Drinking Water Treatment

Thomas Speth
CESER
Office of Research and Development

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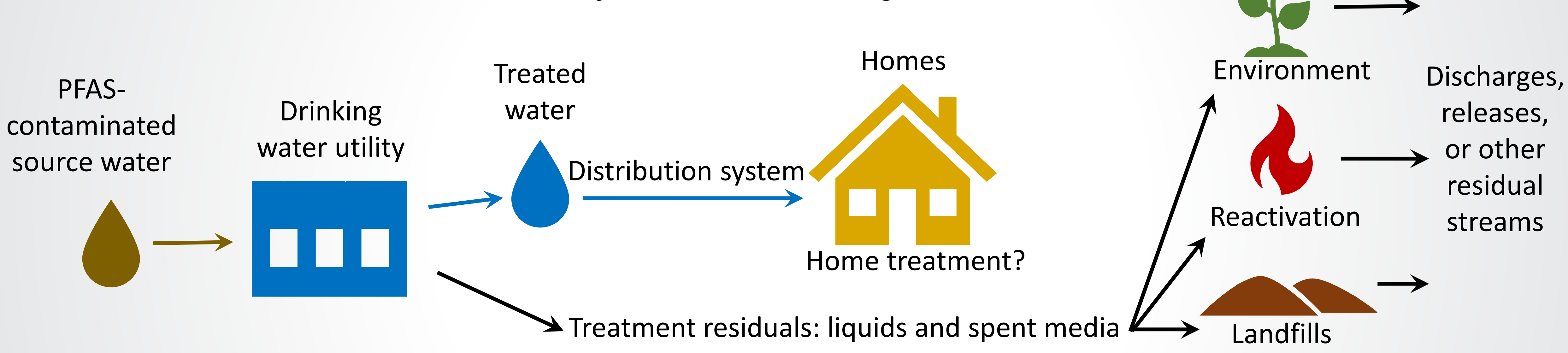
Drinking Water Treatment

How do we remove PFAS from drinking water?



<u>Effective Treatment Technologies for PFAS</u>

- Anion exchange resin, granular activated carbon (GAC), and membrane separation (RO) are generally effective at removing PFAS
- More effective for long-chain than short-chain PFAS
- Removal efficiencies and cost depend on source water characteristics and water system characteristics

<u>Treatment Residuals</u>

- PFAS found in spent GAC and spent resin
- Spent media can be regenerated, landfilled, or incinerated with unknown releases of PFAS or products of incomplete destruction (PICs)
- There are no known fully destructive treatments (mineralization) for RO concentrate streams

Actions and Goals

Data Gap: Treatment technology performance and cost data for PFAS removal

Actions:

- Gather treatment performance and cost data for a range of system sizes (collaborative with utilities, industry, DoD, academia)
- Develop and update treatment models, databases, and cost models
- Evaluate technologies for regeneration, destruction, or disposal of spent GAC and IX resins and other residual streams

Goals:

- To identify approaches for removing PFAS from drinking water that are economically viable and sustainable yet are flexible enough to deal with potential future changes in target PFAS and treatment goals
- To investigate PFAS as a class, with particular interest in shorter chain PFAS
- To evaluate all scales (large systems to POU treatment), especially small systems
- To provide this information to the states, tribes, communities, etc.
- To provide modeling tools that can model other treatment conditions
- To assure there are no unintended consequences of implementing treatment
- To evaluate residual stream management (including novel treatments)

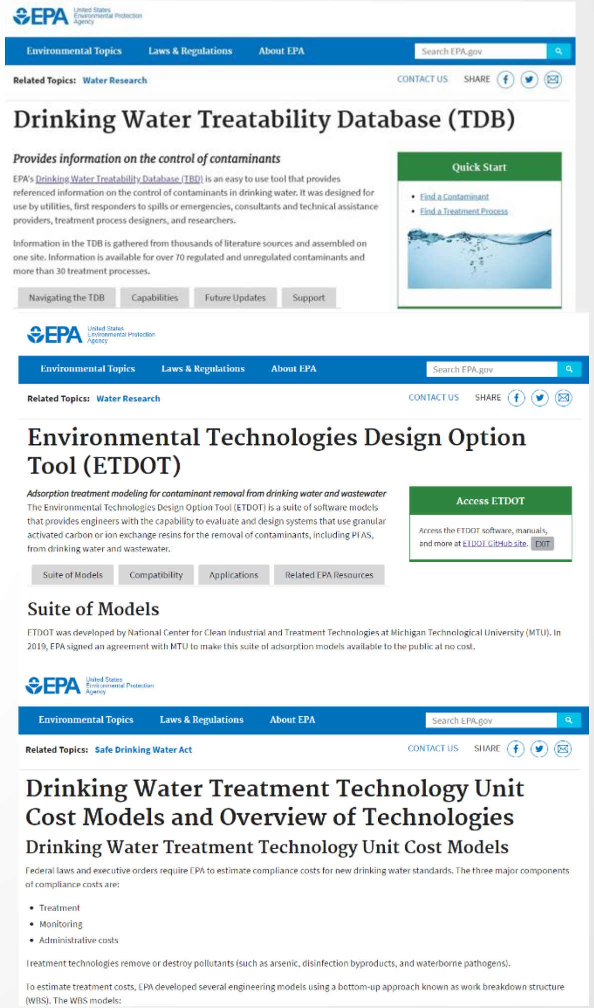
Impact: Utilities will be able to better identify cost-effective and sustainable PFAS treatment strategies

