June 23-26, 2025 | Boston, Massachusetts

Seventh International Symposium on Bioremediation and Environmental Biotechnology

Final Program

battelle.org/biosymp
#BattelleBio25

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Seventh International Symposium on Bioremediation and Environmental Biotechnology

Welcome to Boston! Thank you for attending the 2025 Bioremediation Symposium.

We are so grateful for your participation, and we are excited to gather and discuss advances, innovations, and solutions for the technical challenges that we face each day.

Battelle is pleased to co-host this event with Allonnia which shares a similar mission to utilize science and technology to solve some of the world's most pressing issues. Allonnia is an environmental biotechnology company focused on using a combination of transformative biology and engineered systems to write a new law of conservation—waste is neither created nor destroyed—only transformed. The partnership between Battelle and Allonnia further enhances the technical scope of the Symposium to focus on advances in biological treatment, synthetic biology, and biotechnology-enabled solutions.

This work requires engagement across diverse and multi-dimensional groups of stakeholders representing environmental, economic, political, and social components. The 2025 technical program reflects this multi-dimensional approach and includes sessions and panel discussions focused on emerging contaminants, characterization and management of PFAS, strategies to mitigate climate change, dynamic regulatory frameworks for emerging contaminants, classical and innovative bioremediation technologies, advances in modeling and conceptual site model updating, and biotechnology in the environmental space.

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, short course instructors, and others, who have committed their time and 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 the Symposium.

On Monday, June 23, our Symposium commences with three short courses and a Career KickStarter for students and young professionals. The Plenary Session, featuring Dr. George Church (Professor of Genetics, Harvard Medical School) will be presented at 5:30 p.m. (Independence Ballroom). All attendees, including Exhibitors, are invited to attend the Plenary Session. The Welcome Reception will immediately follow and be held in the Exhibit Hall and will feature refreshments, exhibit booths, and an early display of Group 1 Posters.

Tuesday, June 24, through Thursday, June 26, more than 400 platform and poster presentations will be presented in 45 breakout sessions. Four 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. Both poster receptions will also include a reverse job fair for participating companies. Interested attendees should look for the exhibit booths that have the Job Fair participant indicator displayed.

On Thursday afternoon, June 26, attendees are invited to attend a Closing Panel discussion from 3:00-4:00 p.m. This panel will provide a summary of major topics and themes from each of the five technical tracks while also touching on research needs, innovative approaches, and upcoming challenges. The winning student posters will also be presented prior to the panel discussion and will be followed by a final networking reception.

In your free time, we hope you enjoy exploring Boston's local arts, music, and cuisine.

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.

Symposium Program Chairs
Pamela Chang, PMP (Battelle)
Kent Sorenson, Ph.D., PE (Allonnia)

CONTENTS

Symposium Floor Plan (Sheraton Boston, 2nd Floor)

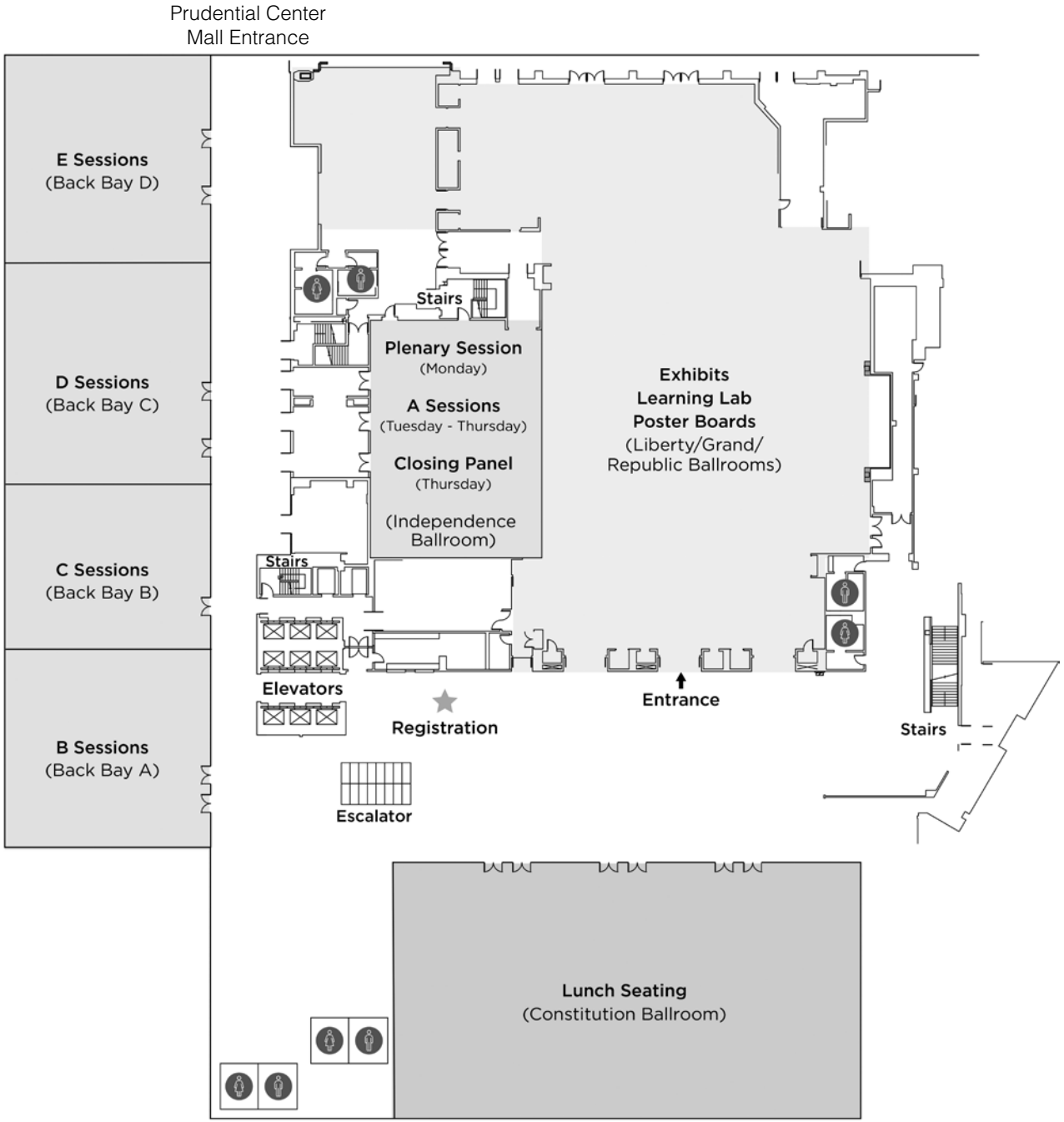


Exhibit Hall Floor Plan

Liberty/Grand/Republic Ballrooms

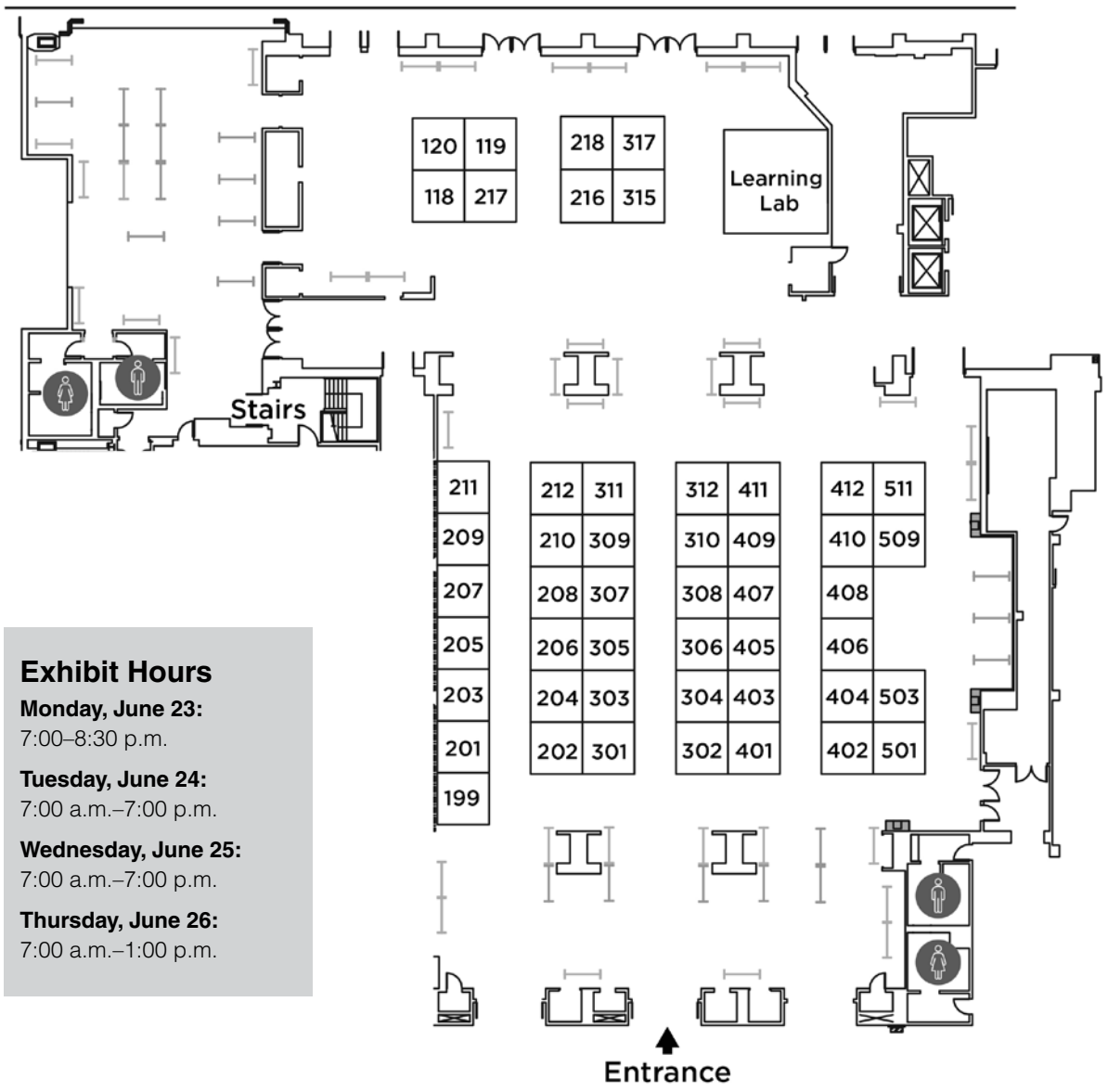


Exhibit Hours

Monday, June 23:
7:00–8:30 p.m.

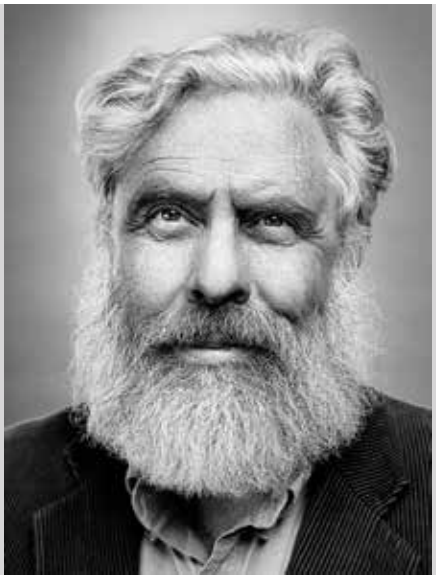
Tuesday, June 24:
7:00 a.m.–7:00 p.m.

Wednesday, June 25:
7:00 a.m.–7:00 p.m.

Thursday, June 26:
7:00 a.m.–1:00 p.m.

Symposium Sponsors are shown in bold.

Plenary Session (Independence Ballroom)



Dr. George M. Church, a pioneering geneticist and molecular engineer, is Professor of Genetics at Harvard Medical School. He also serves as Director of PersonalGenomes.org, which provides the world's only open-access information on human Genomic, Environmental, and Trait data (GET Conference).

Plenary Session Schedule

Monday, June 23, 5:30–7:00 p.m.

Welcome and Opening Remarks
Symposium Chairs:
Pamela Chang, PMP (Battelle)
Kent Sorenson, Ph.D., PE (Allonnia)

Plenary Speaker
Dr. George M. Church (Professor of Genetics, Harvard Medical School)

Genome Synthesis & Editing for Biocontainment & Bioremediation

His 1984 Harvard Ph.D. included the first methods for direct genome sequencing, molecular multiplexing and barcoding which led to the first genome sequence (pathogen, *Helicobacter pylori*) in 1994.

