. Sutton, B. Henry, E.C. Heyse, C. Hewitt, and J. Roberts.*
Aaron Sutton (Parsons/USA)

25. Evaluation and Implementation of Horizontal Biosparging for Expedited Remediation of Petroleum Hydrocarbons. *T. Will, D. Forse, and M. Sequino.*
Tomas Will (Directional Technologies, Inc./USA)

A6. Synthetic Biology Driven Remediation

26. Synthetic Biology-Driven Approach to Repurpose Polyamides (STORM). *E. Beasley, J. Lilly, M. Valiev, M. Cheng, J. Bardhan, and K.H. Kucharzyk.*
Kate Kucharzyk (Battelle/USA)

A7. In Situ Bioremediation Applications

27. Treatability Study Results for In Situ Treatment of Chlorinated Solvents at a Formerly Used Defense Site. *M.L. Alexander, V.K. Peterson, D.J. Lowak, and G. Philpy.*
Matthew Alexander (Leidos/USA)

28. Combined Remediation Technologies Pave the Way for the Rapid Redevelopment of a Legacy Brownfield Site. *J. Freim and C. Lee.*
John Freim (REGENESIS/USA)

29. Biosparging Application Using Horizontal Remediation Wells. *M. Lubrecht, J. Gallagher, and D. Ombalski.*
Jacob Gallagher (Ellingson Companies/USA)

30. Using CSIA to Verify Effectiveness of Coupling Synthetic Iron Sulfide Injections with Bioaugmentation to Address a Trichloroethylene Plume. *A. Karachalios and D. Alden.*
Antonis Karachalios (Tetra Tech, Inc./USA)

31. Bench-Test and Pilot-Scale Bioaugmentation of a Hydrocarbon-Contaminated Site by a High-Performance Bacteria Consortium. *I.J.S. Mello, L.T.M. Cruz, and C. Gonçalves.*
Igor Mello (CPEA/Brazil)

32. A Combined Remedy of In Situ Chemical Oxidation and Aerobic Bioremediation to Treat the Emerging Contaminant Tetrahydrofuran. *O. Miller and R. Moore.*
Ryan Moore (REGENESIS/USA)

33. Easy Installation and Quick BTEX Reductions in Poorly Accessible Off-Site Locations Using Biosparging via Nested Horizontal Wells. *L.I. Robinson and W.F. Wiley.*
Lance Robinson (EN Rx, Inc./USA)

34. Controlling Trichloroethene Aerobic Cometabolism Rate and Microbial Biomass Using Acetylene. *J.P. Skinner, C. McLaughlin, A.G. Delgado, and J. Chu.*
Beatrice Li (Arizona State University/USA)

35. A Case Study of In Situ Bioremediation of Low Permeability Soils Using Specialized Waterjet Technology. *S. Uesawa, J. Yamanobe, K. Takayanagi, K. Ishikawa, T. Shioya, M. Yeh, and R. Borden.*
Susumu Uesawa (Chemical Grouting Co., Ltd./Japan)

B1. Fate and Transport of PFAS

36. Biological and Chemical Transformation of a PFAS Precursor with Insights into PFAS Fate and Forensics. *E.K. Cook, C. Carpenter, A. Lewis, N. Chen, C.I. Olivares, S. Yi, E.H. Antell, D.L. Sedlak, L. Alvarez-Cohen, A. Nickerson, Y.J. Choi, and C.P. Higgins.*
Emily Cook (EKI Environment & Water, Inc./USA)

37. Using a Multi-Phase, Finite-Difference, Multi-Species Model that Accommodates Dynamic Sorption and Competitive Interactions to Interpret and Predict PFAS Fate and Transport. *J. Birnstingl and K.M. Gaskill.*
Keith Gaskill (REGENESIS/USA)

38. Research Gaps and Challenges in Terms of Fate of PFAS during Wastewater Treatment, Incineration and Landfill Disposal. *Y. Kunukcu.*
Yasemin Kunukcu (Roux Inc./USA)

39. PFAS Assimilation during Bacterial Biosynthesis. *D. Ramirez, Y. Xie, and F. Loeffler.*
Frank Loeffler (University of Tennessee/USA)

40. Aerobic Biodegradation of PFOA/PFOS: Promising Benchtop Studies and Preliminary Field Applications. *L. Mankowski, D. Chiang, T. Repas, J. Adams, and H.L. Lord.*
Leonard Mankowski (WSP/USA)

41. Using Groundwater Plume Analytics® Tools to Assess PFAS Fate and Transport. *J.A. Ricker and D.C. Winchell.*
Joseph Ricker (WSP/USA)

B2. Innovative Treatment Technologies for PFAS In Situ

42. PFAS Concentrations in Groundwater Reduced to below Drinking Water Standards at a Former Michigan Manufacturing Facility. *A. Cuellar, R. Moore, K. Gaskill, and E. Bays.*
Angel Cuellar (Tetra Tech, Inc./USA)

43. Thermal Treatment of PFAS-Containing Soil Piles. *G. Heron, P. Joyce, L. Stauch, and E. Crownover.*
Mark Kluger (TRS Group, Inc./USA)

44. How Can Nature-Based Approaches Play a Role in PFAS Remediation? *L. Mankowski, D. Chiang, and A. Quintin.*
Leonard Mankowski (WSP/USA)

45. Coupled High- and Low-Frequency Ultrasound Remediation of PFAS-Contaminated Soils. *R. Marsh, J.A. Kewalramani, B. Wang, and J. Meegoda.*
Richard Marsh (New Jersey Institute of Technology/USA)

46. Immediate and Effective PFAS Treatment in Bedrock Aquifer at a Hazardous Sites Clean-Up Act Site. *G.N. Iosue, J. Dziekan, L. Strobridge, and C.R. Wade.*
Barry Poling (REGENESIS/USA)

B3. PFAS Program Management in a Rapidly Changing Regulatory Environment

47. PFAS Mobile Treatment: Change Is the Only Given. *S.L. Knox and N.A. Williams.*
Sheri Knox (WSP/USA)

48. Exploring PFAS Inhalation Exposures and Toxicity. *K. Patel-Coleman.*
Kanan Patel-Coleman (Burns & McDonnell/USA)

49. Is Your PFAS Project Headed for Litigation? Litigation Lessons Learned with "Forever Chemicals." *D. Woodward, S. Gormley, and O. Elsharnoby.*
Dave Woodward (WSP/USA)

C1. Natural Source Zone Depletion

50. Challenges in Developing Background Temperature Profiles for NSZD Using the Biogenic Heat Method. *N. Babu, D. Collins, and K. Waldron.*
David Collins (Stantec/USA)

51. Quantification of the NSZD Rate for a Petroleum-Based DNAPL Body through Biogas Efflux and Aqueous Indicators. *J. Ford, A. Sidebottom, H. Hernandez, T. Palaia, N. Mahler, and A. Metcalfe.*
Jeffrey Ford (Jacobs/USA)

52. Shifting from Tradition: A Long-Term NSZD Approach for an Active Oil and Gas Facility. *A. Jimmo, S.D. Mamet, N. Higgs, S.D. Siciliano, D. Nuell, and L. Pickering.*
Amy Jimmo (Environmental Material Science Inc./Canada)

53. Sulfate Delivery Methods for Enhancing Biodegradation of Petroleum Hydrocarbons. *K. Sra, R. Kolhatkar, D. Segal, and J. Wilson.*
Kammy Sra (Chevron/USA)

54. Natural Source Zone Depletion (NSZD): Advances in Remote Monitoring and Processing Using Temperature Data. *S.T. Robinson, T.E. McHugh, K.L. Walker, K. Karimi Askarani, T. Sale, and T. Lewis.*
Kenneth Walker (GSI Environmental/USA)

C2. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites

55. Biodegradation of Petroleum Hydrocarbons under Different Redox Conditions to Mitigate Methane Emissions. *I. Afzal, N. Suri, A. Kuznetsova, A. Ulrich, and T. Siddique.*
Iram Afzal (University of Alberta/Canada)

56. Multiple Remediation Technologies: A Challenging Contaminated Site in Colombia. *S. Aluani, C. Spilborghs, E. Pujol, F. Tomiatti, R. Moura, N. Nascimento, J. Mueller, T. Lizer, W. Moody, W. Meese, and M. Scalzi.*
Sidney Aluani (SGW Services/Brazil)

57. Expedited Petroleum Hydrocarbon Destruction via Biostimulation Alone under Baseline Conditions Considered Unsuitable for Bioremediation without Augmentation. *K.C. Armstrong, H. Anderson, K. Rapp, and A.D. Peacock.*
Kent Armstrong (TerraStryke Products, LLC/USA)

58. In Situ Bioremediation of Shallow Dispersed LNAPL Plume Travelling under a Major Highway. *D. Guilfoil, G. Simpson, N. Thacker, and N. Mau.*
Duane Guilfoil (AST Environmental, Inc./USA)

59. Treatment Success and Application Insights with Colloidal Activated Carbon for Hydrocarbon Plumes: A Multi-Site Review. *T. Herrington.*
Todd Herrington (REGENESIS/USA)

60. Sulfate-Enhanced Bioremediation of Petroleum Sites in Alaska. *E. Heyse, B. Henry, and B. Blicker.*
Edward Heyse (Parsons/USA)

61. Measuring Diesel-Range Organic Concentrations in Groundwater. *E. Heyse, B. Henry, and B. Blicker.*
Edward Heyse (Parsons/USA)

62. In Situ Sorption and Biodegradation of Petroleum Hydrocarbons. *A. Oka, K. Kaur, S. Sherman, S. Abrams, and M. Spievack.*
Amita Oka (Langan/USA)

63. Expedited Remediation of Benzene and Attenuation of Metals in Petroleum-Impacted Groundwater Using Activated Carbon-Based Amendment. *H. Singh, J.H. Zavala, and T. Fortner.*
Nasim Pica (Weston Solutions, Inc./USA)

64. Effective Remedial Decision-Making in Hydrocarbon-Impacted Sites Using Sequence Stratigraphy-Based Conceptual Site Models. *J. Sadeque and R. Samuels.*
Junaid Sadeque (AECOM/USA)

65. Apparent Total Petroleum Hydrocarbons (TPH) in Uncontaminated Soils: Quantification, Identification, and Implications for TPH Regulation. *M.I. Silverman, S. Vishnu Sundar, A. Nitzky, E.M. Miranda, P. Dahlen, A.G. Delgado, N. Sihota, and R. Mohler.*
Maxwell I. Silverman (Arizona State University/USA)

C3. LNAPL Bioremediation/NSZD Modeling

66. Key Factors for Modeling Jet Fuel-Contaminated Site to Assess NSZD in Subtropical/Tropical Climates. *H.K. Chang, E.H. Teramoto, M.P.M. Baessa, A.U. Soriano, and M.P.Z. Pede.*
Hung Chang (UNESP/Brazil)

67. Transition from Mechanical-Based Remedies to Natural Remedies: Molecular Biological Tools Demonstrate Petroleum MNA and NSZD in a Fractured Basalt Aquifer in Melbourne, Australia. *B. Harding, B. Oyston, D. Taggart, and T. Key.*
Barry Harding (AECOM/USA)

68. Seasons of Change in Western Canada: NSZD Rates across Twelve Sites Using High-Data Density Technology. *S.D. Mamet, N. Higgs, A. Jimmo, C. Senger, and S.D. Siciliano.*
Steven Mamet (Environmental Material Science Inc./Canada)

69. Case Study for the Injection of BOS 200+ to Remediate Saturated Zone LNAPL at the Former Marshall Iron & Metal Site, Marshall, Michigan. *M. McGowan, J. Gal, and G.E. Simpson.*
Gary Simpson (AST Environmental, Inc./USA)

70. Natural Source Zone Depletion Rate Comparison over a 40-Foot Thick Smear Zone. *P.E. Stumpf, M. Shayan, S. Ganna, and J. Lentini.*
Peter Stumpf (AECOM/USA)

71. Dynamic LNAPL Distributions and the Conceptual Site Model: Using UV-Induced Fluorescence for Non-Destructive Testing. *J.A. Zimbron.*
Julio Zimbron (E-Flux/USA)