Overall Approach: Databases and Tools

Provide tools and approaches to accurately predict the performance and cost of treating PFAS in waters

Model Scenarios

- Variable source waters
- Variable PFAS concentrations in source waters
- Alternate treatment goals
- Changing production rates
- Document secondary benefits
- Different reactivation/disposal options



[Drinking Water Treatability Database](#) or search EPA TDB
[Environmental Technologies Design Option Tool Models](#) or search EPA ETDOT
[Drinking Water Treatment Cost Models](#) or search EPA WBS

Outreach – Select Publications

10 Effectiveness of Point-of-Use/Point-of-Entry Systems to Remove PFAS from Drinking Water

Craig Patterson, Jonathan B. Burkhardt
US Environmental Protection Agency, Cincinnati, Ohio

Donald Schupp, E. Radha Krishnan
Aptim Federal Services, Cincinnati, Ohio

Stephen Dyment
US Environmental Protection Agency, Office of Research and Development, Denver, Colorado

Steven Merritt
US Environmental Protection Agency Region 8, Denver, Colorado

Lawrence Zintek, and Danielle Kleinmaier
US Environmental Protection Agency Region 5, Chicago, Illinois

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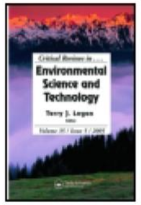
Jonathan B. Burkhardt
US Environmental Protection Agency, USA

Richard H. Anderson
US Air Force Civil Engineer Center, USA

Rajiv Khera, Levi M. Haupert
US Environmental Protection Agency, USA

Patrick Ransom
Abt Associates, USA

David G. Wahman, Page Jordan, Jonathan G. Pressman, Marc A. Mills and Thomas F. Speth
US Environmental Protection Agency, USA



Critical Reviews in Environmental Science and Technology

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Occurrence of per- and polyfluoroalkyl substances (PFAS) in source water and their treatment in drinking water

Brian C. Crone, Thomas F. Speth, David G. Wahman, Samantha J. Smith, Gulizhaer Abulikemu, Eric J. Kleiner & Jonathan G. Pressman

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REVIEW

AWWA WATER SCIENCE

TOPICAL COLLECTION ON PFAS ANALYTICS AND TREATMENT

Avoiding pitfalls when modeling removal of per- and polyfluoroalkyl substances by anion exchange

Levi M. Haupert | Jonathan G. Pressman | Thomas F. Speth | David G. Wahman

U.S. Environmental Protection Agency, Office of Research and Development, Center for Environmental Solutions and Emergency Response, Cincinnati, Ohio

Abstract

Per- and polyfluoroalkyl substances (PFAS) are receiving a great deal of attention from regulators, water utilities, and the general public. Anion-

Check for updates

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REVIEW

AWWA WATER SCIENCE

TOPICAL COLLECTION ON PFAS ANALYTICS AND TREATMENT

Managing and treating per- and polyfluoroalkyl substances (PFAS) in membrane concentrates

Emily W. Tow[1] | Mahmut Selim Ersan[2] | Soyoon Kum[3] | Tae Lee[4] | Thomas F. Speth[4] | Christine Owen[5] | Christopher Bellona[6] | Mallikarjuna N. Nadagouda[4] | Anne M. Mikelonis[7] | Paul Westerhoff[2] | Chandra Mysore[8] | Val S. Frenkel[9] | Viraj deSilva[10] | W. Shane Walker[11] | Andrew K. Safulko[6] | David A. Ladner[12]

[1]F. W. Olin College of Engineering, Needham, Massachusetts, USA
[2]School of Sustainable Engineering and the Built Environment, Nanosystems Engineering Research Center for Nanotechnology-Enabled Water

Modeling PFAS Removal Using Granular Activated Carbon for Full-Scale System Design

Burkhardt, Jonathan B.[1,*], Nick Burns[2], Dustin Mobley[3], Jonathan G. Pressman[4], Matthew L. Magnuson[5], and Thomas F. Speth[6]