His innovations have contributed to nearly all "next generation" DNA sequencing methods and companies (CGI-BGI, Life, Illumina, and Nanopore). His lab's work on chip-DNA-synthesis, gene editing and stem cell engineering resulted in founding additional application-based companies spanning fields of medical diagnostics (Knome/PierianDx, Alacris, Nebula, and Veritas) and synthetic biology/therapeutics (AbVitro/Juno, Gen9/enEvolv/Zymergen/Warpdrive/Gingko, Editas, and Egenesis). He has also pioneered new privacy, biosafety, ELSI, environmental and biosecurity policies, was Director of an IARPA BRAIN Project, and three NIH Centers for Excellence in Genomic Science (2004-2020).

His honors include election to the National Academy of Sciences (NAS), the National Academy of Engineering (NAE) and a Franklin Bower Laureate for Achievement in Science. He has coauthored 716 papers, 156 patent publications and a book (*Regenesis*).

Dr. Church's plenary talk will explore the "realm of the possible," now plausible, through genome synthesis and editing. His work as co-founder of genetic engineering company, Colossal, is responsible for breakthrough de-extinction projects for the dire wolf and continued progress on a similar project for the woolly mammoth.

Many biotechnologies are improving in cost and quality with a doubling time faster than a year. The ability to read, edit, and write proteins and genomes allows for the generation of functional systems, ranging from in vitro binding libraries to xenotransplantation of kidneys, using a combination of artificial intelligence machine learning with multiplex libraries (also known as ML-ML) for new proteins and genomes.

For bioremediation, specifically, non-standard amino acids (NSAA) are desired to achieve high catalysis for recalcitrant pollutant polymers as well as tight biocontainment via engineered dependence of essential proteins on the NSAAs.

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

NOTES

General Information

All Symposium events will be held at the Boston Sheraton (39 Dalton St, Boston, MA 02199).

See the following pages for additional information:

- Page 11: Short Courses offered on Monday
- Page 32: Overview of the platform sessions and panels to be conducted each day. Times for exhibits, breakfasts, lunches, and receptions.

Program Overview

Monday, June 23

- **8:00 a.m.-12:00 p.m.** Morning Short Course
- **1:00-5:00 p.m.** Afternoon Short Courses
- **2:00-8:30 p.m.** Registration Desk Open
- **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, June 24

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

Wednesday, June 25

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

Thursday, June 26

- **7:00 a.m.-4:00 p.m.** Registration Desk Open
- **7:00 a.m.-1:00 p.m.** Exhibit Hall Open
- **7:00-8:00 a.m.** Continental Breakfast
- **8:00 a.m.-2:40 p.m.** Platform Presentations
- **9:30-10:00 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

Platforms. Platform presentations scheduled as of June 9 are listed by day on pages 16-26. Changes after this date are reflected in the mobile app, the online program, and the digital session room signage between session rooms.

Talks are scheduled for 25-minute intervals. Each talk is to begin promptly at the time printed in the schedule. Session chairs will adhere strictly to the schedule, making it possible for registrants to move between breakout rooms to hear the talks most pertinent to them. To minimize distraction, please confine movement between session rooms to the short intervals between talks.

Posters. All poster listings and board numbers can be found only in the mobile app and online program. Go to the "Program" tab and filter by "Type" for "Poster." Poster presenters may find their assigned poster board numbers in the email notification sent prior to the Symposium. A list of board numbers can also be found near the Registration Desk, sorted by last name.

Group 1 Posters
Display: Monday 7:00 p.m.–Tuesday 7:00 p.m.
Presentations: Tuesday 5:45–7:00 p.m.

Group 2 Posters
Display: Wednesday 7:00 a.m.–Thursday 1:00 p.m.
Presentations: Wednesday 5:45–7:00 p.m.

General Attendance Certificate. If you would like to receive a general certificate of attendance sign up at the Registration Desk. PDF certificates will be emailed after the Symposium. Certificates will not include number of attendance hours.

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.

Exhibits

Booths will be displayed in the Grand, Liberty, and Republic Ballrooms by 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 refreshments for poster receptions will be served in the Exhibit Hall.

Ad Hoc Meeting Room

A small meeting room, set for 10-12 people, is available for ad hoc meetings. The room may be reserved in 30-minute increments for up to 2 hours. AV equipment is not provided. Come to the Registration Desk for room details and to reserve a time.

Messages, Job Postings, Lost & Found

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

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

Network Name:
MarriottBonvoy_Conference

Password (case-sensitive): Bio2025

Learning Lab Schedule (Exhibit Hall)

Learning Lab Instructors and descriptions can be found in the mobile app. Go to the "Program" tab and filter by "Type" for "Learning Lab." Presentation times are provided below.

Look for the Learning Lab symbol, seen to the right, in the left-hand margin throughout the platform schedule grids on pages 16-26 for a reminder of when a Learning Lab is scheduled.

Tuesday, June 24

- 8:00-8:25 a.m.—Using Subsurface Imaging to Guide and Monitor Bioremediation
- 8:50-9:15 a.m.—3-D Visualization and Analysis Software Demonstration
- 9:40-10:05 a.m.—Illustrating the Performance Effects of Sorption Enhanced Residence Time on In Situ Chemical Reduction and Enhanced Reductive Dechlorination Permeable Reactive Barriers
- 10:30-10:55 a.m.—New PFAS Sorbents for Broad Acre Agricultural Application
- 11:20-11:45 a.m.—Learn to Capture Accurate, Complete, Highly Resolved Borehole Geologic Logs Using Graphical Logging Forms
- 1:50-2:15 p.m.—Environmental Laboratory Accreditation (ELAP) Certified Laboratory Analysis of Passivex™ Passive Samplers
- 2:40-3:05 p.m.—Program Management with ESdat Field Workflow
- 3:30-3:55 p.m.—Field-Scale Application of Sorbents to Soil: Critical Success Factors
- 4:20-4:45 p.m.—Influence of Amendment Formulations and Injection Methods on Chemical Reduction and Bioremediation Performance

Wednesday, June 25

- 8:00-8:25 a.m.— Influence of Amendment Formulations and Injection Methods on Chemical Reduction and Bioremediation Performance
- 8:50-9:15 a.m.— Program Management with ESdat Field Workflow
- 9:40-10:05 a.m.— Field-Scale Application of Sorbents to Soil: Critical Success Factors
- 10:30-10:55 a.m.— Environmental Laboratory Accreditation (ELAP) Certified Laboratory Analysis of Passivex™ Passive Samplers
- 11:20-11:45 a.m.— Using Subsurface Imaging to Guide and Monitor Bioremediation
- 1:50-2:15 p.m.— Learn to Capture Accurate, Complete, Highly Resolved Borehole Geologic Logs Using Graphical Logging Forms
- 2:40-3:05 p.m.— New PFAS Sorbents for Broad Acre Agricultural Application
- 3:30-3:55 p.m.— Illustrating the Performance Effects of Sorption Enhanced Residence Time on In Situ Chemical Reduction and Enhanced Reductive Dechlorination Permeable Reactive Barriers
- 4:20-4:45 p.m.— 3-D Visualization and Analysis Software Demonstration

Learning Lab Sponsors

Mobile App & Abstract Collection

Abstracts will be available only through the mobile app. Due to the size of the program—four 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 can 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 individually enabled.

Proceedings

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

Meals, Breaks, & Receptions

For the convenience of attendees, the 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 the Constitution Ballroom, directly across from the Exhibit Hall.

The Closing Reception will be served in the Liberty Ballroom prefunction area near the Registration Desk immediately following the Closing Panel Discussion.

For other meals and refreshments not provided by the Symposium, many options are available in the Sheraton Boston and the attached Prudential Center Mall.

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

Food & Beverage Sponsor

westonsolutions.com

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. Service times will begin and end promptly at the times listed.

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

Morning Beverage Break
Tuesday-Thursday, 9:30–10:00 a.m.

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

Afternoon Beverage Break
Tuesday-Wednesday, 3:00–3:30 p.m.

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

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

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

Closing Reception
Thursday, 4:00 p.m.

Student/Young Professional Participation & Events

University students through Ph.D. candidates will find participation 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.

Student Poster Competition

Students with abstracts accepted for the technical program as poster presentations were given the opportunity to participate in a poster competition.

Posters will be judged by a panel of experts and first, second, and third place winners will be awarded at the Closing Panel Discussion.

Career KickStarter

Monday, 3:00-5:00 p.m. | Back Bay Ballroom D

Preregistration 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 Sponsor

wsp.com | Booth #403

Reverse Job Fair

Tuesday & Wednesday
During Poster Receptions

Participating exhibitors will have a designated staff member available to discuss open positions.

Short Course Schedule

Limited onsite Short Course registration may be available. Come to the 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 Registration Desk up to one hour prior to the course start time. Attendance will be taken in the room by the Instructors.

Monday, June 23, 8:00 a.m.-12:00 p.m.

- Technology Selection: Matching Key Contaminant Characteristics and Hydrogeology with Technology Attributes

Monday, June 23, 1:00-5:00 p.m.

- Quantitative Tools for Nature-Based Solutions
- The TA2 Tool and MAROS: Two New Tools for Managing and Transitioning Contaminated Groundwater Sites

NOTES

Program Committee, Session Chairs & Panel Moderators

Program Committee

Symposium Chairs

Pamela Chang, PMP (Battelle)

Kent Sorenson, Ph.D., PE (Allonnia)

Technical Steering Committee

Hunter Anderson, Ph.D. (SERDP/ESTCP)

Ian Brookman (Environmental Earth Sciences International)

James J. Collins, Ph.D. (Massachusetts Institute of Technology)

Elizabeth Edwards, Ph.D., PE (Department of Chemical Engineering and Applied Chemistry, University of Toronto)

David L. Freedman, Ph.D. (Clemson University)

Paul Hatzinger, Ph.D. (Biotechnology Development and Applications Group, APTIM)

Kate Kucharzyk, Ph.D. (Battelle)

Frank Loeffler, Ph.D. (University of Tennessee, Knoxville)

Tamzen W. Macbeth, Ph.D., PE, BCEE (CDM Smith)

Dayal Saran, Ph.D. (Allonnia)

Rick Wice, PG (Sundance Consultants)

TUESDAY PLATFORM SESSIONS

A1. Innovative Treatment Technologies for PFAS In Situ
Emily Pulcher (Burns & McDonnell Engineering Company)
Ian Ross (CDM Smith)

A2. Managing PFAS in Biosolids: Exploring Detection, Fate, and Bioremediation Potential in Wastewater Treatment Plants
Daniel Longbrake (Battelle)
Mahsa Modiri (EA Engineering, Science, and Technology)

A3. Innovative Treatment Technologies for PFAS Ex Situ
Zach Pierce (Allonnia)
Joseph Quinnan (Arcadis US, Inc.)

B1. Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites
J. Michael Hawthorne (GEI Consultants, Inc.)
Barry Poling (REGENESIS)

B2. Natural Source Zone Depletion
Jeffrey Ford (Jacobs)
Julio Zimbron (E-Flux)

B3. Tools for Assessing Contaminant Sources and Fate
Jordan Bochner (ETEC, Inc)
Tomasz Kuder (Kuder Enviro-Isotopes, LLC [KEI])

C1. 1,4-Dioxane Treatment Technologies
Alison Cupples (Michigan State University)
Shaily Mahendra (UCLA)

C2. Combined Treatment of Emerging Contaminants with CVOCs
John Freim (REGENESIS)
Christopher Hook (Tetra Tech, Inc.)

C3. Emerging Contaminants: Detection, Degradation, Fate and Transport
Nasim Pica (WSP)
Hannah Rolston (CDM Smith)

D1. In Situ Bioremediation Applications
Rebecca Daprato (Geosyntec Consultants)
Kimberly Sutter (GEI Consultants)

D2. Innovative and Efficient Amendment Delivery Strategies
Kevin Moore (ETEC, Inc.)
Jake Wilson (Legacy Remediation, Inc.)

E1. Advances in Amendment Formulation
Michael Lee (Terra Systems)
Troy Lizer (Provectus Environmental Products, Inc.)