D1. Innovative Tools for Evaluating Vapor Intrusion Risk

72. Strategic Approach for VI Assessment and Mitigation along a 1,200 feet Trichloroethene Groundwater Plume. *R.H. Christensen, Jr. and M. Grzegorek.*
Richard Christensen (Acuity Environmental Solutions, LLC/USA)

73. Best Practices for Quality Assurance/Quality Control for Passive Barrier Installations at New and Existing Buildings. *H. Nguyen and J. Morgan.*
Jordan Morgan (Land Science/USA)

74. Quality Assurance of Real-Time VOC Measurements Using AROMA-VOC. *H.C. Tay, N. Rezaei, and K.G. Pennell.*
Hong Cheng Tay (University of Kentucky/USA)

D2. Vapor Intrusion from Non-VOC Sources (e.g., mercury, methane, PFOAs, and Radionuclides)

75. Literature Review of the Physicochemical Controls on the Fate of PFAS in Air. *G. Carrasco, T. Thomas, R. Rago, and B. Eklund.*
Gabriela Carrasco (Haley & Aldrich/USA)

76. Evaluation of the Vapor Intrusion Potential of Volatile Per- and Polyfluoroalkyl Substances. *C. Holton and D. Hanigan.*
Chase Holton (GSI Environmental/USA)

D3. HRSC and Conceptual Site Models

77. Do You Know Your Site? Qualitative Characterization, Modeling, and Remediation to Predict Site Closure. *W.L. Brab and R. Paulson.*
Bill Brab (AST Environmental, Inc./USA)

78. Improving Remedial Designs Using Passive Flux Meter Studies and Plume Dimension Analysis. *C. Lee and C. Sandefur.*
Chris Lee (REGENESIS/USA)

79. Incorporating Molecular Biological Tools into High-Resolution Site Characterizations. *B.M. McDowell.*
Briana McDowell (Columbia Technologies/USA)

80. Estimating the Magnitude of 1,4-Dioxane Releases from TCA and Non-Solvent Sources: An Update. *T.K. Mohr.*
Thomas K. Mohr (Mohr HydroGeoScience/USA)

81. Refinement of TCE Conceptual Site Model to Develop Remedial Design. *A. Moore.*
Anthony Moore (Environmental Works, Inc./USA)

E2. Sustainable Remediation Assessment Tools

82. Secure the Bag: Passive Groundwater Sampling as a Sustainable Remediation Assessment Tool at a Large Chlorinated Solvent Site in Texas. *A.R. Denn and J.M. Skaggs.*
Alison Denn (GSI Environmental/USA)

83. Climate Change Resiliency: Using Ecosystem Services Concepts to Guide Risk Assessments and Site Remediation. *J.L. Heisler White.*
Jana Heisler White (Battelle/USA)

84. ENVIRO.wiki: Tech Transfer in the 21st Century. *B. Yuncu, J. Hurley, and R.C. Borden.*
Bilgen Yuncu (TRC/USA)

E3. Robotic Technologies for Environmental Site Assessment and Monitoring

85. Unmanned Aerial Systems for Environmental Assessment Applications. W.M. Stiteler and J.J. Diamond.
Nathan Nagle (Arcadis/USA)

E4. Adaptive Site Management Strategies to Mitigate Climate Change Impacts

86. Communicating the Impact: Moving from Qualitative Inclusion of Sustainable Best Management Practices to an Integrated Sustainable Resilient Remediation Approach. *J. Gattenby, M. Dupre, and J. Sturza.*
Julia Vidonish Aspinall (Arcadis/USA)

87. Understanding the Impact: Comparison of Footprints for Treatment Materials in Fixed Media PFAS Treatment Systems. *A. Mushtaque, J. Gattenby, M. Goncalves, and A. Fischer.*
Shashank Kalra (Arcadis/USA)

Wednesday Platform Sessions—8:00–10:30 a.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
8:00	**Enhanced Reductive Dechlorination after In Situ Chemical Oxidation: Moving Past the Myth to Design Effective Combined Treatment Remedies.** *P.M. Dombrowski, S. Pittenger, P. Kakarla, J. Roberts, and P. Dennis.* Scott Pittenger (In-Situ Oxidative Technologies, Inc. [ISOTEC]/USA)	**Using Colloidal Activated Carbon to Reduce PFAS and PCE Concentrations in Groundwater to below Michigan's Drinking Water Limits for over Four Years.** *R. Moore and P. Lyman.* Ryan Moore (REGENESIS/USA)	**Abiotic Dechlorination in Clay to Support Natural Attenuation.** *C.E. Schaefer, D. Tran, T.M. Blount, and C. Werth.* Charles Schaefer (CDM Smith Inc./USA)	**Using Environmental Metabolomics to Improve Decision Making at Chlorinated Solvent Sites.** *K.C. Clark, S.M. Rosolina, and D.M. Taggart.* Dora Taggart (Microbial Insights, Inc./USA)	
8:25	**Optimization Techniques for Aging SVE Systems.** *M. Ingraham, T. Andrews, and T. Kremmin.* Miles Ingraham (Jacobs/USA)	**Improving Activated Carbon Performance for In Situ Sequestration of Per- and Polyfluoroalkyl Substances.** *A. Meservey, K. Manz, C. Liu, K. Pennell, M. Mitchek, and J. Wong.* Alexis Meservey (Brown University/USA)	**Enhanced DNAPL Dissolution and Rapid, Complete Reductive Dechlorination of Trichloroethene in a Pilot Test in a Perched Aquifer.** *M.M. Lorah, T.P. Needham, E.H. Majcher, E.P. Foss, J.J. Trost, C.T. Livdahl, A.M. Berg, I.M. Cozzarelli, and D.M. Akob.* Michelle Lorah (U.S. Geological Survey/USA)	**Probing Marine Ecosystems for Novel Polycyclic Aromatic Hydrocarbon Degraders.** *J. Walton, E. Bobo, and A. Buchan.* Jillian Walton (University of Tennessee/USA)	**PANEL DISCUSSION** **Opportunities and Challenges for Engineered Biology in Bioremediation** **Moderator** Kent Sorenson, Ph.D., PE (Allonnia)
L 8:50	**Field-Scale Evaluation of Biosparging at a CERCLA Site to Deplete Groundwater Contaminants from Creosote and Achieve Remedial Action Objectives.** *R. Sillan, R. Holm, G. Jeffries, and J. Smith.* Randall Sillan (AECOM/USA)	**Large Full-Scale In Situ Remediation of Groundwater with High Concentrations of PFAS Using PlumeStop™.** *R.H. Mora, J. Cuthbertson, J. Buzzell, S. Krenz, R. Moore, K. Gaskill, and A. Kavanaugh.* Rebecca Mora (AECOM/USA)	**Adaptive Strategies for In Situ Treatment of Shallow and Deep PCE Plumes in Interbedded Geology.** *A.K. Wahi and J. Galemore.* Arun Kumar Wahi (INTERA Inc./USA)	**Gene Markers for Monitoring Anaerobic Dichloromethane Biodegradation: Current Progress and Future Directions.** *R.W. Murdoch, F. Kara Murdoch, G. Chen, and F. Loeffler.* Robert Murdoch (Battelle/USA)	
9:15	**In Situ Treatment for Hexavalent Chromium Using ISCR Enhanced Bioremediation in Saturated Clay Soils Results in No Further Action.** *O. Miller and R. Moore.* Keith Gaskill (REGENESIS/USA)	**The In Situ Treatment of TCE and PFAS-Impacted Groundwater Using Anaerobic Bioremediation, Polylactate Ester, and Colloidal Activated Carbon.** *R. McGregor and L. Benevenuto.* Rick McGregor (InSitu Remediation Services Ltd./Canada)	**Enhanced In Situ Bioremediation within a Complex Heterogeneous Coastal Plain Groundwater Basin.** *S.P. Netto, A.M. Donnelly, and D.J. Sealee.* Steven Netto (Hargis + Associates, Inc./USA)	**Advancements in Remedial Performance Assessments at Complex Sites with Incorporation of Advanced Data Analytics and Innovative Characterization Tools.** *J.S. Konzuk, M. Cho, C. Crea, C. Cheyne, L. D'Agostino, L. Jorstad, J. Stening, and O. Bukhteeva.* Julie Konzuk (Geosyntec Consultants International, Inc./Canada)	
L 9:40	**Evaluating the Effect of Salinity on In Situ Biological Reduction of a 1,2-DCA Plume.** *I. Pelz, A. Chemburkar, A. Breckenridge, J. Kerl, and D. Leigh.* Isaac Pelz (ERM/USA)	**Adsorbents Treatability Evaluation for PFAS Removal from Groundwater Infiltrating into a Chrome-Plating Facility Basement.** *F. Barajas, N. Swiger, M. Van Der Eide, and B. Harding.* Francisco Barajas-Rodriguez (AECOM/USA)	**Microcosm Evaluation of TCE Degradation in Fractured Rock in Response to Amendments.** *H. Wang, D.L. Freedman, R. Yu, and R. Iery.* Hao Wang (Geosyntec Consultants, Inc./USA)	**STUDENT PAPER WINNER** **Proteomic Insights into Fungal-Mediated PFAS Precursor Biotransformations.** *K. Shah, Y. Gao, G. Nurwono, V. Pandey, A. Mayank, J.O. Park, J. Wohlschlegel, and S. Mahendra.* Kshitija Shah (University of California, Los Angeles/USA)	SESSION BREAK
10:05	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	**Potential for Health Effects of Microplastics: San Francisco Bay Area Example.** *U. Vedagiri.* Usha Vedagiri (WSP/USA)