1. Environmental Engineer, US Environmental Protection Agency, Office of Research and Development, 26 W. Martin Luther King Dr., Cincinnati, OH 45268. ORCID: 0000-0002-2935-4422, Email: burkhardt.jonathan@epa.gov (*corresponding author)
2. Director, Black & Veatch, Dallas, TX 75240, Email: burnsnl@bv.com
3. Process Engineer, Black & Veatch, Kansas City, MO 64114, Email: mobleydr@bv.com
4. Branch Chief, US Environmental Protection Agency, Office of Research and Development, 26

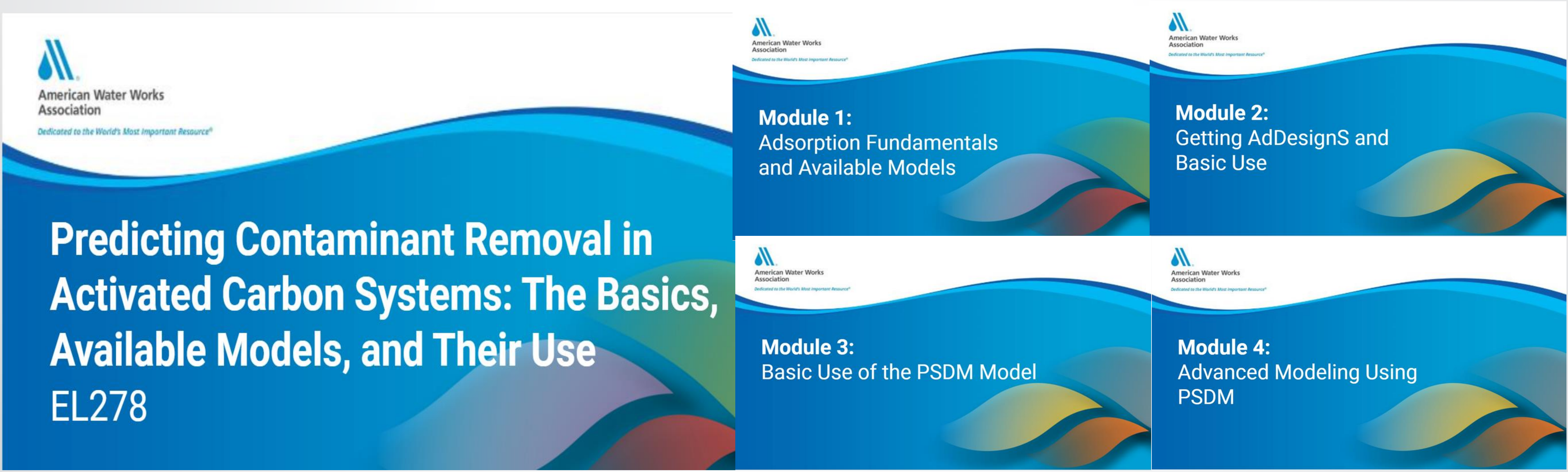
… and dozens of presentations to thousands of attendees

- Webinars regularly attract 500-3000 attendees

Outreach – Training Example

Performance Modeling Training

- EPA Small System Workshop and EPA Webinars
- 2021 → Transitioning this training to AWWA e Learning Platform (free for small systems)



Collaborations (Select)

Lead EPA ORD Researchers

- Jonathan Burkhart
- Brian Crone
- Levi Haupert
- Chris Impellitteri
- Page Jordan
- Eric Kleiner
- Michelle Latham
- Tae Lee
- Matthew Magnuson
- Anne Mikelonis
- Marc Mills
- Mallikarjuna Nadagouda
- Craig Patterson
- Jonathan Pressman
- Toby Sanan
- Samantha Smith
- Thomas Speth
- David Wahman

Select EPA Regional and Program Collaborators

- Rajiv Khera (EPA OW)
- Danielle Kleinmaier (EPA Region 5)
- Steven Merritt (EPA Region 8)
- Lawrence Zintec (EPA Region 5)

Select DOD Collaborators

- Air Force Civil Engineering Center
- Air Force Institute of Technology
- ESTCP Environmental Restoration Program
- DOD PFAS Taskforce

Select Water Utility and Industry Collaborators

- American Water Works Association
- Water Research Foundation
- City of Ridgewood, NJ
- City of Summerville, GA
- City of Wilmington, NC

Select Outside Collaborators

- Gulizhaer Abulikemu (Pegasus)
- Richard Anderson (AFCEC)
- Nick Burns (Black and Veatch)
- David Kempisty (Evoqua)
- Detlef Knappe (N. Carolina St.)
- Radha Krishnan (Aptim)
- David Ladner (Clemson University)
- Dustin Mobley (Black and Veatch)
- Pat Ransom (Abt Assoc.)
- Adam Redding (Calgon Carbon)
- Donald Schupp (Aptim)
- Emily Tow (Olin College)
- Feng Xiao (Univ. of North Dakota)

Supported by Safe and Sustainable Water Resources