E2. Cometabolic Bioremediation
Stewart Abrams (Langan Engineering)
Paul Hatzinger (APTIM)

E3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants
David Freedman (Clemson University)
Alan Seech (Evonik Corporation)

E4. Biogeochemical Remediation Processes
Shandra Justicia-León (Arcadis)
Frank Loeffler (University of Tennessee, Knoxville)

WEDNESDAY PLATFORM SESSIONS

A4. Activated Carbon-Based PFAS Treatment Technologies
Matt Anding (Tepa)
Matthew Spurlin (Noblis)

A5. SERDP & ESTCP Efforts on PFAS Biological Transformation and Remediation
Hunter Anderson (Noblis)
Anastasia Nickerson (ORISE fellow at SERDP/ESTCP)

A6. PFAS Source and Forensic Considerations
Megan Duley (Oneida ESC Group)
Kim-Lee Yarberry (Jacobs)

B4. HRSC for Robust CSM and Decision-Making
Tim Pac (Terra Systems)
Sam Yoon (Noblis, Inc.)

B5. Tools for Site Assessment and Bioremediation Monitoring
Dora Taggart (Microbial Insights, Inc.)
John Xiong (Haley & Aldrich, Inc.)

B6. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation
Rick Cramer (Geosyntec Consultants, Inc.)
J. Mark Stapleton (Noblis)

B7. Improved Conceptual Site Models that Include Molecular Biological Data
Brian Hoye (Burns & McDonnell Engineering Company, Inc.)
Sam Rosolina (Microbial Insights, Inc.)

C4. Microplastics and Nanoplastics in the Environment
Darcy Metzler (Haley & Aldrich)
Nicholas Rogers (CDM Smith)

C5. Biodegradation and Upcycling of Plastics
Rick Eno (Allonnia)
Graeme Howe (Queens University)

C6. Biotechnology for Sustainable Mining
Michaeline Albright (Allonnia)
Bradley Heater (Battelle)

D3. Biobarrier Implementation and Management
Eric Bueltel (ETEC, Inc.)
Jay Shaw (Provectus Environmental)

D4. Challenges in Application of Bioremediation Tools
Francisco Barajas Rodriguez (AECOM)
John Wilson (Scissortail Environmental Solutions, LLC)

D5. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes
Maureen Dooley (REGENESIS)
Will Moody (Provectus Environmental Products, Inc.)

D6. Impacts of Mixed Contaminants on Biodegradation
Brad Elkins (Redox Tech)
Laurie LaPat-Polasko (Matrix New World Engineering)

E5. Optimization of Classical Bioremediation Technologies
Daniel Leigh (Evonik Active Oxygens)
Lydia Ross (GEI Consultants)

E6. Phytoremediation
Arul Ayyaswami (Tetra Tech)
Barry Harding (AECOM)

E7. Advances in Heat-Enhanced Bioremediation
Emily Crownover (TRS Group)
Craig Divine (Arcadis)

THURSDAY PLATFORM SESSIONS

A7. Managing PFAS Regulatory Uncertainty in Response Actions
Rosa Gwinn (AECOM)
Taryn McKnight (Eurofins)

A8. Advances in Biological Wastewater Treatment
Elizabeth Edwards (University of Toronto)
Kate Kucharzyk (Battelle)

B8. HRSC and Conceptual Site Models
Rick Wice (Sundance Consultants)
Edward Winner (Remediation Products Inc.)

B9. Advances in Tools and Techniques for Assessing MNA
Charles Newell (GSI Environmental Inc.)
Matt Rousseau (GHD Limited)

B10. Groundwater/Surface Water Interactions
David Adamson (GSI Environmental Inc.)
Ian Brookman (Environmental Earth Sciences International)

C7. Biocementation
Fadime Kara Murdoch (Battelle)
Rhett Martineau (Air Force Research Laboratory)

C8. Energy and Greenhouse Gas Footprint of Bioremediation
Gareth Leonard (REGENESIS)
Dick Raymond (Terra Systems)

C9. Strategies to Mitigate Climate Change Impacts
Solidea Maria Cristina Bonina (GEI Consultants, Inc.)
Paulina Fiore (AECOM)

D7. Bioremediation in Complex Geological Settings
James Feild (Burns & McDonnell)
Derek Pizarro (AST Environmental, Inc.)

D8. Bioremediation Case Studies
Natalie Cápiro (Cornell University)
Dora Chiang (Jacobs)

E8. Understanding the Microbiome
Elizabeth Deyett (Allonnia)
Robert Murdoch (Battelle)

E9. Novel Sensing Technologies
Aileen Mastouri (RevivBio)
Dayal Saran (Allonnia)

E10. Bioremediation of Munitions Constituents (Platforms)
Bryon Dahlgren (Battelle)
Paul Erickson (Regenesis Bioremediation)

Panel Discussions

TUESDAY, JUNE 24

1:50-3:30 p.m. | D Sessions Room
In Situ Bioremediation: State of the Practice and Emerging Contaminant Challenges
Moderator: Rick Wice (Sundance Consultants)

3:55-5:35 p.m. | C Sessions Room
Believe or Not to Believe Biodegradation of Emerging Contaminants
Moderator: Maggie Radford (Jacobs)

WEDNESDAY, JUNE 25

3:55-5:35 p.m. | C Sessions Room
Synthetic Biology Applications and Challenges to Commercialization
Moderators: Bradley Heater (Battelle) and Kate Kucharzyk (Battelle)

THURSDAY, JUNE 26

8:00-9:40 a.m. | A Sessions Room
Barriers to the Selection and Implementation of Biotechnical Solutions
Moderator: Ian Brookman (Environmental Earth Sciences International)

Group 1 Posters

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.

All poster listings and board numbers may be found only in the mobile app. Go to the "Program" tab and filter by "Type" for "Poster."

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

A1. Innovative Treatment Technologies for PFAS In Situ
A2. Managing PFAS in Biosolids: Exploring Detection, Fate, and Bioremediation Potential in Wastewater Treatment Plants
A3. Innovative Treatment Technologies for PFAS Ex Situ
A4. Activated Carbon-Based PFAS Treatment Technologies
A5. SERDP & ESTCP Efforts on PFAS Biological Transformation and Remediation
B1. Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites
B2. Natural Source Zone Depletion
B3. Tools for Assessing Contaminant Sources and Fate
B4. HRSC for Robust CSM and Decision-Making
B5. Tools for Site Assessment and Bioremediation Monitoring
C1. 1,4-Dioxane Treatment Technologies
C2. Combined Treatment of Emerging Contaminants with CVOCs
C3. Emerging Contaminants: Detection, Degradation, Fate and Transport
D1. In Situ Bioremediation Applications
D2. Innovative and Efficient Amendment Delivery Strategies
E1. Advances in Amendment Formulation
E2. Cometabolic Bioremediation
E3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants
E4. Biogeochemical Remediation Processes

Group 2 Posters

The following posters will be on display from Wednesday morning through Thursday at 12:30 p.m. in the Exhibit Hall. During the Presentations/Reception period on Wednesday evening, presenters will be at their displays to discuss their work.

Display: Wednesday 7:00 a.m. – Thursday 12:30 p.m.
Presentations: Wednesday 5:45–7:00 p.m.

A6. PFAS Source and Forensic Considerations
A7. Managing PFAS Regulatory Uncertainty in Response Actions
A8. Advances in Biological Wastewater Treatment
B6. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation
B7. Improved Conceptual Site Models that Include Molecular Biological Data
B8. HRSC and Conceptual Site Models
B9. Advances in Tools and Techniques for Assessing MNA
B10. Groundwater/Surface Water Interactions
C4. Microplastics and Nanoplastics in the Environment
C5. Biodegradation and Upcycling of Plastics
C6. Biotechnology for Sustainable Mining
C7. Biocementation
C8. Energy and Greenhouse Gas Footprint of Bioremediation
C9. Strategies to Mitigate Climate Change Impacts
D3. Biobarrier Implementation and Management
D4. Challenges in Application of Bioremediation Tools
D5. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes
D6. Impacts of Mixed Contaminants on Biodegradation
D7. Bioremediation in Complex Geological Settings
D8. Bioremediation Case Studies
E5. Optimization of Classical Bioremediation Technologies
E6. Phytoremediation
E7. Advances in Heat-Enhanced Bioremediation
E8. Understanding the Microbiome
E9. Novel Sensing Technologies
E10. Bioremediation of Munitions Constituents

NOTES

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
8:00	**Prospects for PFAS Bioremediation: Inherent Limitations and Reasons for Optimism.** *P.B. Hatzinger.* Paul Hatzinger (APTIM/United States)	**Moving Sites to Closure.** *T.J. Schruben, M. Lahvis, C.C. Stanley, A. Kirkman, C. Bruce, and L. Trozzolo.* Matthew Lahvis (Shell Oil Products/United States)	**Development of Propanotrophic Cultures for 1,4-Dioxane Biodegradation and the Identification of the Propane Monooxygenases Involved.** *Z. Eshghdoostkhatami and A. Cupples.* Zohre Eshghdoostkhatami (Michigan State University/United States)	**Optimizing Enhanced In Situ Bioremediation of Chlorinated Ethenes in Groundwater.** *L.T. LaPat-Polasko, B. Hoagland Stamatovski, and J. Pichtel.* Laurie LaPat-Polasko (Matrix New World Engineering/United States)	**Transitioning Remediation Approaches: From Biological Permeable Reactive Barriers (PRBs) to Biogeochemical Reactive Zones to Mitigate Chlorinated Solvent Plume Discharge to Surface Water.** *R.S. Srirangam, C. Redfern, and G. Angyal.* Ravi Srirangam (Ramboll/United States)
8:25	**Microbial Defluorination of TFA, PFOA, and HFPO-DA by a Native Microbial Consortium under Anoxic Conditions.** *X. Song and Z. Tang.* Xin Song (Institute of Soil Science/Chinese Academy of Sciences/China)	**Petroleum Hydrocarbon Rhizodegradation in the Canadian Boreal Ecozone Using Resilient Plants, Mycorrhizal Fungi and Biosurfactant-Producing Rhizobacteria.** *P. Roy, J.M. Hazell, C. Drew, V. Huppe, and B.A. Zeeb.* Prama Roy (Queen's University/Canada)	**Identification and Enhancement of Naturally-Occurring In Situ Aerobic Metabolic Biodegradation of 1,4-Dioxane.** *K. Diller, D.R. Griffiths, T. Ovbey, E.E. Mack, and P. Barreto.* Kristi Diller (Parsons/United States)	**Evaluation of In Situ Pilot Study Impacts on a TCE Groundwater Plume: Microbial, Geochemical, and Isotopic Analyses over One Year.** *E. Ehret, T. Macbeth, M. Lamar, and W. Lai.* Emma Ehret (CDM Smith/United States)	**Cobalamin Catalyzed ZVI for In Situ Remediation of Chlorinated Alkanes: Laboratory Treatability Results and Integration with the EZVI Amendment.** *J. Booth, N. Lapeyrouse, and C. Yestrebsky.* J. Greg Booth (Woodard & Curran/United States)
8:50	**Demonstration of Closed-Loop In Situ Soil Flushing to Passively Remove PFAS from AFFF Source Areas.** *J. Popovic, D.T. Adamson, P.R. Kulkarni, R. Craycroft, K.F. Welch, and B. Rhiner.* Roger Craycroft (GSI Environmental Inc./United States)	**Adaptive In Situ Remediation at a Challenging Urban Location: Overcoming Challenges to Achieve Remedial Targets.** *N.D. Butcher, T. Weise, R.T. Herrington, and D. Nunez.* Neill Butcher (AEI Consultants/United States)	**Successful Remediation of 1,4-Dioxane Using a Subgrade Biogeochemical Reactor.** *C. Walecka-Hutchison, J. Sprague, P. Weber, C. Katzen, S. Brubaker, M. Fulkerson, and S. Mahendra.* Cassie Katzen (Jacobs/United States)	**Effective In Situ Remediation Strategies for Large Chlorinated Solvent Plumes: Case Studies from the UK and Finland.** *G. Leonard.* Gareth Leonard (REGENESIS/United Kingdom)	**A Unique Enhanced Reductive Dechlorination Substrate Blend Designed to Prevent cis-1,2-Dichloroethene Stall and Vinyl Chloride Accumulation.** *C. Luther and M. Eberle.* Connor Luther (TRC Environmental Corporation/United States)
9:15	**Passive In Situ PFAS Capture and Removal Using a Novel Funnel and Gate System.** *D. Lippincott, G. Lavorgna, S.J. Foxwell, B. Caron, C. Schaefer, and A. Danko.* David Lippincott (APTIM/United States)	**Feasibility Evaluation of Enhanced LNAPL Depletion in a Gypsum Land Application Field Pilot.** *R.V. Kolhatkar and K. Sra.* Ravi Kolhatkar (Chevron/United States)	**Field Demonstration of 1,4-Dioxane Treatment Using Membrane Biofilm Reactors.** *C. Bell, B. Rittmann, C. Zheng, M.B. Heintz, and J. Provolt.* Caitlin Bell (Arcadis/United States)	**Bioborings as a Sustainable, Nature-Based Remediation for Treatment of a TCE Plume and Source at a Former Manufacturing Site in Northern Italy.** *K.A. Morris, L. Ferioli, E. Masut, and A. Legnani.* Kevin Morris (ERM/United States)	**Site-Specific Amendment Formulations for Better Distributed Biotic and Abiotic Chemical Reduction.** *L.G. Kessel.* Lowell Kessel (CERES Remediation Products/United States)
9:40	**Computer Modelling Used in Development of PFAS Pilot Test Design and Subsequent Analysis of Colloidal Carbon Barrier Monitoring Data.** *K.M. Gaskill, J. Birnstingl, A. Danko, and P.B. Hatzinger.* Jeremy Birnstingl (REGENESIS/United States)	SESSION BREAK	**Biological and In Situ Chemical Oxidation Treatability Studies to Achieve Low 1,4-Dioxane Levels.** *M.D. Lee, D. Raymond, P. Kakarla, and P.M. Dombrowski.* Michael Lee (Terra Systems/United States)	**Performance of Different ISB Implementation Methods: Injection and Recirculation versus Passive Backfill.** *P. Hsieh, T.W. Louviere, and T. Gray.* Patrick Hsieh (Dalton Olmsted & Fuglevand [DOF]/United States)	SESSION BREAK
10:05	**PFAS Adsorption Mechanisms of Surface Modified Clay, In Situ Case Studies, and Impacts on Biota.** *R.A. Dickman and M.S. Donovan.* Rebecca Dickman (CETCO/United States)	**Molecular Biological Tools, Magnesium Sulfate, and PetroFix® Achieve Site Closure.** *R. Thompson.* Rob Thompson (Antea Group/United States)	SESSION BREAK	SESSION BREAK	**Examining the Diversity of Methane Monooxygenases and Methanotrophs in Trichloroethene Degrading Cultures.** *M. Faghihinezhad and A. Cupples.* Mohsen Faghihinezhad (Michigan State University/United States)