Wednesday Platform Sessions—10:30 a.m.–1:00 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
10:30	**Tools for the Characterization and Manipulation of Reductive Dehalogenases for Bioremediation of Chlorinated Solvents.** *K.J. Picott, C. Bowers, and E.A. Edwards.* Katherine Picott (University of Toronto/Canada)	**Field Demonstration: Electrochemical Degradation of PFAS Mass in Wastewaters.** *R. Casson, R.E. Gwinn, and R.H. Mora.* Rosa Gwinn (AECOM/USA)	**Characterization of Contaminant Evolution and Ketones Accumulation in an Aged DNAPL Source Zone within a Sedimentary Bedrock Aquifer.** *S. Shafieiyoun, B.L. Parker, and J. Meyer.* Jessica Meyer (University of Iowa/USA)	**Remedial Design Optimization Using Environmental Sequence Stratigraphy.** *J.M. Stapleton.* J. Mark Stapleton (Noblis/USA)	**Microplastics: Challenges and Options for Removal through Wastewater Treatment Plants.** *Y. Kunukcu.* Yasemin Kunukcu (Roux Inc./USA)
10:55	**Developing Novel On-Site Handheld Biosensors for PFAS Constituents.** *D. Saran, A. Banerjee, and K. Sorenson.* Areen Banerjee (Allonnia/USA)	**Soil Washing: Sustainable Cost-Effective Treatment for PFAS Source Zones.** *J.A. Quinnan, C. Morrell, and N. Nagle.* Nathan Nagle (Arcadis/USA)	**Sulfate Enhanced In Situ Biodegradation of MTBE and TBA in Fractured Bedrock for Source Area Treatment and Downgradient Risk Mitigation.** *D. Collins, N. Babu, and K. Waldron.* David Collins (Stantec/USA)	**Environmental Sequence Stratigraphy in Numerical Groundwater Models.** *J.P. Brandenburg, R.M. Suribhatla, and M. Einarson.* J.P. Brandenburg (Haley & Aldrich, Inc./USA)	**Can We Apply a Site-Specific Ecological Risk Assessment Framework for Microplastics?** *R. Zajac-Fay, J.M. Conder, T. Liu, and Z. Pandelides.* Theresa Gabris (Geosyntec Consultants, Inc./USA)
11:20	**A Molecular Approach to Lindane Biodegradation.** *C. Masini and F. Brogioli.* Cosimo Masini (DND Biotech srl/Italy)	**Status of Gas-Based PFAS Remediation Technologies.** *C.J. Newell and P.R. Kulkarni.* Charles Newell (GSI Environmental/USA)	**Compound Specific Isotope Analysis of 2,3-Dichloroaniline Reveals Aerobic Biotransformation in Constructed Wetlands.** *S. Suchana, E. Edwards, L. Lomheim, S. Pimentel Araujo, S. Gavazza, E.E. Mack, and E. Passeport.* Shamsunnahar Suchana (University of Toronto/Canada)	**An Innovative Biocirculation®-System for Chlorinated Aliphatic Hydrocarbon (CAH) Degradation with Groundwater Circulation Well (IEG-GCW®).** *P. Ciampi, M. Petrangeli Papini, C. Esposito, E. Bartsch, E. Alesi, and G. Rehner.* Paolo Ciampi (University of Rome "La Sapienza"/Italy)	**Microplastics and Nanoplastics: Degradation and Effects on the Environment.** *M. Ellis, T. Boom, S. BinAhmed-Menzies, A. McCabe, and L. Carney.* Sara BinAhmed-Menzies (Barr Engineering Co./USA)
11:45	**Biosourcing for Microbially Driven Polyethylene Degradation.** *K.K. Kucharzyk, R.W. Murdoch, J. Lilly, S. Higgins, M. Evans, E. Beasley, and C. DeSanti.* Kate Kucharzyk (Battelle/USA)	**Improved Cost and Performance of PFAS Groundwater Treatment Using a Carbon-Based Micro-Adsorbent and Ceramic Separations Technology.** *J. Quinnan, T. Reid, V. Pulikkal, and C. Bellona.* Terence Reid (Aqua-Aerobic Systems, Inc./USA)	**Polar Organic Chemical Integrative Sampler (POCIS) Allows Compound Specific Isotope Analysis of Substituted Chlorobenzenes at Trace Levels.** *S. Suchana, E. Edwards, L. Lomheim, N. Melo, S. Gavazza, E.E. Mack, and E. Passeport.* Shamsunnahar Suchana (University of Toronto/Canada)	**Effects of Heterogeneity and Back-Diffusion on Cleanup Timeframe.** *D.K. Burnell.* Daniel Burnell (Tetra Tech, Inc./USA)	**Municipal Activated Sludge-Derived Microplastic Microbiomes: The Good, the Bad, and the Promising.** *D. Deng, D.N. Pham, L. Clark, and M. Li.* Mengyan Li (New Jersey Institute of Technology/USA)
12:10	SESSION BREAK	**Supercritical Water Oxidation for PFAS Destruction in Various Matrices.** *M.A. Deshusses, S. McKnight, D. Hatler, and S. Viswanathan.* Marc Deshusses (374Water inc./USA)	**Application of Sequence Stratigraphy in Developing Bioremediation Strategy in a Complex Geological Site: An Example from the Los Angeles Basin, California.** *J. Sadeque, R. Samuels, and K. Carr.* Junaid Sadeque (AECOM/USA)	SESSION BREAK	SESSION BREAK
12:35		**De Novo Enzymes Development for PFAS Compounds Degradation.** *D. Saran, K. Sorenson, and G. Meshulam-Simon.* Dayal Saran (Allonnia/USA)	SESSION BREAK		

A6. Synthetic Biology Driven Remediation

B5. Innovative Treatment Technologies for PFAS Ex Situ

C4. Bioremediation in Complex Geological Settings

D5. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation

E5. Microplastics and Nanoplastics: Degradation and Effects on the Environment

Wednesday Platform Sessions—1:00–3:30 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
1:00	**In Situ Vadose Zone Perchlorate Remediation Using Emulsified Vegetable Oil.** *R. Royer, B. Longino, J. Wood, G. Hamer, N. Amini, and M. Berhooz.* Richard Royer (Arcadis/USA)	SESSION BREAK	SESSION BREAK	**Quantitative High-Resolution Site Characterization (qHRSC) and Lessons Learned.** *D.A. Pizarro and W. Brab.* Derek Pizarro (AST Environmental, Inc./USA)	**Evaluating the Water Reactivity of Expired Propellants.** *R. Le, J. Smith, K. Eden, and D. Graves.* Rosemary Le (SiREM/USA)
1:25	**Biological Degradation and Chemical Reduction to Reduce DNAPL and Dissolved COCs to Turn off an Extraction System.** *R.E. Mayer, P. Bauer, E. Schlegel, and K. Cronin.* Robert Mayer (APTIM/USA)		**PANEL DISCUSSION** **Status of the 2015 Geology Revolution…Where Are We Now and Where Do We Go from Here?** **Moderators** Rick Cramer, PG (Burns & McDonnell) Rick Wice, PG (Battelle) **Panelists** Alex Scott, PE (NAVFAC-DC) Jessi Meyer, Ph.D. (University of Iowa) Mark Stapleton, Ph.D., PE (Noblis) John Wilson, Ph.D. (Scissortail Environmental Solutions, LLC.)	**EPA and HRSC at Superfund Sites.** *B. Bentkowski.* Ben Bentkowski (U.S. Environmental Protection Agency - Region 4/USA)	**Linking Proven Technologies to Bioremediate TNT and Metabolites and Facilitate On-Site Reuse of Soil.** *S.M. Larew, E.D. Meeks, and A.G. Seech.* Scott Larew (Kennedy/Jenks Consultants/USA)
1:50	**Aerobic Cometabolic Remediation of Chlorinated Ethenes as a Barrier to Impacted Groundwater Discharge to a Brook.** *B. O'Dell, S. Sharma, and B. Timmins.* Brent O'Dell (WSP/USA)	**PFAS-Laden Spent Media Destruction Using Supercritical Water Oxidation Technology.** *D.S.-Y. Chiang, J. Gal, D. Hatler, and M. Deshusses.* Dora Chiang (WSP/USA)		**Costs, Cost Savings, and Best Practices for High Resolution Site Characterization at Petroleum Underground Storage Tank Release Sites.** *D. Kaufman, T. Schruben, and A. Wardle.* Thomas Schruben (U.S. Environmental Protection Agency/USA)	**Co-Removal of Energetics and Oxyanions via In Situ Coupling of Catalytic and Enzymatic Destructions: A Solution to Ammunition Wastewater Treatment.** *C. Zheng, C. Zhou, and B. Rittmann.* Chenwei Zheng (Arizona State University/USA)
2:15	**Steam-Enhanced Biodegradation of TCE in Mixed LNAPL Under Active Building: Naval Air Station North Island.** *V. Hosangadi, K. Asam, G. Christensen, A. Hoseyni, R. Robitaille, P. Chang, and M. Pound.* Vitthal Hosangadi (NOREAS, Inc./USA)	**Nanofiltration followed by Electrical Discharge Plasma for Destruction of PFAS and Co-Occurring Chemicals in Groundwater: A Treatment Train Approach.** *S. Richardson, P. Kulkarni, W. Bailey, S. Mededovic, T. Holsen, C. Nau-Hix, W. Knudson, C. Bellona, and C. Schaefer.* Stephen Richardson (GSI Environmental/USA)		**Utilizing Dye-Laser Induced Fluorescence Tooling with Soil Borings to Map Residual Free-Phase DNAPL at Former Solvent Disposal Trenches.** *J. Briegel, J. Pavlowsky, K. Kehoe, B.L. Porter, and P. Tamashiro.* Benjamin Porter (APTIM/USA)	**Isolation and Characterization of Nitroguanidine-Degrading Bacteria.** *J. Kim, K. Chu, M.E. Fuller, and P.B. Hatzinger.* Kung-Hui (Bella) Chu (Texas A&M University/USA)
2:40	**In Situ Treatment of Polychlorinated Biphenyl-Impacted Sediments with Bioamended Activated Carbon.** *K.R. Sowers and U. Ghosh.* Kevin Sowers (University of Maryland, Baltimore County/USA)	**Mechanochemical Destruction as a Scalable Treatment Technology for Per- and Polyfluoroalkyl Substances.** *K. Gobindlal, M. Glucina, and J. Sperry.* Kapish Gobindlal (Environmental Decontamination [NZ] Limited/New Zealand)		**Quantitative High-Resolution Site Characterization to Support Petroleum Remediation in Piedmont Geology.** *N. Thacker, S. Ghiold, and A. Quarles.* Nathan Thacker (AST Environmental, Inc./USA)	**Bioaugmentation Design for Treatment of Munitions Constituents.** *S. Downey, R. Mayer, and Z. Parham.* Steven Downey (APTIM/USA)
3:05	SESSION BREAK	**On-Site Demonstration of Thermal Desorption Coupled with Thermal Oxidation Technology to Treat Solid PFAS-Impacted Soil Investigation Derived Waste.** *P. Challa Sasi, F. Barranco, I. Harvey, C. Palmer, and G. Hay.* Pavankumar Challa Sasi (EA Engineering, Science, and Technology, Inc., PBC/USA)	SESSION BREAK	SESSION BREAK	SESSION BREAK

A7. In Situ Bioremediation Applications

B6. Comparing Ex Situ Destructive Technologies

Panel Discussion

D6. High-Resolution Site Characterizatio

E6. Bioremediation of Munitions Constituents

Wednesday Platform Sessions—3:30–5:35 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
3:30	**Accessing Difficult Geology for Characterization and Injection Using the New GeoTAP™ Method.** *D. Pizarro and T. McCullough.* Derek Pizarro (AST Environmental, Inc./USA)	SESSION BREAK	**Optimizing Bioremediation at Mixed Contaminant Sites.** *C. Scales, J. Roberts, and P. Dennis.* Corey Scales (SiREM/Canada)	**Monitoring of Subsurface Contaminant Remediation at the Former Moab Uranium Mill Site by In Situ Nuclear Magnetic Resonance.** *D. Morozov, C. McLaughlin, K.H. Williams, and D. Walsh.* Darya Morozov (Vista Clara/USA)	**Using Molecular Biological Tools to Address Nitrogen Transformation in Groundwater.** *D. Taggart, K. Clark, and S. Rosolina.* Sam Rosolina (Microbial Insights, Inc./USA)
3:55	**Selection of Drilling Method for Effective Amendment Delivery.** *R.A. Meyer.* Robert Meyer (Talon/LPE, Ltd./USA)	**Successful Implementation of Interim Control Measures (ICMs) for PFAS Treatment from SW at Selfridge Air National Guard Base, Michigan.** *W. Myer, B. Cuento, C. Paslawski, J. Ralston, J. Santacroce, and S. Tjan.* Bill Myer (National Guard Bureau/USA)	**Combined Remedy Enhancements to Treat a Groundwater TCE Plume Commingled with Cr(VI) via In Situ Chemical Reduction and Enhanced Anaerobic Bioaugmentation.** *K. Diller, D. Griffiths, and T. Blaney.* Kristi Diller (Parsons/USA)	**Using HRSC to Rapidly Assess LNAPL Distribution, Optimize Well Placement and Accelerate Remedial Design.** *E. Gessert, B. Taylor, and R. St. Germain.* Erik Gessert (Terracon/USA)	**Compound Specific Isotope Analysis to Identify the Source of Ammonia and Nitrate in Surface Water Adjacent to a Fertilizer Plant.** *S. Dore, D. Pope, and A. Cox.* Sophia Dore (GHD/USA)
4:20	**Coupling Hydraulic Fracturing with Bioremediation for Treatment of Chloroethenes and 1,4-Dioxane in Low-Permeability Formations.** *D. Baird, C.M. Ross, M. Klosky, and A. Lorenz* Drew Baird (FRx, Inc./USA)	**Mitigating PFAS in Streams.** *P.K. Juriasingani, D. Liu, C. Pike, and D. Forester.* Purshotam Juriasingani (Tetra Tech, Inc./USA)	**Iterative Selection of Remedial Alternatives for Mixed Contaminants in Complex Geology.** *P. Jacob, F. Nchako, S. Barker, and J. Smith.* Priya Jacob (AECOM/USA)	**Integrating Diverse High-Resolution Data Sets to Assess Aquitard Integrity in a DNAPL-Contaminated Sedimentary Rock Aquifer System.** *J.R. Meyer and B.L. Parker.* Jessica Meyer (University of Iowa/USA)	**Nitrogen Compound Metabolism Insights Gained by a Holistic Testing Regime.** *P. Dennis, J. Roberts, S. Volkoff, and E. Nesbit.* Philip Dennis (SiREM/Canada)
4:45	**Direct Sonic Injection for Enhanced Remediation.** *S. Chen, C. Lacko, and J. Haselow.* John Haselow (Redox Tech, LLC/USA)	**Molecularly Imprinted Polymer (MIP)-Based Electrochemical Sensor for Rapid Detection of PFAS on Site.** *J. Grove, K. Huynh, E. Zumbro, J. Roberts, L. Goodnight, T. Villafana, N. Walton, and J. Dick.* Joe Roberts (MITRE/USA)	**In Situ Bioremediation of Chlorinated Solvents at a Low pH Site.** *B. Yuncu.* Bilgen Yuncu (TRC/USA)	**Interpretation of 2-D and 3-D Images of Ultraviolet Optical Image Profiler (OIP-UV), Hydraulic Profiling, and Electrical Conductivity (HPT/EC) Log Data at Complex LNAPL Sites.** *J.V. Fontana.* John Fontana (Vista GeoScience/USA)	**Enhanced Denitrification for Treatment of Nitrate Plumes Associated with Fertilizers: Laboratory and Pilot Studies.** *S. Dore, D. Pope, and A. Cox.* Sophia Dore (GHD/USA)
5:10	**Quantifying Delivery of Particulate Amendments in Heterogeneous Aquifers Using Electrical Resistance Tomography.** *T.W. Macbeth, I. Lo, J. Romig, T. Johnson, K. Muller, and L. Zhong.* Tamzen Macbeth (CDM Smith Inc./USA)	**Treatment Train for Removing PFAS from High Concentration Stormwater.** *J. Cuthbertson, R. Mora, P. Tacy, and M. McCloskey.* John Cuthbertson (AECOM/USA)	**Treatment Technology Considerations at Plating Facilities Commingled with PFAS and Chromium-6.** *K.M. Gaskill, P. Erickson, and R. Moore.* Keith Gaskill (REGENESIS/USA)	**Using High Resolution Site Characterization and Chemical Fingerprinting and Forensics to Develop Four Dimensional Conceptual Site Models.** *L.J. Mastera, R.J. Fiacco, and B. Shaver.* Larry Mastera (ERM/USA)	**Biostimulation to Promote Total Nitrogen Loss in a Coastal Aquifer.** *B. Lazenby, F. Cosme, J. Konzuk, K. Phillips, A. Black, B. Howarth, S. McCollin, and B. Schultz.* Brent Lazenby (Geosyntec Consultants, Inc./USA)

A8. Innovative and Efficient Amendment Delivery Strategies

B7. PFAS in Surface Water and Storm Water

C5. Impacts of Mixed Contaminants on Biodegradation

D6. High-Resolution Site Characterization

E7. Treatment of Nitrate-Impacted Groundwater

5:45-7:00 p.m. POSTER GROUP 2 PRESENTATIONS AND RECEPTION (EXHIBIT HALL)

Group 2 Posters

Display: Wednesday, 7:00 a.m.-Thursday, 1:00 p.m.
Presentations: Wednesday 5:45-7:00 p.m.

The following posters will be on display from Monday evening through Tuesday evening in the Exhibit Hall. During the Presentations/Reception period on Tuesday evening, presenters will be at their displays to discuss their work. The poster board number assigned to each presentation appears below.

A8. Innovative and Efficient Amendment Delivery Strategies
A9. Ex Situ and Vadose Zone Biological Treatment
A10. Biobarrier Installation and Management
A11. Challenges in Application of Bioremediation Tools
B4. Activated Carbon-Based PFAS Treatment Technologies
B5. Innovative Treatment Technologies for PFAS Ex Situ
B6. Comparing Ex Situ Destructive Technologies
B7. PFAS in Surface Water and Storm Water
B8. Addressing Emerging Contaminants in a Regulatory Framework
B9. Emerging Contaminants: Detection, Degradation, Fate and Transport
B10. 1,4-Dioxane Treatment Technologies
C4. Bioremediation in Complex Geological Settings
C5. Impacts of Mixed Contaminants on Biodegradation
C6. Bioremediation Case Studies
C7. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes
D4. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics
D5. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation
D6. High-Resolution Site Characterization
D7. Chemical Fingerprinting and Forensics
D9. Tools for Site Assessment and Bioremediation Monitoring
E5. Microplastics and Nanoplastics: Degradation and Effects on the Environment
E6. Bioremediation of Munitions Constituents
E7. Treatment of Nitrate-Impacted Groundwater
E8. Advances in Tools and Techniques for Assessing MNA
E9. Groundwater/Surface Water Interactions

A8. Innovative and Efficient Amendment Delivery Strategies

1. Analysis of the Viability of Gravel as a Backfill Material for Biostimulation Systems. *A. Alvarez and S.D. Siciliano.*
Alejandro Alvarez (University of Saskatchewan/ Canada)

2. Hydraulic Emplacement of Zero-Valent Iron Coupled with In Situ Bioremediation for VOC Treatment in a Low-Permeability Aquifer. *C.J. Voci, E. Bausher, and C.M. Ross.*
Emily Bausher (Terraphase Engineering/USA)

3. In Situ Biological Remediation of Chromium, Nitrate and Chlorinated VOCs Using an Innovative Electron Donor Delivery Approach. *T. Carlson, H. Cox, C. Marks, and M. Williams.*
Trevor Jason Carlson (Geosyntec Consultants/Canada)

4. Combined In Situ Remediation to Address DNAPL in Shallow Overburden and Weathered Bedrock. *K. Lazzeri, J. McNew, W. Moody, and W. Meese.*
Jason McNew (EA Engineering, Science, and Technology, Inc., PBC/USA)

5. Amendment Delivery Methodology for Permeable Reactive Barrier (PRB) Installation in a Challenging Lithology at Shaw AFB, Sumter, South Carolina. *G. Simpson, D.A. Pizarro, D. Christensen, S. Palakur, and J. Chytil.*
Derek Pizarro (AST Environmental, Inc./USA)

6. Permeable Reactive Transects for Treatment of Hexavalent Chromium in Varied Geology. *D.A. Pizarro and T. McCullough.*
Derek Pizarro (AST Environmental, Inc./USA)

7. How Much Carbon and Bioaugmentation is Needed for Effective Reductive Dechlorination? *L. LaPat-Polasko, B.H. Stamatovski, and J. King.*
Bridget Hoagland Stamatovski (Matrix New World Engineering/USA)

A9. Ex Situ and Vadose Zone Biological Treatment

8. Ex Situ Biological Treatment of Hydrocarbon Contaminated Soil with eCUBE Microbial Electrochemical Technology. *A. Franzetti, A. Espinoza, F. Formicola, T. Stella, V. Suagher, and L. Righini.*
Andrea Franzetti (University of Milano BIcocca/Italy)

9. Community-Level Bacterial Evolution for the Bioremediation of Biofuel n-butanol. *K.T. You Mak, E.R. Hanschen, and B.T. Hovde.*
Kayley You Mak (Los Alamos National Laboratory/USA)

10. Lessons Learned during Ex Situ Bioremediation at a Large Hydrocarbon Contaminated Site. *G. Overbeeke and P. Wilson.*
Gavin Overbeeke (AEL Environment/Canada)

11. Immobilization of Lead in Contaminated Soil Using Enzyme-Induced Calcite Precipitation (EICP) along with Coconut Fiber Biochar (CFB). *K. Roksana, S.A. Hewage, W. Xue, and C. Zhu.*
Kaniz Roksana (Rowan University/USA)

12. Soil Bioremediation at a Former Insecticide Warehouse. *R.E. Guerra and A. Seech.*
Alan Seech (Evonik/USA)

13. Treatability Testing for Effective In Situ Metals Immobilization at Complex Sites: Objectives, Methods, Results, and Lessons Learned from Vadose Zone Applications. *R.S. Srirangam and A. Seech.*
Ravikumar Srirangam (Evonik/USA)

A10. Biobarrier Installation and Management

14. Design and Installation of a Thermally-Enhanced Biological Barrier. *F. Coelho.*
Flavio Coelho (ERM/USA)

A11. Challenges in Application of Bioremediation Tools

15. Fast-Tracking Aggressive Remediation in Clay Soils with a Challenging Site Setting. *E. Bishop, A. Gerringer, M. Bennett, P.M. Dombrowski, and K. O'Neal.*
Elizabeth Bishop (Haley & Aldrich, Inc./USA)

16. Toluene-Producing Bacteria from Sediments and Groundwater of the Southeastern U.S. *R.J. Poche, K.G. Namikas, M.M. L'Hoste, and W.M. Moe.*
William Moe (Louisiana State University/USA)

B4. Activated Carbon-Based PFAS Treatment Technologies

17. Remediate PFAS-Impacted Soils Using Magnetic Activated Carbon (MAC). *C.H. Shih, S.H. Yang, A. French, and K.H. Chu.*
Kung-Hui (Bella) Chu (Texas A&M University/USA)

18. Biosorption Technology: PFAS Removal in Water by the Use of Novel Carbonaceous Materials. *M. Senofonte, R. Cuzzola, R. Remmani, C. Riccardi, G. Simonetti, and M. Petrangeli Papini.*
Marta Senofonte ("La Sapienza"/University of Rome/ Italy)

19. Mobile Cleanout of AFFF and PFAS in Wastewater and Fire Suppression Systems Using the PerfluorAd Process. *D. Fleming, G. Knight, E. Crownover, and I. Godinez.*
Lauren Soos (TRS Group, Inc./USA)

B5. Innovative Treatment Technologies for PFAS Ex Situ

20. Yorba Linda Water District Installs Largest Ion Exchange PFAS Water Treatment Plant in U.S. *R. Bergsgaard, R. Weston, and C. Olsen.*
Bob Bergsgaard (Aqueous Vets/USA)

21. Sustainable Bioremediation of PFAS via Biomimetic Plant-Fungal Nano-Framework. *J. Li, X. Li, J. Yu, B. Long, J.S. Yuan, and S.Y. Dai.*
Susie Dai (Texas A&M University/USA)

22. Challenges during the Treatment of PFAS at a Wastewater Treatment Plant. *P.K. Juriasingani, D. Liu, C. Pike, and D. Forester.*
Purshotam Juriasingani (Tetra Tech, Inc./USA)

23. Feeding Two Birds with One Scone: Regenerable Resin for Today's Treatment Goals and Tomorrow's Destructive Technologies. *D.M. Kempisty, M. Thompson, J. Haxen, E.F. Houtz, and S. Woodard.*
David Kempisty (Montrose Environmental/USA)

24. AFFF Cleanout and PFAS Treatment in a Firefighting Vehicle Using the PerfluorAd Process at a Major West Coast International Airport. *G. Knight and D. Fleming.*
Mark Kluger (TRS Group, Inc./USA)

25. Reed Straw-Derived Biochar (RESCA) for Effective Adsorption Removal of Per- and Polyfluoroalkyl Substances (PFAS). *N. Liu and M. Li.*
Mengyan Li (New Jersey Institute of Technology/USA)

26. Characterizing PFAS-Degrading Microbial Communities in Environmental Samples Collected from a PFAS-Contaminated Site. *F. Kara Murdoch, K. Dasu, L. Mullins, M. Gander, and K.H. Kucharzyk.*
Fadime Kara Murdoch (Battelle/USA)

27. Firefighting System Cleanout: Lessons Learned from Bench-Scale Treatability Studies and Field-Scale Demonstration. *D. Nguyen, H. Lanza, C. Bellona, A. Lau, G. Knight, and D. Fleming.*
Dung (Zoom) Nguyen (CDM Smith Inc./USA)

28. Kinetic Routes of PFAS Destruction in Supercritical Water Oxidation. *J. Li, C. Austin, B.R. Pinkard, and I.V. Novosselov.*
Brian Pinkard (Aquagga, Inc./USA)