A1. Innovative Treatment Technologies for PFAS In Situ

B1. Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites

B1.

C1. 1,4-Dioxane Treatment Technologies

D1. In Situ Bioremediation Applications

E1. Advances in Amendment Formulation

E2.

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
10:30	SESSION BREAK	**Enhanced Hydrocarbon Biodegradation via Soil Vapor Extraction (SVE) System Operation.** *T.E. McHugh, P.R. Kulkarni, J. Cook, A. Farnell, C. Bruce, L. Bealer, and M. Lahvis.* Thomas McHugh (GSI Environmental/United States)	**Enhanced In Situ Bioremediation Upgradient of an Adsorptive Barrier for Perfluoroalkyl Acids and Chlorinated Ethenes Contaminated Groundwater Treatment.** *S. Dong, P. Yan, M. Woodcock, J. Fortner, K. Pennell, and N.L. Cápiro.* Natalie Cápiro (Cornell University/ United States)	**Injection of Nitrate Solution at Soil/ Basalt Interface to Accelerate In Situ Biodegradation of Petroleum Hydrocarbons.** *M.A. McGraw, A. Pettley, R. Phillips, and R. Reed.* Maureen McGraw (Ayuda Companies/United States)	**Transformation of PFAS in AFFF-Impacted Site Material by Environmentally Relevant Cometabolic Organisms.** *J. LaFond, R. Rezes, J. Guelfo, A.A. Jackson, and P.B. Hatzinger.* Paul Hatzinger (APTIM/United States)
10:55	**From Extraction to Analysis: The Trials and Tribulations of Detecting PFAS in Biosolids.** *S.J. Choyke and* J. Thorn. Jonathan Thorn (Eurofins Environment Testing [USA]/United States)	**Implementing in Impermeable Clay a Funnel and Gate Permeable Reactive Barrier (PRB) with Bioavailable Absorbent Media.** *J. Rose and E. LeBlanc.* Juliette Rose (Ramboll Americas Engineering Solutions, Inc./United States)	**Treating a Cocktail of Contaminants New and Old: A Subgrade Biogeochemical Reactor Case Study.** *M. Fulkerson, J.P. Ford, and P. Favara.* Jeffrey Ford (Jacobs/United States)	**Use of Adsorbent-Based Remediation Technologies to Limit Surface Water Impacts from Contaminated Groundwater.** *M.C. Mazzarese and D. Pizarro.* Michael Mazzarese (AST Environmental, Inc./United States)	**Cometabolic Biodegradation of MTBE Coincident with Anaerobic Bioremediation of BTEX.** *L.G. Kessel.* Lowell Kessel (CERES Remediation Products/United States)
11:20	**Anaerobic Biotransformation and Biodefluorination of 6:2-Fluorotelomer Carboxylic Acid (6:2 FTCA) by Biosolids under Nitrate-Reducing Conditions.** *M. Li and S. Yaqoob.* Sumbel Yaqoob (New Jersey Institute of Technology/United States)	**Smart Sensors and Algorithms: Leveraging Fundamental Chemistry and Autonomous Sensors to Transform PHC Monitoring with Continuous Data Insights.** *S.D. Mamet, C. Doolin, B. Unni, Z. Johnston, and S.D. Siciliano.* Steven Mamet (LiORA by EMS/ Canada)	**Assimilation of cis-1,2-Dichloroethene by a 1,4-Dioxane-Metabolizer.** *S. Mahendra, I.Y. Kwok, H. Bose, and S. Ray.* Shaily Mahendra (UCLA/United States)	**Polluted to Potable: Key ISB Lessons Learned from a Hard Earned (Groundwater) Par.** *D.A. Kapson.* Dustin Kapson (AKRF/United States)	**Unveiling the Fate of n:3 Fluorotelomer Acids: Co-Metabolic Biodefluorination and Incorporation into Biomass.** *A.S. Dey, D. Wang, J. Zhang, J. Liu, and N. Perreault.* Anindya Dey (McGill University/ Canada)
11:45	**Managing PFAS Discharges from Wastewater Treatment Plants.** *C. Schaefer, D. Nguyen, and E. Novak.* Charles Schaefer (CDM Smith/ United States)	**From Characterization to Remediation: A Time-Sensitive Hydrogeophysical Framework for Targeted LNAPL Remediation.** *P. Ciampi, M. Petrangeli Papini, and G. Cassiani.* Paolo Ciampi (Sapienza University of Rome/Italy)	**Balancing Construction Timeline and Technical Approach: Regulatory and Logistical Challenges Addressing Commingled TCE and PFAS Plumes While Managing Client Expectations.** *C. Redfern, H. Reccelli, R.S. Srirangam, K. Boretsky, and M. Kozar.* Christine Redfern (Ramboll/United States)	**Successful Degradation of Chloropicrin in Soil Using ZVI and Anaerobic Bioremediation.** *M. Healey, K. Ashworth, J. Roberts, and C. Martin.* Michael Healey (SiREM/Canada)	**Cometabolic Treatment of 1,4-Dioxane and cVOCs Utilizing a Fluidized Bed Bioreactor: Batch to Pilot Studies.** *T.S. Webster, P.B. Hatzinger, and R. Rezes.* Todd Webster (Envirogen Technologies, Inc./United States)
12:10	**Modeling PFAS Leaching from Municipal Biosolids at Land Disposal Sites.** *F. Vahedian, M. Modiri, and M.A. Mills.* Faran Vahedian (EA Engineering, Science, Technology/United States)	**The LNAPL-PFAS Conceptual Site Model: State of the Practice.** *J.P. Ford, S. Park, D. Chiang, and C. Heron.* Jeffrey Ford (Jacobs/United States)	SESSION BREAK	**Accelerating Site Restoration with Thermal In Situ Sustainable Remediation (TISR®).** *J. Vidonish and J. Munholland.* Julia Vidonish (Arcadis/United States)	**Using Aerobic Cometabolic Biodegradation and Groundwater Recirculation to Treat 1,4-Dioxane in a Deep, Dilute Plume.** *M.J. Chu, A. Robles, and M. Hyman.* Min-Ying Chu (Haley & Aldrich/United States)
12:35	SESSION BREAK	SESSION BREAK		SESSION BREAK	SESSION BREAK

A2. Managing PFAS in Biosolids: Exploring Detection, Fate, and Bioremediation Potential in Wastewater Treatment Plants

B1. Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites

C2. Combined Treatment of Emerging Contaminants with CVOCs

D1. In Situ Bioremediation Applications

E2. Cometabolic Bioremediation

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
1:00	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK
1:25			**Exploring the Colloidal Properties of Extracellular Vesicles from Yeast and Bacteria: Environmental Transport Implications.** *N. Rogers.* Nicholas Rogers (CDM Smith/United States)		
1:50	A3. Innovative Treatment Technologies for PFAS Ex Situ **Soil Washing of PFAS-Contaminated Soil Stockpiles: A High-Throughput Success.** *T. Mehraban, C. Enochs, R. Singer, and R. Rapuzzi.* Toni Mehraban (Brice Engineering, LLC/United States)	B2. Natural Source Zone Depletion **Quantifying Natural Source Zone Depletion Using Single-Stick Method: Implementation, Challenges, and Rewards.** *D. Akhbari and T. Carlson.* Trevor Carlson (Geosyntec Consultants, Inc./Canada)	C3. Emerging Contaminants: Detection, Degradation, Fate and Transport **Discovery, Characterization and In Situ Tracking of Novel Sulfolane-Degrading Microbes.** *P.C. Dennis, M. Vachon-Gregory, K. Finney, J. Webb, S. Dworatzek, S. Matthew, T.A. Key, E.A. Edwards, and C. Toth.* Philip Dennis (SiREM/Canada)	Panel Discussion **PANEL DISCUSSION** **In Situ Bioremediation: State of the Practice and Emerging Contaminant Challenges** **Moderator** Rick Wice (Sundance Consultants) **Panelists** Elizabeth Edwards (University of Toronto) Paul Hatzinger (APTIM) Frank Loeffler (University of Tennessee, Knoxville) Dick Raymond (Terra Systems) Kent Sorenson, Jr. (Allonnia) Dora Taggart (Microbial Insights, Inc.)	E3. Enhanced Methods for Biodegradation/Biotransformation of Organic and Inorganic Contaminants **In Situ Treatment of Heavy Metals and Chlorinated Solvents in Groundwater at a Brownfields Redevelopment Site.** *F. Lakhwala and J. Stapleton.* Fayaz Lakhwala (Evonik Corporation/ United States)
2:15	**Thermal Desorption of PFAS-Impacted Soil.** *G. Katski, M. Kluger, and E. Crownover.* Emily Crownover (TRS Group/United States)	**Use of Snapshot Temperature Profiles in Existing Monitoring Wells to Evaluate Natural Source Zone Depletion.** *T.E. McHugh, B. Actkinson, K. Walker, C. Bruce, L. Bealer, and M. Lahvis.* Thomas McHugh (GSI Environmental/ United States)	**Degration of Perfluorohexane Sulfonate (PFHxS) Using Indigenous Hydrocarbon Degrading Microbes.** *C.C. Nwankwo, V.I. Obidiugwu, and E.E. Destiny.* Chika Nwankwo (University of Port Harcourt/Nigeria)		**Metabolic Interactions in a Mini-Pilot Scale Technology for the Reductive Dechlorination of Chlorinated Ethenes through the Coupling of Biological Processes and Adsorption with Bio-Based Materials.** *B. Matturro, S. Rossetti, L. Niccolini, L. Lorini, M. Abruzzese, and M. Petrangeli Papini.* Bruna Matturro (Water Research Institute, IRSA-CNR/Italy)
2:40	**Long-Term Stability of PFAS Immobilization in Soil: How Long Is Long Enough?** *R. Stewart.* Richard Stewart (RemBind/Australia)	**Is It Time to Reset Expectations for the Rates of NSZD?** *J. Zimbron.* Julio Zimbron (E-Flux/United States)	**Microbial Transformation of Nitrogen-Containing Precursors from Aqueous Film-Forming Foams.** *J. Zhang, A.S. Dey, J. Liu, G. Chen, D. Ramirez, F.E. Loeffler, and S.M. Rosolina.* Ju Zhang (McGill/Canada)		**Synergistic Effects of Sulfidated Zero Valent Iron and TCE-Degrading Bacterial Communities.** *N. Khan and K. Millerick.* Nofil Khan (Texas Tech University/ United States)
3:05	**Soil Washing 2.0: Sustainable Cost-Effective Treatment for PFAS.** *N.C. Nagle.* Nathan Nagle (Arcadis/United States)	**Soil Gas Gradient Approaches for Estimating Natural Source Zone Depletion.** *M. Lahvis, I. Verginelli, P. Jourabchi, and G. DeVaull.* Matthew Lahvis (Shell Oil Products/ United States)	**Anaerobic Biodegradation of PFAS by a Dehalogenating Culture: Implications for Subsurface Fate and Bioremediation.** *M.M. Lorah, A. Mumford, D.M. Akob, A. Tokranov, Z. Hopkins, K. He, L. Blaney, M. Siao, and A. Bett.* Michelle Lorah (U.S. Geological Survey/United States)		**In Situ Bioremediation of Polychlorinated Biphenyl-Impacted Sediments in a Former Industrial Cooling Pond.** *K.R. Sowers and U. Ghosh.* Kevin Sowers (University of Maryland Baltimore County/United States)