29. Field Deployment of a Supercritical Water Oxidation Technology to Destroy Per- and Polyfluorinated Alkyl Substances in Aqueous Film-Forming Foam. *S. Rosansky, X. Xia, K. Dasu, and S. Al-Dirani.*
Stephen Rosansky (Battelle/USA)

30. Thermal Treatment of PFAS in Spent GAC and PFAS-Impacted Soil. *P. Challa Sasi, F. Barranco, F. Xiao, and A. Alinezhad.*
Pavankumar Challa Sasi (EA Engineering, Science, and Technology, Inc., PBC/USA)

B6. Comparing Ex Situ Destructive Technologies

31. An Innovative Plasma Technology for Treatment of PFAS-Impacted Water at Two Fire Training Areas. *S. Richardson, P. Kulkarni, W. Bailey, S. Mededovic, T. Holsen, C. Nau-Hix, W. Knudson, H. Luckarift, and B. Ashley.*
Whitney Bailey (GSI Environmental/USA)

32. Thermal Destruction of PFAS during Full-Scale Reactivation of PFAS-Laden Granular Activated Carbon (GAC). *D. Farmer, R. Distefano, T. Knowlton, A. Harris, and M. O'Brien.*
Dana Farmer (Calgon Carbon Corporation/A Kuraray Company/USA)

33. Effective Comparison of the Parameters for Per- and Polyfluoroalkyl Substances Destructive Technologies. *P.K. Juriasingani and R. Arnseth.*
Purshotam Juriasingani (Tetra Tech, Inc./USA)

34. Treating PFAS-Impacted Bulk Soil: Evaluation of High-Pressure Thermal Treatment Technologies. *P.R. Kulkarni, Y. Li, H. Javed, J.S. Cook, C.J. Newell, and R. Iery.*
Beatrice Li (GSI Environmental Inc./USA)

35. Current Insights on Reaction Kinetics and Mechanisms of PFAS Destruction during Hydrothermal Alkaline Treatment (HALT). *B.R. Pinkard, S. Hao, C. Austin, I.V. Novosselov, and T.J. Strathmann.*
Brian Pinkard (Aquagga, Inc./USA)

B7. PFAS in Surface Water and Storm Water

36. Role of Sequence Stratigraphy for Evaluating Topographic Pathways Impacting Distribution of PFAS. *B. Campanaro, D. Parse, J. Sadeque, and D. Stock.*
Ben Campanaro (AECOM/USA)

37. Development of an Equilibrium Passive Sampler for PFAS Detection and Quantification in Aqueous Environments. *B.G. Pautler, M. Healey, A. Sweett, J. Roberts, B. Medon, A. Pham, F. Risacher, L. D'Agostino, J. Conder, R. Zajac-Fay, M. Vanderkooy, M. McAlary, H. Groenevelt, J. Gautier, S. Mabury, A.O. De Silva, C.J. Brinovcar, P. McIsaac, A. Patterson, and R. Mitzel.*
Philip Dennis (SiREM/Canada)

38. Development and Field Validation of an Equilibrium Regimen Passive Sampler for PFAS. *E.M. Kaltenberg and K. Dasu.*
Eliza Kaltenberg (Battelle/USA)

39. Shifting of Target and Non-Target Per- and Polyfluorinated Alkyl Substances (PFAS) over Municipal Wastewater Treatment. *C. Wu, Q. Wang, H. Chen, and M. Li.*
Mengyan Li (New Jersey Institute of Technology/USA)

B8. Addressing Emerging Contaminants in a Regulatory Framework

40. Is Something "Fishy" Going On? *C. Cheatwood, P. Caprio, J. Suski, and E. Thieleman.*
Cynthia Cheatwood (EA Engineering, Science, and Technology, Inc., PBC/USA)

B9. Emerging Contaminants: Detection, Degradation, Fate and Transport

41. Testing of a Long-Term Solution for Low-Level 1,2,3-TCP in a Deep Aquifer Using Colloidal Activated Carbon with Monitoring Natural Attenuation. *A. Kiggen and C. Lee.*
Chris Lee (REGENESIS/USA)

42. Discovery of Gram-Negative Sulfonamide Degraders from Municipal Activated Sludge. *D.N. Pham and M. Li.*
Mengyan Li (New Jersey Institute of Technology/USA)

43. A Novel Biodefluorination Pathway of Fluorotelomer Carboxylic Acids (FTCAs) by Municipal Activated Sludge. *C. Wu, Q. Wang, H. Chen, and M. Li.*
Mengyan Li (New Jersey Institute of Technology/USA)

44. Investigating Microbial Biodegradation of 6PPD-Quinone, A Ubiquitous Rubber Tire-Derived Chemical Killing the Coho Salmon. *C. McLaughlin and A.G. Delgado.*
Caleb McLaughlin (Arizona State University/USA)

B10. 1,4-Dioxane Treatment Technologies

45. Dual-Culture System Enables the Degradation of 1,4-Dioxane and Co-Occurring Chlorinated Aliphatic Hydrocarbons. *D. Deng, J. Antunes, and M. Li.*
Jose Antunes (New Jersey Institute of Technology/USA)

46. Novel Group-6 Propane Monooxygenases in Charge of 1,4-Dioxane Biodegradation in Psychrophilic Propanotrophic Consortia. *J. Antunes and M. Li.*
Jose Antunes (New Jersey Institute of Technology/USA)

47. Bioremediation of 1,4-Dioxane Using Cometabolic Bioreactors. *C. Bell, B. Rittmann, C. Zhou, T. Applebury, M. Heintz, and J. Provolt.*
Caitlin Bell (Arcadis/USA)

48. Containment of a 1,4-Dioxane Plume Using TreeWell® Phytoremediation Technologies. *C. Gale and F. Volkering.*
Christopher Gale (Applied Natural Sciences/USA)

49. Innovative Treatment of a Large, Dilute, and Commingled Plume Using a Solar-Powered In Situ Bioremediation and Phytoremediation System. *F.J. Krembs, M. Hinman, and G. Risse.*
Fritz Krembs (Trihydro Corporation/USA)

50. Propane and 1-Propanol as Auxiliary Substrate Alternatives for Effective Cometabolic Bioremediation of 1,4-Dioxane. *D. Deng, D.N. Pham, and M. Li.*
Mengyan Li (New Jersey Institute of Technology/USA)

51. Examining the Microorganisms Assimilating Carbon from 1,4-Dioxane in Contaminated and Uncontaminated Samples. *Z. Li and A.M. Cupples.*
Zheng Li (Michigan State University/USA)

52. Degradation of 1,4-Dioxane and CVOCs by Iron-Impregnated Activated Carbon (CAT100). *S. Noland.*
Derek Pizarro (AST Environmental, Inc./USA)

C4. Bioremediation in Complex Geological Settings

53. Installation of Four Permeable Reactive Zones for Enhanced Bioremediation and Field Changes to Mitigate Geologic Challenges. *T. Hartwell, G. Geckeler, and T. Eilber.*
Grant Geckeler (In-Situ Oxidative Technologies, Inc. [ISOTEC]/USA)

54. Paired Enhanced In Situ Bioremediation and In Situ Chemical Oxidation of Chlorinated VOCs in a Fine-Grained Aquifer. *H. Schneider, A. Kline, K. Agustsson, J. Yerton, and I. Contreras.*
Haley Schneider (Geosyntec Consultants/USA)

55. In Situ Bioremediation of Chlorinated Ethenes in Heterogeneous Glacial Till. *R. Britton, E. Huss, L. LaPat-Polasko, and B.H. Stamatovski.*
Bridget Hoagland Stamatovski (Matrix New World Engineering/USA)

56. Implementation of Monitored Natural Attenuation Combined with Source Zone Control and a Technical Impracticability Waiver at Air Force Plant 4. *J.R. Woertz and J.C. Wolfe.*
Jennifer Woertz (Los Alamos Technical Associates, Inc/USA)

C5. Impacts of Mixed Contaminants on Biodegradation

57. Chlorinated/Boron Bioremediation Challenges in Brazil. *S. Aluani, C. Spilborghs, E. Pujol, F. Tomiatti, R. Moura, N. Nascimento, J. Mueller, T. Lizer, W. Moody, W. Meese, and M. Scalzi.*
Sidney Aluani (SGW Services/Brazil)

C6. Bioremediation Case Studies

58. Bacterial Bioremediation of Printed Circuit Boards. *J.T. Pentz, K.T. You Mak, E.R. Hanschen, and B.T. Hovde.*
Jennifer Pentz (Los Alamos National Laboratory/USA)

C7. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes

59. Full-Scale Application in Italy of a Combined ISCR and ERD Technology for the Treatment of an Aerobic Aquifer Impacted with Tetrachloromethane and Chloroform. *A. Leombruni, M. Mueller, F. Lakhwala, and D. Leigh.*
Alberto Leombruni (Evonik/Italy)

60. Bioremediation of Chromium-Contaminated Groundwater in Complex and Large Plumes. *B. Liu.*
Beth Liu (EA Engineering, Science, and Technology, Inc., PBC/USA)

61. Combined In Situ Treatment Methods and Technologies Reduce Mass at Large DNAPL Solvent Site. *M. Mazzarese and G. Simpson.*
Mike Mazzarese (AST Environmental, Inc./USA)

62. Bioremediation in a Combined Remedial Strategy for a Complex Contaminated Site with Ecologically Sensitive Receptors in Brazil. *M. de Q. Omote, A.C. Gatti, G.D.C. de Mello, and R. Campos.*
Mariana Omote (Ramboll/Brazil)

63. Combining Technologies for a Complete Remedial Solution at a Complex Superfund Site. *L. Soos and K. Cottrell.*
Lauren Soos (TRS Group, Inc./USA)

D4. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics

64. Comparison of Whole Genome Sequencing, 16S Amplicons, and qPCR for Assessment and Monitoring of an EPA Superfund Site. *P. Guerra, R.A. Reiss, and O. Makhnin.*
Peter Guerra (Lynker Corporation/USA)

65. Bioremediation Treatment Optimization Study: Oilfields in the Persian Gulf Area. *C. Masini and F. Brogioli.*
Cosimo Masini (DND Biotech srl/Italy)

66. Advances for the Rapid and Sensitive Biomonitoring of the Reductive Dechlorination's Biomarkers: Digital Droplet PCR. *B. Matturro, M.L. Di Franca, and S. Rossetti.*
Bruna Matturro (Water Research Institute, National Research Council/Italy)

D5. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation

67. Advanced Data Analysis (ADA) Guides Remedial Decisions by Improving the Site Conceptual Model with High-Resolution Site Characterization Data. *W.C. Benni.*
William C. Benni (Improved Analysis through Modeling (IAtM)/USA)

68. Optimization of Groundwater Recovery and Monitoring Network Facilitated by 3DVA and Innovative Hydrogeologic Evaluation Toolbox. *J. Jackson, K. Bostick, and J. Drummond.*
Jonah Jackson (Environmental Standards, Inc./USA)

D6. High-Resolution Site Characterization

69. Remedial Design Characterization Using Electrical Hydrogeology. *T. Halihan, K.W. Spears, and S.W. McDonald.*
Todd Halihan (Oklahoma State University/USA)

70. High-Resolution Investigation and MIP Visualization to Optimize In Situ Bioremediation of VOCs in Groundwater and Aquifer Sediments. *T. Houghton and C.S. Alger.*
Tyler Houghton (Terraphase Engineering/USA)

71. Using Ultraviolet-Induced Fluorescence to Enhance LNAPL Conceptual Site Model for Remedial Design. *A. Moore.*
Yvonne Huff (Environmental Works, Inc./USA)

D7. Chemical Fingerprinting and Forensics

72. Determination of Mass Balance for Fluorine Using Three Analytical Techniques (LC-MS-QQQ, F NMR, and Fluorine-ISE) as a Practical Tool for Testing Ultrasonic Treatment for Degradation of Per- and Polyfluorinated Alkyl Substances. *B.B. Souza, J.A. Kewalramanai, D. Prajapati, R. Marsh, J. Meegoda, and P. Juriasingani.*
Bruno Bezerra de Souza (New Jersey Institute of Technolog/USA)