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
3:30	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK
3:55	A3. Innovative Treatment Technologies for PFAS Ex Situ **EradiFluor: An Innovative PFAS Destruction Technology.** *J.Z. Xiong.* John Xiong (Haley & Aldrich, Inc./ United States)	B3. Tools for Assessing Contaminant Sources and Fate **Field Comparison of Groundwater and Contaminant Mass Flux: Better Remediation Design through Improved Conceptual Site Models.** *P.R. Erickson and J. Rincon-Rodriguez.* Paul Erickson (Regenesis Bioremediation/United States)	Panel Discussion **PANEL DISCUSSION** **Believe or Not to Believe Biodegradation of Emerging Contaminants** **Moderator** Maggie Radford (Jacobs) **Panelists** Dora Chiang (Jacobs) Michelle Lorah (U.S. Geological Survey) Shaily Mahendra (UCLA)	D2. Innovative and Efficient Amendment Delivery Strategies **Automated Bioventing Optimization: Algorithm to Machine Learning.** *B. McAlexander, J. Eichert, C. Smith, and F. Krembs.* Fritz Krembs (Trihydro Corporation/ United States)	E4. Biogeochemical Remediation Processes **Meta-Study of In Situ CVOC Degradation Using Combined Organic Carbon and ZVI Reagents.** *J. Tillotson.* Jason Tillotson (Arcadis US, Inc./ United States)
4:20	**Technologies for Effective Treatment of Ultra-Short Chain PFAS.** *P. McKeown and S. Woodard.* Steve Woodard (ECT2/United States)	**Shovel or Scalpel? Modern Simulated Distillation, Updated TPH Fraction Methods to Define Contamination and Remediate.** *K. Horiuchi.* Kelly Horiuchi (VSOL Group/United States)		**Can ISCO Promote Biodegradation? Synergistic Effects of Combining Sodium Persulfate and Sulfate-Enhanced Biostimulation Relying on Reusable Direct Push Points.** *D.F. Alden, C. Bianco, G.M. Birk, D. Wiley, J. Suarez, and X. Druar.* David Alden (Tersus Environmental/ United States)	**High Concentrations of Hydrogen Sulfide Can Consume FeS and Reduce the Potential for Abiotic Degradation of TCE.** *J.T. Wilson.* John Wilson (Scissortail Environmental Solutions, LLC/United States)
4:45	**Foam Fractionation PFAS Treatment Considerations from Three Distinct Landfill Leachate Process Treatment Waste Streams.** *B. Miatke, B. Bailey, D. Liles, A. Baumeister, B. Brazil, R. Menon, and L.A. March.* Lauren March (Arcadis/United States)	**Use of Compound-Specific Isotope Analysis (CSIA) to Assess Remediation Treatment Performance of Petroleum Hydrocarbon Sites.** *D. Bouchard.* Daniel Bouchard (GHD/Canada)		**Horizontal Remediation Wells: Amplifying Results from Design to Implementation for Bioremediation.** *E. Andelman.* Elliott Andelman (Directional Technologies, Inc./United States)	**Galvanostatic Control of a Bioelectrochemical Reactor for the Reduction of Trichloroethylene.** *G. Sassetto, M. Presutti, L. Lorini, M. Zeppilli, and M. Petrangeli Papini.* Geremia Sassetto (University of Rome La Sapienza/Italy)
5:10	**Field Demonstration of Biosurfactants to Enhance Foam Fractionation Performance and Applicability in Low-Foaming Water.** *Z. Pierce, K. Sorenson, Jr., and J. Hnatko.* Zach Pierce (Allonnia/United States)	**Compound Specific Isotope Analysis for Advanced Site Characterization and Bioremediation.** *K.J. Warner, L. Mastera, and T. Daniluk.* Kevin Warner (ERM/United States)		**Evolution of Remedial Design: Transitioning from Multiphase Extraction to Advanced Bioremediation for Petroleum-Impacted Sites.** *J. Bochner, J. Hayes, and K. Moore.* Jordan Bochner (ETEC, Inc/United States)	**TBD**

5:45-7:00 p.m. POSTER GROUP 1 PRESENTATIONS AND RECEPTION (Exhibit Hall—Liberty/Grand/Republic Ballrooms)

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
8:00	**PFAS Efficient Activated Carbon and Longer Term Performance.** *L.G. Kessel.* Lowell Kessel (CERES Remediation Products/United States)	**Improving CSMs and Remediation Programs by Wringing High-Resolution Value Out of Existing Injection Data.** *J. Flattery and A. Kavanagh.* Andrew Kavanagh (REGENESIS/United States)	**Microplastics as Vectors of Contaminants and Microorganisms in Aquatic Environments: Current Knowledge and Future Directions.** *Y. Kunukcu.* Yasemin Kunukcu (WSP/United States)	**Permeable Reactive Barriers: In Situ Treatment Strategies to Mitigate Nitrate Discharge to Surface Water.** *P.M. Dombrowski, M.D. Lee, D. Raymond, M. Graffam, K. Rathjen, Y. Kamal, T.J. Pac, and V. Gonsalez.* Paul Dombrowski (ISOTEC Remediation Technologies/United States)	Panel Discussion **TBD**
8:25	**Bench-Scale Testing Colloidal Activated Carbon (CAC) Amendments for PFAS Immobilization under Realistic Site Conditions.** *J. Stults, C. Schaefer, B. Ulrich, E. Ziegelmeyer, and A. McRae.* John Stults (CDM Smith/United States)	B4. HRSC for Robust CSM and Decision-Making **High-Resolution Remedial Design Characterization of a cVOC Site in Africa.** *B.M. McDowell and J. Sohl.* John Sohl (COLUMBIA Technologies/United States)	C4. Microplastics and Nanoplastics in the Environment **Impact of Microplastics on the Biodegradation of Pharmaceuticals and the Microbial Population in Aquatic Environments.** *F. Ali Ahmad and D.A. Salam.* Farah Ali Ahmad (American University of Beirut/Lebanon)	D3. Biobarrier Implementation and Management **Methanotrophic Biobarrier (MBB): Pilot Testing a Solution for Methane Emissions from Abandoned Wells.** *M. Olson, A.J. Rhoades, T. Sale, K. Karimi Askarani, K. Walker, and T. McGuire.* Mitchell Olson (Colorado State University/United States)	
8:50	A4. Activated Carbon-Based PFAS Treatment Technologies **Chemometric and Matrix Back Diffusion Analysis of PFAS Compounds following Colloidal Activated Carbon Injection.** *M.E. Garcia, G. Kusel, J. Gootee, M. Zenker, J. Ceather, D. Johansen, and N. Darre.* Megan Garcia (AECOM/United States)	**Use of OIP, MIP, HPT/EC HRSC and Quantitative Tools in Remedial Design Characterization for Bioremediation Projects.** *J. Fontana.* John Fontana (Vista GeoScience/United States)	**Unveiling the Adaptive Potential of *Bacillus inaquosorum* (EC30O5B-F5) for NanoplasticDegradation and Sustainable Agriculture.** *F.A. Olabemiwo, S. Mangelsdorf, S. Greisner, C. Edwards, F.M. Cohan, and P. Arevalo.* Fatai Olabemiwo (Wesleyan University/United States)	**Optimizing In Situ Treatment Barriers: An Adaptive Strategy for a Superfund Site.** *B. Yezuita, M. Lamar, T. Macbeth, M. Renko, M.B. Smith, J. Vincent, and K. Caldwell.* Benjamin Yezuita (CDM Smith/United States)	
9:15	**Rapid and Inexpensive Delivery of Activated Carbon for In Situ Sorption of PFAS in Groundwater.** *S.D. Richardson, B. Langan, M. Mathioudakis, M.L. Schofield, K.J. Kearney, J. Kolz, M. Singletary, K.F. Welch, S.E. Clay, and C. Powell.* Stephen Richardson (GSI Environmental Inc/United States)	**Mapping Hydraulic Connectivity in Fractured Bedrock to Enhance Bioremediation Efficacy.** *K.J. Warner and L. Mastera.* Kevin Warner (ERM/United States)	**Occurrence and Removal of Microplastics by Advanced and Conventional Drinking Water Treatment Facilities.** *C. Balkenbusch, M. Jung, Y. Wu, K. Munno, J. Glienke, H. Almuhtaram, and R. Andrews.* Chuck Balkenbusch (Burns & McDonnell/United States)	**Successful Synergistic Abiotic and Biotic Remediation of a Chlorinated Solvent Plume Using a mZVI PRB.** *A. Przepiora, N. Durant, D. Eberle, T. Jørgensen, C.L. Jensen, and O. Mikkelsen.* Dylan Eberle (Geosyntec/United States)	
9:40	**Over Three Years of Data from a Large Full-Scale Colloidal Activated Carbon PFAS Groundwater Remedy.** *R. Mora, J. Buzzell, R. Moore, K.M. Gaskill, and J. Birnstingl.* Keith Gaskill (REGENESIS/United States)	SESSION BREAK	SESSION BREAK	**Bugs to the Rescue: Building a Biobarrier for Managing the Influx of Heavily Contaminated CVOC-Impacted Groundwater from Unknown Off-Site Source(s).** *P. Patel.* Paresh Patel (Pinchin Ltd./Canada)	SESSION BREAK
10:05	SESSION BREAK	B5. **Optimizing Long-Term Groundwater Monitoring Programs Using the New MAROS Web App.** *N. Goodkind, L. Beckley, B. Sackmann, B. Actkinson, and C.J. Newell.* Noah Goodkind (GSI Environmental Inc./United States)	C5. **Biodeconstruction of Polyethylene by Enzymes and Microbial Communities from the Gut of Yellow Mealworms.** *R. Klauer, J. Ott, A. Hansen, N. Miller, K. Solomon, and M. Blenner.* Mark Blenner (University of Delaware/United States)	SESSION BREAK	E5. **Application of a Modified Activated Carbon-Based Injectate to Manage and Remediate LNAPL.** *M.C. Mazzarese.* Michael Mazzarese (AST Environmental, Inc./United States)

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
10:30	A5. SERDP & ESTCP Efforts on PFAS Biological Transformation and Remediation **Unraveling PFAS Biodegradability: New Discoveries and Challenges.** *J. Liu, D. Wang, J. Zhang, A.S. Dey, J. Van Hamme, N. Perreault, S.M. Rosolina, and F.E. Loeffler.* Jinxia Liu (McGill University/Canada)	B5. Tools for Site Assessment and Bioremediation Monitoring **Integrating Passive Flux Data for an Innovative PRB Design at an Operational Shopping Plaza.** *K. Seymour, A. Miller, M.P. Raffoni, and M.A. Dooley.* Maureen Dooley (REGENESIS/ United States)	C5. Biodegradation and Upcycling of Plastics **High Throughput Mass Spectrometric Screening of Polyamide Hydrolases to Identify Substrate and Product Selectivity.** *J.F. Cahill, E.E. Drufva, C. Bourgery, V. Bocharova, V. Kertesz, D.L. Carper, I.T. Dishner, J. Foster, D.P. Vasileva, L.H. Hochanadel, L. Qian, S.H. Chen, and J.K. Michener.* John Cahill (Oak Ridge National Laboratory/United States)	D4. Challenges in Application of Bioremediation Tools **Evaluating In Situ Carbon Tetrachloride Remediation: Insights from Diverse Performance Monitoring Tools.** *D.F. Alden, G.M. Birk, C. Scales, and R. Baumann.* David Alden (Tersus Environmental/ United States)	E5. Optimization of Classical Bioremediation Technologies **Full-Scale Application in Italy of an ERD Technology for the Treatment of an Aquifer Impacted with Chlorocarbons Near a Salt Pond Ecosystem.** *A. Leombruni, M. Mueller, and D. Leigh.* Alberto Leombruni (Evonik Operations GmbH/Italy)
10:55	**An Unexpected Sink of Organofluorine: Covalent Incorporation of Polyfluoroalkyl Substances into Bacterial Lipid Bilayers.** *F.E. Loeffler, D. Ramirez, B.M. Wong, G. Chen, Y. Xie, M.J. Keller, and R.L. Hettich.* Frank Loeffler (University of Tennessee, Knoxville/United States)	**Analysis of PFAS: Are We Missing Anything with Standard Methods?** *J. Thorn.* Jonathan Thorn (Eurofins Environment Testing [USA]/United States)	**Effect of Nylon-6 Crystallinity on its Enzymatic Depolymerization.** *A. Frank, J. Lilly, E. Bell, and K.H. Kucharzyk.* Kate Kucharzyk (Battelle/United States)	**Using Innovation to Jump Hurdles When Employing Molecular Biological Tools.** *S.M. Rosolina, D.M. Taggart, and K. Osei.* Sam Rosolina (Microbial Insights, Inc./United States)	**Robustness of Combined Process for Trichloroethylene-Contaminated Aquifers, Employing Waste Material as Sorbent and Electron Donor.** *M. Abruzzese, L. Lorini, B. Matturro, and M. Petrangeli Papini.* Micaela Abruzzese (Sapienza University of Rome/Italy)
11:20	**Biotransformation of Per- and Polyfluoroalkyl Substances (PFAS) Precursors by Fungi Isolated from Impacted Sites.** *A. Connolly, A. Banerjee, K. Sorenson, Jr., M. Shreve, L. Bagdonas, S. Balaban, S. Mahendra, K. Shah, J. Park, H. Bose, I.Y. Kwok, and H. Wyner.* Allison Connolly (Allonnia/United States)	**Practical Applications of Lysimeters within a Regulatory Framework and Lessons Learned.** *K.H. Hasbrouck, A. Getchell, and B. Rudd* Kristen Hasbrouck (ERM/United States)	**Towards the Discovery of C-C Backbone Plastic Degrading Enzymes and Microorganisms.** *K.H. Hasbrouck, A. Getchell, and B. Rudd.* Ariel Tastassa (University of Toronto/ Canada)	**Reexamining Inconsistency between Microbial Testing Data and Other Biodegradation Indicators Observed at a Petroleum Cleanup Site.** *S. Stromberg and K.A. Waldron.* Scott Stromberg (Orion Environmental Inc./United States)	**A Holistic Approach to Site Remediation: A Decade of Integrated In Situ Remedies for Multiple AOCs in a Commercial Setting.** *C. Redfern, G. Angyal, and R.S. Srirangam.* Christine Redfern (Ramboll/United States)
11:45	**Study of PFAS Precursors Transformation Using In Situ Microcosms.** *J.Z. Xiong.* John Xiong (Haley & Aldrich, Inc./ United States)	**Long-Read Sequencing Technologies: Advantages, Applications, and Functional Prediction for In Situ Bioremediation.** *B. Matturro, S. Rossetti, L. Niccolini, A. Firrincieli, M. Petruccioli, and M. Cappelletti.* Bruna Matturro (Water Research Institute, IRSA-CNR/Italy)	SESSION BREAK	**Application of an All-in-One Technology for a Combined Bioremediation and ISCO Treatment of a Commingled Source Area at a Former Pharmaceutical Facility.** *A. Leombruni, M. Mueller, and B. Smith.* Alberto Leombruni (Evonik Operations GmbH/Italy)	SESSION BREAK
12:10	SESSION BREAK	SESSION BREAK		**Identification of Benzene Activation Enzymes in a Methanogenic Enrichment Culture.** *C. Toth, O. Molenda, C. Nesbø, F. Luo, C. Devine, X. Chen, K. Wu, X. Johnny, R. Puri, S. Guo, N. Bawa, and E.A. Edwards.* Courtney Toth (University of Toronto/ Canada)	
12:35				SESSION BREAK	

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
1:00	SESSION BREAK	SESSION BREAK	**Microbial Communities and Adaptations in an In Situ Field-Scale Mine Drainage Treatment Bioreactor.** *L.H. Olson, Y. Fan, J. Zhou, K. De León, and R. Nairn.* Leif Olson (The University of Oklahoma/United States)	SESSION BREAK	**Nanomaterial-Enhanced PFAS Phytoremediation.** *J.C. White, R. Lewis, C. Huang, C. Haynes, S.L. Nason, Z.C. Nubia, and V. Vasiliou.* Jason White (The Connecticut Agricultural Experiment Station/ United States)
1:25	**Application of Multiple Chemical Analytical Techniques for Forensic Analysis of PFAS Sources to Fingerprint PFAS and Identify their Plumes.** I*.F. Ross and N.J. Gonda.* Ian Ross (CDM Smith/United States)	**Evaluating Electrical Resistivity for Monitoring Sulfate-Enhanced Biodegradation.** *J. Massey, T. Halihan, N. Igwebuike, K. Sra, and R.V. Kolhatkar.* Jordon Massey (Oklahoma State University/United States)	**Treatment of Mining-Impacted Waters Using Biological Sulfate Reduction and Direct Reduced Iron Pellets.** *W. Newman and J.J. Hanson.* William Newman (RNAS Remediation Products/United States)		**The Phytoremediation of Road Salts Using Halophytes and Their Bacterial Endophyte Communities.** *A. Chiasson, B.A. Zeeb, L. Nawroth, and J.M. Hazell.* Amanda Chiasson (Queen's University/Canada)
1:50	**Key Design Considerations for PFAS Soil Investigations: Forensic Evaluation with Standard Lab Methods.** *C.R. Fath, B. Angerman, and J. Dippert.* Casy Fath (Barr Engineering Co./ United States)	**Quantity Produces Quality: The Case for Ensembles of Screening Models for PFAS in the Vadose Zone.** *J. Stults, T. Macbeth, and B. Guo.* John Stults (CDM Smith/United States)	**Using Microbially-Derived Solvents (Bio-Solvents) to Selectively Solubilize Impurities from Diverse Mining Substrates.** *M. Albright, B.N. Cruz, C. Zimmermann, N. Vereshchuk, D. Stigers, K. Sorenson, Jr., D. Saran, and K. Radloff.* Michaeline Albright (Allonnia/United States)	**Synergistic Destruction of TCE DNAPL and Plume Using Emulsified Zero Valent Iron and ZVI PRBs.** *S. Rathmell.* Sylvia Rathmell (Woodard & Curran/ United States)	**Comprehensive Monitoring of a Phytoremediation System Using Advanced Methods.** *M. Poltorak, D. Collins, and K.A. Waldron.* Matthew Poltorak (Stantec/United States)
2:15	**Conventional and Novel Approaches to Identify/Distinguish PFAS Sources and Evaluate their Fate and Transport.** *H. Singh, L. Idleman, K. Engle, S. Rice, and M. Duley.* Lauren Idleman (Oneida ESC Group/ United States)	**Reactive Transport Kinetic Schemes for PFAS.** *C. Johnson.* Christian Johnson (Pacific Northwest National Laboratory/United States)	**Valorization of Acid Mine Drainage Impacted Waters through Protein-Enabled Rare Earth Element (REE) Extraction.** *K. Radloff, M. Albright, A. Banerjee, E. Costa, D. Stigers, D. Saran, and K. Sorenson, Jr.* Dayal Saran (Allonnia/United States)	**Innovative Bioremediation Approach for Wood Treating Site Cleanup Using Groundwater Recirculation, Oxygenation, and Nitrate Reduction.** *K. Moore, T. Veselka, E. Mott-Smith, and K. Ogunsusi.* Kevin Moore (ETEC, Inc./United States)	**Use of Phytoremediation to Enhance In Situ Stabilization of PFAS: Lessons Learned at Three Years.** *L. Mankowski and J. Adams.* Len Mankowski (WSP/United States)
2:40	**Decoding PFAS: Advanced PFAS Fingerprinting for Source Differentiation.** *J. Zenobio, M. Fulkerson, A. Forsberg, and D. Chiang.* Dora Chiang (Jacobs/United States)	**Applying State-of-the-Practice Tools to Determine the Presence and Transport of PFAS at a Former Air Force Base.** *R. Samuels.* Ryan Samuels (AECOM/United States)	**Weak-Affinity Calcium-Binding Proteins for Facile Separation of Rare-Earth Elements.** *B.S. Heater, D. Marzolf, J.S. Picking, S. Higgins, F. Castillo, M. Rowley, K.H. Kucharzyk, F. Khoury, and S. Banta.* Bradley Heater (Battelle/United States)	**In Situ Adsorption Technologies Successfully Addresses Large and Dilute CVOC Plumes at a Superfund Site.** *A. Miller, E. Maker, and S. Lorden.* Alana Miller (REGENESIS/United States)	SESSION BREAK
3:05	**Considerations for PFAS Forensics: From PFAS Sources, to Analytical Methods, to a Conceptual Site Model.** *M.J. Benotti and T. Schwichtenberg.* Mark Benotti (New Fields/United States)	**Lessons from Building Three Stratigraphically Complex Groundwater Flow Models.** *J. Brandenburg.* JP Brandenburg (Barr Engineering/ United States)	**Evolving Calmodulin Affinity to REEs Using Phage-Assisted Continuous Evolution.** *F. Khoury, X. Hu, S. Abeyarthna, M.A. Herishko, B.S. Heater, K.H. Kucharzyk, and S. Banta.* Farid Khoury (Columbia University/ United States)	**Reductive Dechlorination of Multi-Acre CVOC Plume in Overburden and Bedrock to Support Site Redevelopment.** *P.M. Dombrowski, P. Kakarla, M. Temple, J. Kazanjian, and P. Downham.* Paul Dombrowski (ISOTEC Remediation Technologies/United States)	**TISR® to Enhance Biotic and Abiotic Reactions and Accelerate Remediation Timeframes.** *S. Justicia-León, C. Divine, J. Munholland, J. Vidonish, E.A. Zardouzian, D.L. Freedman, and R.W. Falta.* Shandra Justicia-León (Arcadis/ Puerto Rico)

A6. PFAS Source and Forensic Considerations

B6. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation

C6. Biotechnology for Sustainable Mining

D5. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes

E6. Phytoremediation

E7.