73. PFAS Forensics through Applied Statistics: A Review of Case Studies in Chemometrics, Pattern Recognition, and Machine Learning. *Z. Neigh, R. Gwinn, H.A. Brown, and J.K. McCurdy.*
Zachary Neigh (AECOM/USA)

D9. Tools for Site Assessment and Bioremediation Monitoring

74. Rate of Extracellular Transfer of Charge and Bioremediation. *S.R. Burge, R.G. Burge, E.D. Taylor, and K.D. Hristovski.*
Scott Burge (Burge Environmental, Inc./USA)

75. Metagenomic and Metatranscriptomic Analysis of Organohalide-Respiring Microbial Communities in PCB-Contaminated Sediment Microcosms. *H. Dang, J. Ewald, and T.E. Mattes.*
Hongyu Dang (University of Iowa/USA)

76. Long-Term Performance of a Carbon Barrier Evaluated through Integrated Use of Aspect Ratio, Passive Flux and Modelling Analytical Tools. *J. Birnstingl, C. Lee, and C. Sandefur.*
Keith Gaskill (REGENESIS/USA)

77. Multiple Contaminants and Aquifers: 4D Mass Flux and Volumetric Analyses. *T. Kremmin, T. Andrews, W. Nolan, and M. Ingraham.*
Todd Kremmin (Jacobs/USA)

78. Advancements in Analytical Techniques to Demonstrate Successful Mineralization of PFAS. *T. McKnight.*
Taryn McKnight (Eurofins Environment Testing/USA)

79. Field-Collected Soil Gas Data as an Inexpensive Line of Evidence to Monitor Natural Attenuation. *K.A. Morris.*
Kevin Morris (ERM/USA)

80. A Novel Biomarker for Monitoring Anaerobic In Situ Degradation of Benzene. *C.R.A. Toth, O. Molenda, C. Nesbø, N. Bawa, S. Guo, F. Luo, C. Devine, R. Flick, E.A. Edwards, J. Webb, and S. Dworatzek.*
Katherine Picott (University of Toronto/Canada)

81. Microbially Mediated p-Cresol and Toluene Production from Biomass Decay: An Unintended Consequence of Biostimulation for Treatment of Chlorinated Solvents. *S.J. Reynolds, A.B. Gathings, and W.M. Moe.*
Samuel Reynolds (Ramboll/USA)

82. Impacts of Hydrodynamic Conditions and Surface Roughness on the Critical Conditions and Thickness of Early-Stage Biofilm Development. *G. Wei and J. Yang.*
Judy Yang (University of Minnesota-Twin Cities/USA)

E5. Microplastics and Nanoplastics: Degradation and Effects on the Environment

83. Plastics Biodegradation and Plastispheres of Engineered and Natural Environments. *M. Hwangbo, Z. Chen, J. Kameoka, and K.H. Chu.*
Kung-Hui (Bella) Chu (Texas A&M University/USA)

84. Synergistic Interactions of Fungal Enzymes and Bacteria on Polyurethane (PUR) Biodegradation. *W.J. Park, M. Hwangbo, and K.H. Chu.*
Kung-Hui (Bella) Chu (Texas A&M University/USA)

85. Microplastics as Vectors of Persistent Organic Pollutants and Metals in Aquatic Environment. *Y. Kunukcu.*
Yasemin Kunukcu (Roux Inc./USA)

86. Evaluation of Presence of Nylon 6 and Polystyrene Micro- and Nanoplastics on Degradation of Chlorinated Solvents and Energetics. *F. Kara Murdoch, Y. Sun, F. Loeffler, M. Fuller, J. Lilly, and K.H. Kucharzyk.*
Fadime Kara Murdoch (Battelle/USA)

E6. Bioremediation of Munitions Constituents

87. Application of Proteomics to Assess Degradation of RDX in Pure Cultures and Groundwater from Impacted Sites. *F. Kara Murdoch, R.W. Murdoch, S. Higgins, M. Fuller, A. Hill, L. Mullins, M. Gander, A. Danko, and K.H. Kucharzyk.*
Fadime Kara Murdoch (Battelle/USA)

E7. Treatment of Nitrate-Impacted Groundwater

88. Post-Injection Evaluation of In Situ Chemical Reduction as Treatment Remedy for Nitro-Aromatic Compounds. *C.A. Montero, C. Macon, and W. Lundy.*
Charles Montero (WSP/USA)

E8. Advances in Tools and Techniques for Assessing MNA

89. Long-Term Evaluation of Chlorinated Solvent Attenuation Rates in Groundwater. *M.L. Ferrey, W. Bouchard, and J.T. Wilson.*
Mark L. Ferrey (Minnesota Pollution Control Agency/USA)

90. Automated Data Analysis and Decision Making to Support Pump and Treat Shutdown Evaluation. *J. Ford, A. Sidebottom, H. Hernandez, T. Palaia, A. Forsberg, and J. Rankin.*
Jeffrey Ford (Jacobs/USA)

91. Evaluating Natural Attenuation Using Multiple Lines of Evidence in Complex Geologic/Hydrogeologic Conditions. *D. Gray, S. Martin, E. Mack, and N. Grosso.*
Doug Gray (AECOM/USA)

92. Enhancing Remedial Performance Assessments at Complex Sites Using Compound Specific Isotope Analysis and Molecular Biological Tools. *J.S. Konzuk, C. Cheyne, L. D'Agostino, M. Cho, B. Goodwin, and C. Coladonato.*
Julie Konzuk (Geosyntec Consultants International, Inc./Canada)

93. Prolonged Effects from Short-Term In Situ Microcosm Deployment in Monitoring Wells at a Chlorinated Solvents Remediation Site. *E. Pulcher and E. Dulle.*
Emily Pulcher (Burns & McDonnell/USA)

94. The Importance of Archaea in Biofilm Development and Sustainable Bioremediation Programs. *K.B. Rapp, J. Neve, R.A. Wojciak, and S.M. Rapp.*
Keith Rapp (Pinnacle Engineering/USA)

95. Transition to Monitored Natural Attenuation for a CVOC Plume after 28 Years of Pump and Treat: Lessons Learned. *J.A. Ricker and D.C. Winchell.*
Joseph Ricker (WSP/USA)

96. Using Automated Analytics to Optimize Groundwater Monitoring at MNA Sites. *V. Ward, K. Elich, K. Hadley, and R. Simon.*
Tori Ward (Woodard & Curran/USA)

E9. Groundwater/Surface Water Interactions

97. Field Studies of PFAS Retention of Groundwater at Freshwater/Saltwater Interfaces. *R.D. Cardoso, S.A. Lee, D. Roff, H.M. Hort, B.Y. Li, and C.J. Newell.*
Rebecca Cardoso (U.S. Navy/USA)

98. Natural Attenuation of Metals in an Abandoned Mine in the Spanish Pyrenees. *M.G. Giannetta.*
Max Giannetta (GSI Environmental Inc/USA)

99. Investigating Groundwater: Surface Water Interaction Using Distributed Temperature Sensing (DTS) Technology. *S. Lee, H. Tahon, D. Adilman, F. Selker, and C. Gabrielli.*
Sung-Woo Lee (Geosyntec Consultants/USA)

NOTES

Thursday Platform Sessions—8:00–10:30 a.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
8:00	**Field Test of a Pilot-Scale Sequential Reductive/Oxidative Bioelectrochemical Process for CAH Removal from Contaminated Groundwater.** *E. Dell'Armi, M. Zeppilli, M. Majone, and M. Petrangeli Papini.* Edoardo Dell'Armi (University of Rome "La Sapienza"/Italy)	**Change is Always Different: Calibrating the PFAS Regulatory Crystal Ball.** *R.E. Gwinn.* Rosa Gwinn (AECOM/USA)	**Source Area Bioremediation in Fractured Bedrock with Karst Features Revisited as Sustainable and Resilient Remediation.** *K.A. Morris and P. Beyer.* Kevin Morris (ERM/USA)	**Groundwater Recovery System Replacement Using a Multiple Lines of Evidence MNA Demonstration.** *D. Gray, T. Vannest, C. Wasteneys, and B. Witt.* Doug Gray (AECOM/USA)	**Matrix Diffusion as a Key Attenuation Process for PFAS in Groundwater.** *C.J. Newell, P.R. Kulkarni, S.K. Farhat, and D.T. Adamson.* Charles Newell (GSI Environmental/USA)
8:25	**Managing the Health of an Ex Situ Anoxic Bioreactor.** *J. Hyrman, M. Otto, B. Robinson, J.T. Slater, P. Flaherty, and M. Azad.* Joshua D. Hyrman (ERM/USA)	**Are Regulatory PFAS Screening Levels Good Enough to Assess the Soil to Groundwater Pathway?** *J. Reeve, H. Dennis, and M. Hertz.* Michael Hertz (EA Engineering, Science, and Technology, Inc., PBC/USA)	**Development of an Adaptive Framework for Optimizing Bioremediation Implementation at a Fractured Bedrock Chlorinated Solvent DNAPL Site.** *J.S. Konzuk, C. Repta, C. Crea, M. Cho, F. Cosme, T. Teoh, and C. Coladonato.* Julie Konzuk (Geosyntec Consultants International, Inc./Canada)	**PFAS Signature®: A Forensic Tool to Differentiate AFFF and Non-AFFF PFAS Sources.** *K. Dasu, C. Orth, L. Mullins, D. Friedenberg, and B. Hill.* Cameron Orth (Battelle/USA)	**An Approach to Evaluate Whether There Has Been Sufficient Active Treatment to Justify a Transition to MNA.** *J.T. Wilson, B. Wilson, M.L. Ferrey, D.L. Freedman, O. Dunn, D. Adamson, and C. Newell.* John Wilson (Scissortail Environmental Solutions, LLC/USA)
8:50	**Optimizing Bioremediation of Recalcitrant Soil Contaminants in Canada's Cold Climate.** *J. Pare and M. Bendouz.* Jean Pare (Chemco, Inc./Canada)	**The Reality and Strategies of Conducting PFAS Remedial Investigations in Evolving Uncertainty.** *M. Duley, R. Ofili, and M. Wanek.* Megan Duley (Sustainment and Restoration Services/USA)	**Improving Performance of Abiotic Destruction and Anaerobic Bioremediation at Multiple Sites through the Use of Passive Flux Meters.** *C. Lee and C. Sandefur.* Chris Lee (REGENESIS/USA)	**Advanced Diagnostic Tools as Measures of Petroleum-Hydrocarbon Remedial Performance.** *K. Sra, R. Kolhatkar, and E. Daniels.* Kammy Sra (Chevron/USA)	**Remediation of AFFF/PFAS-Impacted Soil by Sequestration and Natural Attenuation.** *J. Ramey, K. Quinn, and T. Martin.* Jeff Ramey (TRC/USA)
9:15	**Bioremediation of Soils Containing Organic Explosive Compounds Using ZVI/Organic Carbon Reagents.** *J. Valkenburg and A. Seech.* John Valkenburg (Evonik/USA)	**Clean Water and a Warming Planet: Are Low-Level PFAS Regulations and Greenhouse Gas Reduction Goals Compatible?** *B.L. McAlexander, O.G. Apul, M.R. Olson, and J. MacRae.* Mitchell Olson (Trihydro Corporation/USA)	**Enhanced In Situ Reductive Bioremediation of Trichloroethene in an Aerobic, Fractured Bedrock Aquifer, MCB Camp Pendleton, San Diego, California.** *N.I. Rothell, M. Cutler, and D. Leigh.* Daniel Leigh (Evonik/USA)	**Case Closed? Full Remediation of a 1980's Era Superfund Site.** *T. McHugh and L. Beckley.* Thomas McHugh (GSI Environmental/USA)	**Leveraging a Robust Microbial Profile for an MTBE Sorptive Biobarrier.** *J.K. Sheldon and D. Bush.* Jack Sheldon (Antea Group/USA)
9:40	**Enhanced Bioremediation of Pentachlorophenol-Contaminated Soil.** *A.G. Seech.* Alan Seech (Evonik/USA)	SESSION BREAK	SESSION BREAK	SESSION BREAK	**Groundwater Monitoring Efficiencies Using Modern Data Collection and Analysis Tools at a Site Transitioning to MNA.** *R.T. Simon, V. Ward, and G. Booth.* Ralph Simon (Woodard & Curran/USA)
10:05	SESSION BREAK	**B9. Biotransformation of 8:2 Fluorotelomer Alcohol Using Microbial Communities from AFFF-Impacted Soils.** *S. Dong, P. Yan, C. Liu, K.E. Manz, M.J. Woodcock, L.M. Abriola, K.D. Pennell, and N.L. Cápiro.* Natalie Capiro (Auburn University/USA)	**C6. Facilitating Property Transfer Using In Situ Bioremediation within Glacial Till Environments: Three Case Studies.** *G. Overbeeke, P. Wilson, W. Lee, L.A. Beese, M. Dotto, and P.M. Dombrowski.* Gavin Overbeeke (AEL Environment/Canada)	**D8. Quantifying Order-of-Magnitude (OoM) Impacts of Back Diffusion in Conceptual Site Models.** *R.C. Borden.* Robert Borden (North Carolina State University/USA)	SESSION BREAK