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
3:30	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	**Leveraging Synergistic In Situ Abiotic and Biotic Remediation Processes in Groundwater following Thermal Remediation at Three Sites.** *L. Hellerich, C. Rockwell, D. Collins, and K. Lauer.* Lucas Hellerich (Woodard & Curran, Inc./United States)
3:55	A6. PFAS Source and Forensic Considerations **Branched and Linear PFAS Isomers: A Tool for Identifying PFAS Manufacturing Sources in the Environment?** *J. Pietari, R. Mozumder, and B. Drollette.* Jaana Pietari (Ramboll/United States)	B7. Improved Conceptual Site Models that Include Molecular Biological Data **Natural Attenuation Road Map: From "Do Nothing" to Using Innovative Tools to Support Natural Attenuation Evaluations.** *D. Gray.* Doug Gray (AECOM/United States)	Panel Discussuon **PANEL DISCUSSION** **Synthetic Biology Applications and Challenges to Commercialization** **Moderators** Bradley Heater (Battelle) Kate Kucharzyk (Battelle) **Panelists** Hunter Anderson (Noblis) Elizabeth Edwards (University of Toronto) Wendy Goodson (Battelle) Timothy Miller (AV) Kent Sorenson, Jr. (Allonnia) Dora Taggart (Microbial Insights, Inc.)	D6. Impacts of Mixed Contaminants on Biodegradation **Application of Bioremediation Strategies at Complex Mixed Contaminant Sites.** *C. Scales, J. Roberts, P.C. Dennis, and S. Dworatzek.* Jeff Roberts (SiREM/Canada)	E7. Advances in Heat-Enhanced Bioremediation **Advances in Heat-Enhanced Reductive Bioremediation.** *D.F. Alden, G.M. Birk, M. Healey, and J. Sankey.* Gary Birk (Tersus Environmental/ United States)
4:20	**Application of High-Resolution Mass Spectral and Advanced Statistical Tools for PFAS Forensic Analysis.** *K. Dasu, C.W. Orth, L. Mullins, D. Friedenberg, and D.W. Longbrake.* Daniel Longbrake (Battelle Memorial Institute/United States)	**Applications of Molecular Biological Data to Facilitate Real Estate Transactions.** *M. Burns and J.E. Odencrantz.* Matt Burns (WSP/United States)		**Identifying and Overcoming Impediments to Bioremediation: Keys to Successful Remediation of a Mixed Contaminant Plume.** *P. Lepczyk, C. Weber, and D. Lingle.* Peter Lepczyk (Fishbeck/United States)	**Evaluating ISTR Influence on a Passive EISB Biobarrier: A Multi-Faceted Approach to Mitigate CVOC Impacts to Surface Water on an Accelerated Timeline.** *C. Redfern, R.S. Srirangam, and G. Angyal.* Christine Redfern (Ramboll/United States)
4:45	**Temporal Dynamics of Target and Non-Target PFAS in Agricultural Soils Over Two Years.** *B. Su and M. Li.* Boyuan Su (New Jersey Institute of Technology/United States)	**Using Microbial Data to Underpin a Strategic Shift in a Site Cleanup.** *J.R. Stening, J.S. Konzuk, C. Cheyne, and M. Lee.* James Stening (Orica Australia Pty Ltd/Australia)		**In Situ Bioremediation of 1,4-Dioxane in Mixed Plume with Cycled Anaerobic and Aerobic Metabolic Bioaugmentation and Cometabolism.** *F. Krembs, K. McDonald, M.A. Settembrino, A. Hopper, and S. Dworatzek.* Fritz Krembs (Trihydro Corporation/ United States)	**Twinning TISR: A 'Hot' Take on Digital Design and Monitoring for Sustainable Heat-Enhanced Bioremediation.** *J. Munholland.* Jonah Munholland (Arcadis/United States)
5:10	**Explainable AI (XAI) for Understanding PFAS Distributions at Landfill, Refinery/Terminal, Chrome Plating, and Airport Sites.** *U. Vedagiri, S. Sorsby, and D. Lay.* Skyler Sorsby (WSP/United States)	**Using qPCR Data on the bssA Biomarker to Select Appropriate Rate Constants for Biodegradation of Toluene in Groundwater.** *J.T. Wilson, G. Pilloni, T.A. Key, D.M. Taggart, and S.M. Rosolina.* John Wilson (Scissortail Environmental Solutions, LLC/United States)		**Multiomics Assessment of Natural Attenuation of 1,4-Dioxane and CVOC Mixtures.** *S. Mahendra, H. Bose, I.Y. Kwok, and S. Ray.* Himadri Bose (University of California, Los Angeles/United States)	**Effect of Low Temperature Heating on Rates of TCE Dechlorination.** *D.L. Freedman, N. Cotter, C. Divine, and S. Justicia-León.* David Freedman (Clemson University/United States)

5:45-7:00 p.m. POSTER GROUP 2 PRESENTATIONS AND RECEPTION (Exhibit Hall—Liberty/Grand/Republic Ballrooms)

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
8:00	Panel Discussion **PANEL DISCUSSION** **Barriers to the Selection and Implementation of Biotechnical Solutions** **Moderator** Ian Brookman (Environmental Earth Sciences International) **Panelists** David Freedman (Clemson University) Barry Harding (AECOM) James Stening (Orica Australia Pty Ltd) John Wilson (Scissortail Environmental Solutions, LLC)	B8. HRSC and Conceptual Site Models **Incorporating High-Resolution Data into a Digital Platform to Understand DNAPL within the Complex Hydrogeology of an Enhanced Reductive Dechlorination Site.** *K. Yarberry, P. Favara, and K. Simmons.* Kim-Lee Yarberry (Jacobs/United States)	C7. Biocementation **Enhancing Porous Building Materials Using Biocementation Techniques.** *B. Nagy, P. Hanisch, M. Pechtl, B. Enogieru, C. Eulenkamp, R. Huber, and A. Kustermann.* Brigitte Nagy (Munich University of Applied Sciences HM/Germany)	D7. Bioremediation in Complex Geological Settings **Reductive Dechlorination with Concurrent Sequestration of PFAS and 1,4-Dioxane in a Large Commingled Plume at a Former Manufacturing Facility.** *M.C. Mazzarese and R. Vaske.* Michael Mazzarese (AST Environmental, Inc./United States)	E8. Understanding the Microbiome **25 Years of Groundwater Bioremediation Omics.** *P.A. Guerra and R. Reiss.* Peter Guerra (Lynker/United States)
8:25		**Looking at NAPL in the Eye: Non-Destructive Testing to Measure NAPL Soil Distributions.** *J. Zimbron.* Julio Zimbron (E-Flux/United States)	**Production and Stabilization of *Sporosarcina pasteurii* Using Encapsulation and Cryo-Protection Approaches.** *F. Kara Murdoch, S. Agler, C. Hinton, C. Hart, V. Fulwider, M. Gupta, R. Martineau, M. Carter, and K.H. Kucharzyk.* Fadime Kara Murdoch (Battelle/United States)	**Reactive Longevity and Permanence of a Microscale Zero Valent Iron Remedy to Treat a Chlorinated Solvent Source Area in Clay Till: Results from Ten Years of Performance Monitoring.** *D. Eberle, N. Durant, M. Dreyer, T. Jørgensen, K. Rügge, N. Tuxen, and A. Przepiora.* Dylan Eberle (Geosyntec/United States)	**Microbe Interactions with Environmental Variables in Hydrocarbon Polluted Mangrove Swamp of Niger Delta Region, Nigeria.** *V.I. Obidiugwu and C.C. Nwankwo.* Victor Obidiugwu (University of Port Harcourt/Nigeria)
8:50		**Deployment of Multiple High-Resolution Site Characterization Tools to Identify Preferential Flow Pathways in Fractured Bedrock.** *R. Henson, J. Mark, and J. Farmer.* Richard Henson (Environmental Resources Management, Inc./United States)	**The Impact of Various Additives on Bacterial Adsorption, Ammonia Removal, and Compressive Strength for MICP.** *P. Hanisch, M. Pechtl, B. Nagy, C. Eulenkamp, S. Bischoff, A. Kustermann, H. Maurer, F. Maier, and R. Huber.* Patrick Hanisch (Munich University of Applied Sciences HM/Germany)	**Enhancing Permeability for Groundwater Recirculation and Bioremediation of BTEX and MTBE in Clayey Silt and Bedrock.** *E. Bueltel, J. Midwig, and K. Moore.* Eric Bueltel (ETEC, Inc./United States)	**Genomic Goldmine: Fungal Genes Revolutionizing Greentech.** *E. Deyett, M. Shreve, A. Banerjee, K. Sorenson, Jr., K. Shah, and S. Mahendra.* Elizabeth Deyett (Allonnia/United States)
9:15		**Let's Get Petro-Physical.** *S. Urban, C. Plank, M. Shultz, and R. Cramer.* Stone Urban (Geosyntec/United States)	**Mainstreaming Precast and Block Hempcrete: A Carbon Sequesturing Solution for the Built Environment.** *P.A. Gibson.* Pandwe Gibson (EcoTech Visions/ United States)	**Pre-Drill Emplacement of a Bio-Enhanced Carbon Reagent at a Heavily Impacted Retail Station with Challenging Geology.** *W. Caldicott, T. Musser, B. Hasty, P. Gallagher, and K. Gombosi.* Krystian Gombosi (ISOTEC Remediation Technologies/United States)	**EcoGenoRisk: High Performance Computing for Synthetic Biology Invasion and Cross Biome Functional Modeling.** *J.T. Docter and C. Mansfeldt.* John Docter (University of Colorado, Boulder/United States)
9:40	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	**Environmental Conditions Shaping Dechlorinating Microbial Communities: A Case Study on Biostimulation and Bioaugmentation in Chlorinated Solvent-Contaminated Groundwater.** *B. Matturro, S. Rossetti, L. Niccolini, M. Zeppilli, L. Lorini, G. Sassetto, M. Presutti, and M. Petrangeli Papini.* Bruna Matturro (Water Research Institute, IRSA-CNR/Italy)
10:05	A7. **Setting the Stage for PFAS Biosolutions.** *B. Dahlgren and S. Thomas.* Bryon Dahlgren (Battelle/United States)	B9. **Evaluating MNA at a Large, Complex Site Using Groundwater CSIA Data.** *C. Cheyne, J.S. Konzuk, L. D'Agostino, and J.R. Stening.* James Stening (Orica Australia Pty Ltd/Australia)	C8. **Understanding the Environmental Footprint: Tracking a Project from Concept to Completion.** *H.F. Nichols and S. Pantazis.* Howard Nichols (TRC Environmental/ United States)	D7. **Appropriate Use of Molecular Biological Tools in a Complex Geological Setting Can Improve Site Decisions.** *D.M. Taggart, S.M. Rosolina, and S.K. Kalule.* Dora Taggart (Microbial Insights, Inc./ United States)	SESSION BREAK

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
10:30	A7. Managing PFAS Regulatory Uncertainty in Response Actions **Implications of Class-Based PFAS Policy for Regulating Contaminated Sites.** *B. Bani, B. DiGuiseppi, K. Bowles, and J. Thrasher.* Bahman Bani (Jacobs/Canada)	B9. Advances in Tools and Techniques for Assessing MNA **Transition to Monitored Natural Attenuation After 30 Years of Pump and Treat at the Former Uniroyal Site in Edmonton, Alberta.** *J. Ricker.* Joe Ricker (WSP/United States)	C8. Energy and Greenhouse Gas Footprint of Bioremediation **Assessment of Environmental Footprints for Per- and Polyfluoroalkyl Substances (PFAS) Treatment Technologies for Liquids and Solids.** *P. Molzahn, B. Collins, B. DiGuiseppi, P. Favara, and N. Fitzgerald.* Paige Molzahn (Jacobs/United States)	D7. Bioremediation in Complex Geological Settings **In Situ Bioremediation of Chlorinated Ethenes in Epikarst Groundwater.** *J. Tillotson, U. Tulsiani, and K. White.* Jason Tillotson (Arcadis US, Inc./ United States)	E9. Novel Sensing Technologies **In-Field Demonstration of FRED-PFAS: A Novel, Portable Field Sensor for Rapid PFAS Measurement Onsite.** *S. Chaudhuri, J. Guegueniat, M.M. Renaud-Young, S. Stietz, M. McDonald, and E. Hicks.* Emily Hicks (FREDsense Technologies Corp./Canada)
10:55	**Optimized Treatment Train for Removing PFAS from High Concentration Stormwater.** *R. Mora, M.R. Riley, and P. Tacy.* Rosa Gwinn (AECOM/United States)	**Attenuation of a Mixed Organic Contaminant Plume in Sedimentary Rock.** *G.T. Hook, J.R. Meyer, R.A. Aravena, C. Swift, F.E. Loeffler, and B. Parker.* Glen Hook (ERM/Morwick G360/ United States)	**Sustainable In Situ Bioremediation in Bedrock and Quantifying Actual Footprint Reduction with SiteWise™.** *P.M. Dombrowski, P. Kakarla, M. Temple, and D. Raymond.* Paul Dombrowski (ISOTEC Remediation Technologies/United States)	**Targeted TCE DNAPL Recovery from a Complex Bedrock Aquifer: Field and Laboratory Studies.** *M. Healey, D.F. Alden, G.M. Birk, S. Sharma, and C. Staples.* Charles Staples (WSP/United States)	**LAMP-PCR Based Biosensor for Identification of Contaminants and Biodegradation Pathways.** *K. Sulich, H. Shih, and E.M. Hénaff.* Karolina Sulich (NYU Tandon School of Engineering/United States)
11:20	**Determining PFAA Plume Stability Condition Quickly and Efficiently.** *T.E. McHugh, D.T. Adamson, B. Actkinson, and C.J. Newell.* Thomas McHugh (GSI Environmental/United States)	**Methanotrophic Biodegradation and Natural Attenuation of Chlorinated Solvents under Acidic Conditions.** *P.B. Hatzinger, K.B. Chu, R. Rezes, D.L. Freedman, J. Chung, and N.A. Szwast.* Paul Hatzinger (APTIM/United States)	**Assessing Resiliency to Climate Change at Two Coastal Chemical Sites in Colombia Preparing for Sustainable and Resilient Remedy Selection.** *K.A. Morris.* Kevin Morris (ERM/United States)	**Challenges and Solutions for Enhanced In Situ Bioremediation in Low Permeability Groundwater.** *L.T. LaPat-Polasko, B. Hoagland Stamatovski, A.T. Nagle, and H.T. Brenton.* Bridget Hoagland Stamatovski (Matrix New World Engineering/ United States)	**Versatile Genetic Recombination Circuits for Synthetic Biology Applications and Arsenite Sensing Using *Escherichia coli*.** *E. Garabello, H. Yoon, M.C. Reid, and A. Giometto.* Elisa Garabello (Cornell University/ United States)
11:45					
12:10	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK	SESSION BREAK
12:35					

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

	A SESSIONS Independence Ballroom	B SESSIONS Back Bay A	C SESSIONS Back Bay B	D SESSIONS Back Bay C	E SESSIONS Back Bay D
1:00	**Development and Scale-Up of Continuous, Advanced Reduction Processes (CARPs) for Remediation of Wastewater.** *V.G. Yadav.* Vikramaditya Yadav (The University of British Columbia/Canada)	**Understanding the Spreading of a Complex Multi-Component Contamination to the North Sea from a Danish Megasite.** *B. Gerdmundsson, F. Solano, L.K. MacKinnon, N. Durant, J. Sørensen, K. Mortensen, T. Jørgensen, and T.H. Jensen.* Felipe Solano (Geosyntec Consultants/Canada)	**Remediation Site Portfolio Quantification and Performance Tracking to Achieve GSR Policy Shifts.** *H.F. Nichols and S. Pantazis.* Howard Nichols (TRC Environmental/ United States)	**The Time Has Come: Case Studies of Petroleum Hydrocarbon Bioremediation Using Anaerobic Bioaugmentation Cultures.** *J. Roberts, S. Dworatzek, C. Scales, J. Webb, E.A. Edwards, and C. Toth.* Jeff Roberts (SiREM/Canada)	**Biochemical Treatment of Organic Explosive Compounds in Soil and Sediment at U.S. Military Sites.** *A.G. Seech, E.D. Meeks, S.M. Larew, J. Valkenburg, and S. Telesz.* Alan Seech (Evonik Corporation/ United States)
1:25	**Optimizing Nitrogen Remediation Approaches with Anaerobic Ammonium Oxidation (Anammox).** *B.K. Lazenby and P.C. Dennis.* Brent Lazenby (Geosyntec Consultants, Inc./United States)	**Functional Equivalence: The Increasing Importance of Groundwater-Surface Water Evaluations in Light of the Recent SCOTUS Maui Decision.** *M. Mathioudakis, J.M. Skaggs, and A.I. El-Kadi.* Michael Mathioudakis (GSI Environmental Inc./United States)	**Remediation of the Mystic River Boathouse Park Shoreline Parcel.** *J.M. Brogden, D. Byttautas, and Y. Zhang.* John Brogden (AECOM/United States)	**Full-Scale Enhanced In Situ Bioremediation and Chemical Reduction of Chlorinated Ethenes in Groundwater.** *L.T. LaPat-Polasko, E.J. Huss, R.D. Britton, and M. Heye.* Laurie LaPat-Polasko (Matrix New World Engineering/United States)	**In Situ Bioremediation of Perchlorate in Vadose Zone.** *T. Perina, S. Boudreau, P.B. Hatzinger, R.E. Mayer, A. Poach, and M. Hauv.* Tomas Perina (APTIM/United States)
1:50	**Electric Microbes for Wastewater and Fuel Cell Applications.** *A. Boghossian.* Ardemis Boghossian (Ecole Polytechnique Federale de Lausanne [EPFL]/Switzerland)	**Lessons Learned from Updating a Conceptual Site Model to Incorporate the Interaction between Topography, Surface Water, and Groundwater at a Chlorinated Solvent Release Site.** *W.A. Foss, P. Srivastav, and R.E. Mayer.* William Foss (APTIM Federal Services, LLC/United States)	**Enhancement of Passive Soil-Vapor Extraction (PSVE) via Renewable Energy in Northern Michigan Climate.** *G.G. Austin and C.K. Foutch.* Clara Foutch (AECOM/United States)	**A Multi-Site Evaluation of High Concentration CVOC Source Treatments Using In Situ Chemical Reduction (ISCR) and Enhanced Reductive Dechlorination (ERD).** *D. Nunez and C. Lee.* Daniel Nunez (REGENESIS/United States)	**Optimization of In Situ Anaerobic Bioremediation for Source Zone and Barrier Treatment of Perchlorate in Groundwater.** *S. Moore, C. Scala, M. Singletary, and B. Kissam.* Samuel Moore (Battelle/United States)
2:15	**Battelle GreenLoop™: Combining Chemical and Biological Upcycling of Mixed Textile and Packaging Waste to Biopolymers.** *W.R. Henson, J. Lilly, and M. Moore.* William Henson (Battelle Memorial Institute/United States)	**Mitigating LNAPL Migration to Adjacent Surface Water Bodies Using Regenerative PRBs.** *D. Pizarro and N. Thacker.* Derek Pizarro (AST Environmental, Inc./United States)	**Using Groundwater Recirculation for Sustainable Chlorinated Solvent Remediation and Water Reuse.** *E. Bueltel and K. Moore.* Eric Bueltel (ETEC, Inc./United States)	**Full-Scale Application of ERD following ISCO/S-ISCO® for Treatment of NAPL Pharmaceutical Waste Mixture.** *F. Solano, L.K. MacKinnon, N. Durant, T. Jørgensen, B. Gerdmundsson, J. Sørensen, K. Mortensen, and J. Christensen.* Felipe Solano (Geosyntec Consultants/Canada)	**Application of Molecular Tools for Monitoring RDX Bioremediation and Estimating Degradation Rates.** *F. Kara Murdoch, R.W. Murdoch, S. Higgins, A. Hill, L. Mullins, M. Fuller, M.J. Gander, A. Danko, and K.H. Kucharzyk.* Kate Kucharzyk (Battelle/United States)

A8. Advances in Biological Wastewater Treatment

B10. Groundwater/Surface Water Interactions

C9. Strategies to Mitigate Climate Change Impacts

D8. Bioremediation Case Studies

E10. Bioremediation of Munitions Constituents

3:00-4:00 p.m.—CLOSING PANEL DISCUSSION (Independence Ballroom)

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

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SiREM provides products and services for site remediation and monitoring for sites across the globe. We currently have laboratories in Guelph, Ontario and Knoxville, TN where we perform treatability testing for groundwater, wastewater, soil, and other matrices for a variety of remedial technologies and site contaminants. We provide molecular genetic testing under our Gene-Trac trademark, which includes both targeted testing and next generation sequencing for microbial community characterization. We grow bacterial cultures to degrade a variety of contaminants including chlorinated solvents, BTEX, and 1,4-dioxane that are used at sites all over the world. We also manufacture passive samplers for applications for sediment pore water investigations and soil gas/sub-slab applications. We pride ourselves on providing innovative solutions to complex challenges and work closely with clients to develop custom solutions and support the interpretation of data, ensuring they derive the maximum value from their results. **siremlab.com**

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MONDAY, June 23	TUESDAY, June 24	WEDNESDAY, June 25	THURSDAY, June 263
7:00-8:00 a.m. —Morning Course Check-In 12:00-1:00 p.m. —Afternoon Course Check-In 2:00-8:30 p.m. —Symposium Registration Open	7:00 a.m.-7:00 p.m.—Registration, Exhibits, Poster Group 1 Display 7:00-8:00 a.m.—Breakfast 9:30-10:00 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch 3:00-3:30 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 9:30-10:00 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch 3:00-3:30 p.m.—PM Beverage Break	7:00 a.m.-4:00 p.m.—Registration 7:00 a.m.-1:00 p.m.—Exhibits, Poster Group 2 Display 7:00-8:00 a.m. —Breakfast 9:30-10:00 a.m.—AM Beverage Break 11:30 a.m.-1:00 p.m.—Lunch
8:00 a.m.-5:00 p.m.	**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 **Indicates a "**laptop-required**" course.* **Limited onsite Short Course registration may be available. Come to the 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. Attendance will be taken in the room by the Instructors.** **8:00 a.m.-12:00 p.m.** • Technology Selection: Matching Key Contaminant Characteristics and Hydrogeology with Technology Attributes **1:00-5:00 p.m.** • *Quantitative Tools for Nature-Based Solutions • *The TA2 Tool and MAROS: Two New Tools for Managing and Transitioning Contaminated Groundwater Sites **Student & Young Professional Event** See page 11 for room assignment. **3:00-5:00 p.m.** • Career KickStarter	A1. Innovative Treatment Technologies for PFAS In Situ A2. Managing PFAS in Biosolids: Exploring Detection, Fate, and Bioremediation Potential in Wastewater Treatment Plants A3. Innovative Treatment Technologies for PFAS Ex Situ	A4. Activated Carbon-Based PFAS Treatment Technologies A5. SERDP & ESTCP Efforts on PFAS Biological Transformation and Remediation A6. PFAS Source and Forensic Considerations	**Panel:** Barriers to the Selection and Implementation of Biotechnical Solutions A7. Managing PFAS Regulatory Uncertainty in Response Action A8. Advances in Biological Wastewater Treatment
	B1. Remediation and Management of Petroleum Hydrocarbon-Contaminated Sites B2. Natural Source Zone Depletion B3. Tools for Assessing Contaminant Sources and Fate	B4. HRSC for Robust CSM and Decision-Making B5. Tools for Site Assessment and Bioremediation Monitoring B6. Modeling and Monitoring Approaches to Improve Remedy Design and Implementation B7. Improved Conceptual Site Models that Include Molecular Biological Data	B8. HRSC and Conceptual Site Models B9. Advances in Tools and Techniques for Assessing MNA B10. Groundwater/Surface Water Interactions
	C1. 1,4-Dioxane Treatment Technologies C2. Combined Treatment of Emerging Contaminants with CVOCs C3. Emerging Contaminants: Detection, Degradation, Fate and Transport **Panel:** Believe or Not to Believe Biodegradation of Emerging Contaminants	C4. Microplastics and Nanoplastics in the Environment C5. Biodegradation and Upcycling of Plastics C6. Biotechnology for Sustainable Mining **Panel:** Synthetic Biology Applications and Challenges to Commercialization	C7. Biocementation C8. Energy and Greenhouse Gas Footprint of Bioremediation C9. Strategies to Mitigate Climate Change Impacts
	D1. In Situ Bioremediation Applications **Panel:** In Situ Bioremediation: State of the Practice and Emerging Contaminant Challenges D2. Innovative and Efficient Amendment Delivery Strategies	D3. Biobarrier Implementation and Management D4. Challenges in Application of Bioremediation Tools D5. Bioremediation Approaches for the Innovative Management of Large or Dilute Plumes D6. Impacts of Mixed Contaminants on Biodegradation	D7. Bioremediation in Complex Geological Settings D8. Bioremediation Case Studies
	E1. Advances in Amendment Formulation E2. Cometabolic Bioremediation E3. Enhanced Methods for Biodegradation/ Biotransformation of Organic and Inorganic Contaminants E4. Biogeochemical Remediation Processes	E5. Optimization of Classical Bioremediation Technologies E6. Phytoremediation E7. Advances in Heat-Enhanced Bioremediation	E8. Understanding the Microbiome E9. Novel Sensing Technologies E10. Bioremediation of Munitions Constituents
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**	**5:45-7:00 p.m. Poster Group 2 Presentations and Reception**	**3:00 p.m. Closing Panel Discussion** **4:00 p.m. Closing Reception**