A9. Ex Situ and Vadose Zone Biological Treatment

B8. Addressing Emerging Contaminants in a Regulatory Framework

C6. Bioremediation Case Studies

D7. Chemical Fingerprinting and Forensics

E8. Advances in Tools and Techniques for Assessing MNA

Thursday Platform Sessions—10:30 a.m.–1:00 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
10:30	**A10. Biobarrier Installation and Management** **Identification of Actionable Data for Maintenance Permeable Reactive Biobarriers.** *M. Burns and M.J. Brown.* Matthew Burns (WSP/USA)	**B9. Emerging Contaminants: Detection, Degradation, Fate and Transport** **Effects of Coating Iron Phases with Polyacrylic Acids on the Ammonium Oxidation/PFAS Defluorination by *Acidimicrobium* sp. A6.** *J. Park, S. Huang, B.E. Koel, and P.R. Jaffe.* Jinhee Park (Princeton University/USA)	**C6. Bioremediation Case Studies** **Comparison of Bioremediation of Biosparge Systems from Two Sites.** *A. Lothe and A. Rees.* Anjali Lothe (AECOM/USA)	**D8. Improved Conceptional Site Models that Include Biodegradation Data** **Using Molecular Tools to Predict Rate Constants for Anaerobic Biodegradation of cis-DCE and Vinyl Chloride in Groundwater.** *J.T. Wilson, B. Wilson, M. Michalsen, K. Kacharzyk, F. Murdock, and F. Loeffler.* John Wilson (Scissortail Environmental Solutions, LLC/USA)	**Panel Discussion** **PANEL DISCUSSION** **Science, Application, Monitoring, and Illustrative Case Studies of Biogeochemical Remediation** **Moderator** Brant Smith, P.E., Ph.D. (Evonik) **Panelists** Paul Tratnyek, Ph.D. (Oregon Health & Sciences University) Alan Seech, Ph.D. (Evonik) Eric Moskal (Cascade) Dora Taggart (Microbial Insights) Dan Leigh, PG (Evonik)
10:55	**Furthering Hydrologic Characterization by Visual Mapping of Injection Data.** *A. Kavanagh and D. Davis.* Andrew Kavanagh (REGENESIS/USA)	**1,4-Dioxane Cometabolic Biological Treatment in a Fluidized Bed Bioreactor: Bench- and Full-Scale Results.** *J. Hatton, T. Webster, P. Hatzinger, and H. Anderson.* James Hatton (Jacobs/USA)	**ISCR Remediation on a Shallow and Extremely Variated Geological Conditions: Chlorinated Compounds Contamination in Brazil.** *S. Aluani, C. Spilborghs, E. Pujol, F. Tomiatti, R. Moura, N. Nascimento, J. Mueller, T. Lizer, W. Moody, W. Meese, and M. Scalzi.* Sidney Aluani (SGW Services/Brazil)	**Assessing the Genetic Potential for Natural Source Zone Depletion at a Petroleum-Contaminated Site.** *K.L. Sublette, K.C. Clark, S.M. Rosolina, and D.M. Taggart.* Sam Rosolina (Microbial Insights, Inc./USA)	
11:20	**Design of Permeable Reactive Barriers to Reduce Nitrogen Flux.** *M.D. Lee, R.L. Raymond, Jr., P. Dombrowski, M. Charrette, P. Henderson, K. Rathjen, J. Begley, T. Parece, M. Owen, J. Marrion, J.C. Thomas, B. Howes, B. Paulsen, and D. Heely.* Michael Lee (Terra Systems, Inc./USA)	**Implications of 1,4-Dioxane Source Attenuation and Plume Biodegradation on Its Behavior at Groundwater Sites.** *D.T. Adamson, L.M. Smith, and P.C. de Blanc.* David Adamson (GSI Environmental/USA)	**Innovative Bioremediation Approach Implemented in Complex Karst Geology to Treat LNAPL Releasing from Seeps to a Creek and Residential Properties in Gallatin, Tennessee.** *D. Guilfoil and G. Stephenson.* Duane Guilfoil (AST Environmental, Inc./USA)	**Subsurface Depositional Environment of Ellsworth Air Force Base (AFB), South Dakota, and Its Role in Bioremediation Strategy.** *J. Sadeque.* Junaid Sadeque (AECOM/USA)	
11:45	**Challenging In Situ Chemical Reduction PRB Approach on Industry Impacted by Chlorinated/Zinc/Copper Bioremediation in Brazil.** *S. Aluani, C. Spilborghs, E. Pujol, F. Tomiatti, R. Moura, N. Nascimento, J. Mueller, T. Lizer, W. Moody, W. Meese, and M. Scalzi.* Sidney Aluani (SGW Services/Brazil)	SESSION BREAK	SESSION BREAK	SESSION BREAK	
12:10	SESSION BREAK				SESSION BREAK
12:35		**B10.** **Enhancing 1,4-Dioxane Bioremediation at Low Concentrations by Combining a Metabolic Degradation Culture with Adsorbents.** *C. Zhou and B.L. Petty.* Chao Zhou (Geosyntec Consultants, Inc./USA)	**C7.** **Scientific and Engineering Considerations for Cost-Effective In Situ Bioremediation of Large, Deep Plumes.** *J. Skinner and M.-Y. Chu.* Justin Paul Skinner (Arizona State University/USA)	**D9.** **Development of ASTM Guidance on Application of Molecular Biological Tools to Assess Biological Processes at Contaminated Sites.** *S. Dworatzek, B. Harding, P. Hatzinger, M. Heintz, E. Jennings, T.A. Key, R. Kolhatkar, T. Macbeth, E. Mack, A. Madison, C. Waletka-Hutchinson, C. Acheson, and S. Fiorenza.* Stephanie Fiorenza (Arcadis/USA)	

Thursday Platform Sessions—1:00–2:40 p.m.

	A SESSIONS Waterloo 1-2 (Level 5)	B SESSIONS Waterloo 3 (Level 5)	C SESSIONS Waterloo 4 (Level 5)	D SESSIONS Waterloo 5-6 (Level 5)	E SESSIONS Waller A-B (Level 3)
1:00	**Achieving Project Success through Remediation Failure.** *R. Oesterreich.* Ryan Oesterreich (Arcadis/USA)	**Results from a 1,4-Dioxane Biogeochemical Reactor Field Pilot Test.** *C. Walecka-Hutchison, J. Sprague, J. Gamlin, R. Caird, Y. Miao, I. Kwok, and S. Mahendra.* Claudia Walecka Hutchison (Dow/USA)	**Combining Biotic and Abiotic Treatment Processes Post In Situ Thermal Treatment (ISTT).** *J.G. Booth, R.D. Collins, R. Hogdahl, and R. Simon.* J. Greg Booth (Woodard & Curran/USA)	**Role of Stratigraphic Models to Refine Site Assessments.** *B. Campanaro, J. Sadeque, R. Samuels, and D. Parse.* Ben Campanaro (AECOM/USA)	**Natural Occurrence of Feammox Conditions and Anammox Microbiota within a PFAS Plume at the Groundwater-to-Surface Water Interface.** *B. Harding, R. Gwinn, and J. Buzzell.* Barry Harding (AECOM/USA)
1:25	**Comparison of In Situ Bioremediation of Perchlorate and Chlorinated Solvents at Three Sites in Close Proximity: Challenges and Lessons Learned.** *W.A. Foss, P. Srivastav, and R.E. Mayer.* William Foss (APTIM/USA)	**Anaerobic and Aerobic Biostimulation and Bioaugmentation of Chlorinated Solvents and 1,4-Dioxane.** *L. LaPat-Polasko, I. Kwok, A. Polasko, and S. Mahendra.* Laurie LaPat-Polasko (Matrix New World Engineering/USA)	**Large-Scale In Situ Biotic and Abiotic Dechlorination of Groundwater Impacted with Commingled Chlorinated Ethenes and Chlorinated Methanes.** *M.M. Mejac, U. Patel, N. Walchuk, and F. Razmdjoo.* Mark Mejac (Ramboll/USA)	**Where is the Vinyl Chloride? Alternative Natural and Enhanced Degradation Pathways for Chlorinated Solvents.** *J.R. Hesemann.* John Hesemann (Burns & McDonnell/USA)	**Groundwater/Surface Water Interactions at the Transition Zone: Utilizing an In Situ Passive Sampling Program to Evaluate Groundwater Upwelling.** *B.G. Pautler, M. Healey, J. Roberts, J. Conder, D. Toler, L. Fontenot, and S. Aufdenkampe.* Sandra Dworatzek (SiREM/Canada)
1:50	**EVO Use in Hard Water Aquifers: Implications and Strategies for Successful Substrate Distribution.** *J.F. Ortiz-Medina, L. Ross, and R.C. Borden.* Fausto Ortiz (EOS Remediation/USA)	**Novel Organism Deployed for In Situ Bioremediation of 1,4-Dioxane in Groundwater.** *A. Banerjee, Z. Pierce, S. Koenigsberg, D. Saran, K. Sorenson, and L. Sazbo.* Areen Banerjee (Allonnia/USA)	**Innovative ZVI Application for Sustainable Remediation of Chlorinated Solvent Plumes.** *M. Dreyer, K. Rugge, T.H. Jørgensen, J. Wang, D. Fan, N. Durant, R. Thalund-Hansen, P.L. Bjerg, M.T. Hag, and N. Tuxen.* Morten Dreyer (COWI/Denmark)	**Groundwater Plume Analytics® Tools for Improved Conceptual Site Models at Bioremediation Sites.** *J.A. Ricker and D.C. Winchell.* Joseph Ricker (WSP/USA)	**A Seep Origin Story: Using Electrical Hydrogeology to Find Mysterious Deep LNAPL Source.** *T. Halihan, K.W. Spears, and S.W. McDonald.* Todd Halihan (Oklahoma State University/USA)
2:15	**Successful Enhanced Reductive Dechlorination in Bedrock with Long-Term Monitoring: Two Case Studies.** *P.M. Dombrowski, P. Kakarla, M. Temple, M. Lee, D. Raymond, and C. Weeden.* Paul Dombrowski (In-Situ Oxidative Technologies, Inc. [ISOTEC]/USA)	**In Situ Bioremediation of 1,4-Dioxane in Mixed Contaminant Plume with Metabolic Bioaugmentation and Cometabolism.** *F.J. Krembs, K. McDonald, M. Olson, and S. Dworatzek.* Fritz Krembs (Trihydro Corporation/USA)	**In Situ Enhanced Bioremediation to Reduce Large TCE/PCE Plumes and Government's Life Cycle Costs.** *P. Srivastav, W.A. Foss, and R.E. Mayer.* Praveen Srivastav (APTIM/USA)	**Quantitative Proteomics Approach to Monitor cVOC Bioremediation and Degradation Rates.** *K.H. Kucharzyk, F. Kara Murdoch, F.E. Loffler, J. Wilson, P.B. Hatzinger, J.D. Istok, R.W. Murdoch, L. Mullins, A. Hill, and M. Michalsen.* Kate Kucharzyk (Battelle/USA)	**Assessing the Origin of Groundwater Springs and Implications for PFAS Fate and Transport at Mountain Home Air Force Base, Idaho.** *M.R. Shultz and M. Anding.* Mike Shultz (Burns & McDonnell/USA)

A11. Challenges in Application of Bioremediation Tools

B10. 1,4-Dioxane Treatment Technologies

C7. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes

D9. Tools for Site Assessment and Bioremediation Monitoring

E9. Groundwater/Surface Water Interactions

3:00–4:00 p.m.—CLOSING PANEL DISCUSSION (Waterloo 1-2, Level 5)

4:00 p.m.—CLOSING RECEPTION (Waterloo Ballroom Foyer)

NOTES

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Battelle gratefully acknowledges the financial commitment and support of the following organizations for the 2023 Bioremediation Symposium.

AECOM is a world leader in developing innovative environmental solutions with cutting-edge expertise in remediation technologies. Our expertise in managing emerging contaminants such as 1,4-dioxane and per- and polyfluoralkyl substances (PFAS) is unmatched. We solve complex site challenges using an effective endpoint strategy, addressing a broad range of contaminants and incorporating sustainable and nature-based solutions in our closure strategies. AECOM remediation teams critically assess the nature and extent of contamination, risks to receptors, and safe exposure levels; leverage leading-edge biological, chemical and physical technologies to reduce project costs; and prepare and implement effective remedial designs. Stop by our booth to hear about our DE-FLUORO™ PFAS destruction technology! A fortune 200 firm, AECOM had revenue of approximately $13.1 billion during fiscal year 2022. **aecom.com**

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We received the first US patent [patft.uspto.gov] to utilize emulsified vegetable oil for groundwater remediation in 2002, and developed six more US Patents, a Canadian patent, and a Japanese patent over the next 14 years. Thanks to our amazing clients, EOS products have been used successfully at thousands of sites around the nation and world as we continue to innovate and grow.

Contact the friendly and knowledgeable EOS Team at info@EOSRemediation.com for technical assistance with remedy selection and demand calculations; product quotes; or to schedule a customized webinar for your team! **eosremediation.com**

Provectus Environmental Products, Inc., is a performance technology/ chemistry provider to the soil and groundwater remediation industry. We specialize in the development and global commercialization of next-generation, synergistic in situ chemical reduction (ISCR), in situ chemical oxidation (ISCO), bioremediation technologies, and methane inhibition. Our proprietary technology portfolio represents our industry's most effective, safest, and cost-efficient solutions. Our mission is to support responsible parties, environmental engineers, technical consultants, government regulators, and the wider academic community by continually providing innovative solutions to complex and challenging environmental issues with a selection of the most premium remediation strategies. Our team has over 100 years of combined in situ remediation

experience addressing common and emerging constituents of interest. For more information about our technologies, please visit provectusenvironmental.com or call us at (815) 650-2230. **provectusenvironmental.com**

REGENESIS is an expert provider of cost-effective in situ soil and groundwater remediation products, vapor barrier systems and services. Offering turn-key solutions for remediating and polishing off a wide range of sites at the lowest total cost-to-closure. For over 25 years, REGENESIS has demonstrated a proven track record on more than 26,000 projects around the world. REGENESIS leads the industry with proven solutions to eliminate PFAS compounds and other emerging contaminants. REGENESIS is considered a technology leader in environmental remediation, working with environmental consulting firms serving a broad range of clients, including developers, insurance companies, manufacturers, municipalities, regulatory agencies and federal, state and local governments. **regenesis.com**

Terra Systems (TSI) was founded in 1992 and holds the first United States Patent for the use of emulsified vegetable oil substrate, lactate and nutrients for the in-situ bioremediation of chlorinated solvents in groundwater (US Patent 6,398,960). Using our core competencies in R&D, in-house manufacturing, and unsurpassed pre- and post-sales technical support, our family of patented SRS® slow-release emulsified substrates has expanded and offers our clients the broadest solutions for today's challenging aquifer conditions. Research & Development is focused on the advancement of bioremediation technology and implementation cost reduction. The SRS® EVO family includes our popular SRS®-SD small droplet EVO (0.6 µm) for maximum radius of influence, SRS®-FRL large droplet EVO (5 µm) for maximum adherence in fractured rock formations, high groundwater aquifers, or permeable reactive barriers, and near surface water like rivers, streams, and estuaries. Leveraging the EZVI patent (emulsified zero valent iron) from NASA, TSI manufactures its SRS®-ZVI family of emulsified zero valent iron with different iron particle sizes and percentages. Newer products like SRS®-STA are manufactured with a shear thinning agent for better distribution in heterogeneous aquifers. Sodium persulfate is the latest addition to our portfolio. For additional information, visit www.terrasystems.net, call 888-600-3500, or email mfree@terrasystems.net. **terrasystems.net**

As one of the world's leading professional service firms, **WSP** brings clarity and vision to complex challenges by working with and advising governments and private-sector clients on key aspects of earth sciences and environmental sustainability. With the recent acquisitions of the Environment & Infrastructure business (E&I) of John Wood plc. and Golder, we have built the largest environmental practice in the world. Our over 23,000 environmental professionals provide specialized services to clients in some of the most highly regulated industries, including mining, oil and gas, energy, industrial, property and buildings, water and transportation. They advise on matters ranging from clean air, water and land, to biodiversity, green energy solutions, climate change and Environmental, Social and Governance ("ESG") issues. From design, permitting, planning and operations, to decommissioning and asset remediation, our environmental professionals are ready to support you through the entire lifecycle of your projects. **wsp.com**

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Environmental Material Science, Inc. (EMS) was founded upon the commercialization of 15 years of university-based research conducted by the world's foremost soil scientists in soil fertility and remediation. We create and deliver technology that autonomously monitors and remediates hydrocarbon spills by using solar power and local groundwater to biostimulate soil health. EMS products/services: 1) Soil Sense - Our sensor packs installed at different depths constantly assess hydrocarbon vapours, oxygen, carbon dioxide and methane year-round. 2) Distributor – Our compact, solar-powered injection system uses ground water while it delivers a lab-tested nutrient and electron acceptor solution to help clean hydrocarbon spills at a site. 3) Optimizer - Our proprietary amendment solution provides a tailored blend of macro- and micro-nutrients for each site, creating an optimal environment for "hydrocarbon hungry" microorganisms to thrive, translating into significantly quicker remediation time. EMS Proven Value Proposition: 1) help customers predict when and how much to spend on contaminated sites; 2) increase customer revenue by minimizing disruptions to operations; 3) reduce customer costs by using natural processes to clean contaminated soil; 4) help customers comply with regulations and improve ESG metrics by continuously measuring pollutants and pollutant degradation. **ems-inc.ca**

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NOTES

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Battelle's environmental engineers, scientists, and professionals offer focused expertise to government and industrial clients in the U.S. and abroad. Combining sound science and engineering solutions with creative management strategies, Battelle works with clients to develop innovative, sustainable, and cost-effective solutions to complex problems in site characterization, assessment, monitoring, remediation, restoration, and management. Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio, since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries.

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MONDAY, May 8	TUESDAY, May 9	WEDNESDAY, May 10	THURSDAY, May 11
7:00-8:00 a.m.—Morning Short Course Check-In 12:00-1:00 p.m.—Afternoon Short Course Check-In 2:00-8:30 p.m.—Symposium Registration Open 3:00-5:00 p.m.—Career KickStarter	7:00 a.m.-7:00 p.m.—Registration, Exhibits, Poster Group 1 Display 7:00-8:00 a.m.—Breakfast 9:30-10:15 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch 3:00-3:45 p.m.—PM Beverage Break	7:00 a.m.-7:00 p.m.—Registration, Exhibits, Poster Group 2 Display 7:00-8:00 a.m.—Breakfast 9:30-10:15 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch 3:00-3:45 p.m.—PM Beverage Break	7:00 a.m.-1:00 p.m.—Registration, Exhibits, Poster Group 2 Display 7:00-8:00 a.m. —Breakfast 9:30-10:15 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch
8:00 a.m.-5:00 p.m. Short Courses	**8:00 a.m.-5:35 p.m. Platform Sessions**	**8:00 a.m.-5:35 p.m. Platform Sessions**	**8:00 a.m.-2:40 p.m. Platform Sessions**
Short Courses **8:00 a.m.-12:00 noon (half-day)** • Best Practices for Bioremediation and Reductive Technologies **1:00-5:00 p.m. (half-day)** • Application of Molecular Biological Tools to Assess Biological Processes at Contaminated Sites **3:00-5:00 p.m.** • Career KickStarter for Students and Young Professionals	A1. Advances in Amendment Formulation A2. Engineering Biogeochemical Transformation A3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants A4. Phytoremediation	A5. Optimization of Classical Bioremediation Technologies A6. Synthetic Biology Driven Remediation A7. In Situ Bioremediation Applications A8. Innovative and Efficient Amendment Delivery Strategies	A9. Ex Situ and Vadose Zone Biological Treatment A10. Biobarrier Installation and Management A11. Challenges in Application of Bioremediation Tools
	B1. Fate and Transport of PFAS B2. Innovative Treatment Technologies for PFAS In Situ **PANEL:** PFAS Program Management in a Rapidly Changing Regulatory Environment B3. PFAS Program Management in a Rapidly Changing Regulatory Environment	B4. Activated Carbon-Based PFAS Treatment Technologies B5. Innovative Treatment Technologies for PFAS Ex Situ B6. Comparing Ex Situ Destructive Technologies B7. PFAS in Surface Water and Storm Water	B8. Addressing Emerging Contaminants in a Regulatory Framework B9. Emerging Contaminants: Detection, Degradation, Fate and Transport B10. 1,4-Dioxane Treatment Technologies
	PANEL: What are the Knowledge Gaps for Fate and Transport at Complex Sites? C1. Natural Source Zone Depletion C2. Remediation and Management of Petroleum-Hydrocarbon Contaminated Sites C3. LNAPL Bioremediation/NSZD Modeling	C4. Bioremediation in Complex Geological Settings **PANEL:** Status of the 2015 Geology Revolution… Where Are We Now and Where Do We Go from Here? C5. Impacts of Mixed Contaminants on Biodegradation	C6. Bioremediation Case Studies C7. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes
	D1. Innovative Tools for Evaluating Vapor Intrusion Risk D2. Vapor Intrusion from Non-VOC Sources (e.g., mercury, methane, PFOAs, and Radionuclides) D3. HRSC and Conceptual Site Models	D4. Big Data and Integration of Molecular Tools in Site Assessment: Advanced Omics D5. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation D6. High-Resolution Site Characterization	D7. Chemical Fingerprinting and Forensics D8. Improved Conceptional Site Models that Include Biodegradation Data D9. Tools for Site Assessment and Bioremediation Monitoring
	E1. Best Practices in Green and Sustainable Remediation (GSR) E2. Sustainable Remediation Assessment Tools E3. Robotic Technologies for Environmental Site Assessment and Monitoring E4. Adaptive Site Management Strategies to Mitigate Climate Change Impacts	**PANEL:** Opportunities and Challenges for Engineered Biology in Bioremediation E5. Microplastics and Nanoplastics: Degradation and Effects on the Environment E6. Bioremediation of Munitions Constituents E7. Treatment of Nitrate-Impacted Groundwater	E8. Advances in Tools and Techniques for Assessing MNA **PANEL:** Science, Application, Monitoring, and Illustrative Case Studies of Biogeochemical Remediation E9. Groundwater/Surface Water Interactions
5:30-7:00 p.m.—Plenary Session **7:00-8:30 p.m.—Welcome Reception, Exhibits, Poster Group 1 Display**	**5:45-7:00 p.m.—Poster Group 1 Presentations and Reception** **See page 18 for sessions in Poster Group 1.**	**5:45-7:00 p.m.—Poster Group 2 Presentations and Reception** **See page 26 for sessions in Poster Group 2**	**3:00 p.m.—Closing Panel Discussion** **4:00 p.m.—Closing Reception**