Federal Remediation Technologies Roundtable

Agency Perspectives of Remediation Challenges Over the Next Decade

FRTR Spring 2021 Webinar

Session 1

May 19, 2020

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Objective

- Highlight significant remediation challenges facing Federal agency cleanup programs in the coming decade
- A panel discussion by senior remediation program managers and from FRTR member agencies

Moderator: Greg Gervais (EPA)

Panelists: Dana Stalcup (EPA)
Lara Beasley (USACE)
Rob Sadorra (NAVFAC)
Kent Glover, Ph.D. (AFCEC)
Mark Gilbertson (DOE)
Mark Thaggard (NRC)
Geoff Plumlee, Ph.D. (USGS)
William Suk, Ph.D. (NIEHS)

FRTR Spring 2021 Webinar and Meeting May 19, 2021 2

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U.S. Environmental Protection Agency

U.S. Environmental Protection Agency Perspectives: Remediation Challenges Over the Next Decade

Dana Stalcup

Deputy Director, Office of Superfund Remediation and Technology Innovation, Office of Land and Emergency Management, U.S. Environmental Protection Agency

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The Hazardous Waste Site Universe

- The waste site universe remains large and will require continued solutions to support program implementation
- Superfund comprises only a small percentage of the sites. Currently 1,327 sites on the National Priorities List.
- The universe is diverse, with multiple authorities and statutes, but technology is a cross-cutting issue

The Hazardous Waste Site Cleanup Universe Includes:
Superfund (NPL & Removal)
RCRA Corrective Action
UST
Federal Facilities
State and Private

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Site and Program Challenges

- Groundwater
- Mining
- Sediments
- Contaminant: emerging and known contaminants and emerging science
  - PFAS
  - 1,4 Dioxane
  - Lead

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Site and Program Challenges (cont.)

- Addressing Leadership Priorities and Overarching Program Issues
  - Environmental Justice
    - Remedying exposures of historically, disproportionately impacted communities
    - Minimizing impacts of cleanup activities
    - Green remediation/environmental footprint analysis
  - Climate change including resiliency of remedies to impacts of climate
  - Land revitalization, redevelopment, reuse
    - Productive reuse of land
    - Creating economic opportunities for impacted communities
    - Supply chain of Critical Minerals and Rare Earth Elements

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Site Characterization Still Matters

- Remediation technologies are a priority, but over 20 years of optimization and our cleanup experience over the past 30 years tells us that characterization is still important
  - Site characterization occurs throughout the cleanup process (i.e., life cycle CSMs); not only site investigation
  - Remediation requires accurate and often high-resolution information
  - Site geology and our understanding drives the ultimate performance/success of remedies
  - Sites are dynamic

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Technology has changed program practice Example 1: Site Characterization

- Site characterization tools and approaches have improved our understanding and management of sites
  - Tools like direct-push, field analytics, rapid sampling, and *in situ* sensors
  - Triad, site strategies, adaptive management
  - Life-cycle CSMs
  - Focus on geology
  - New horizons: remote sensing and imaging tools
- The collaboration of the member agencies has greatly contributed to the innovation that has shaped our cleanup practice today
  - More effective sharing of information
  - Support for innovation
  - Leveraging experience and expertise

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Technology has changed program practice Example 2: Groundwater

- Advances in technology and science has significantly impacted program practice
- Groundwater Remediation approaches are markedly different now
  - In the early 1990's, the overwhelming majority of remedies involved pump and treat. Other options we extremely limited.
  - In our latest analysis,
    - 51 % of the remedies chosen between 2015-2017 involved *in situ* treatments that were rarely or not available, including bioremediation, chemical treatment and thermal treatment
    - At sites where pump and treat was chosen, only a small minority did not also include some form of source treatment
  - The Roundtable and the member Agencies were leading the way in sharing experience, performance information, and collaborating on joint demonstrations to advance the practice that is now established practice

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The Challenge Ahead

- We have made great progress cleaning up contaminated sites but …
- We have opportunities to apply lessons learned, innovations and best management practices to future sites
- We still have a considerable workload moving ahead with site issues we have continually addressed over the past 30 years
- New remediation challenges exist, e.g. treating landfill leachate containing PFAS; re-evaluation of human health risks posed by registered products may affect remediation planning

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U.S. Army Corps of Engineers

US Army Corps of Engineers

U.S. Army Corps of Engineers Perspectives: Remediation Challenges Over the Next Decade

Lara Beasley

Chief, Environmental Division,
U.S. Army Corps of Engineers
Headquarters

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U.S. Army Corps of Engineers: Remediation Initiatives

New Directive

Executive Order 14008, Tackling The Climate Crisis:

- Specifies **Net Zero Emissions**, economy-wide by 2050.
- Encourages **Nature-Based Solutions**.
- Underscores **Environmental Justice** (EJ).

Are there remediation practices that support these initiatives?

Ongoing Initiatives

PFAS / Emerging Chemicals of Environmental Concern:

- Sampling and analytical methods / remediation strategies.

Munitions Response:

- Deployable in various environments, including underwater.
- Quality processes to account for variable geologic background.

Complex Groundwater:

- Predict transition point from active remediation to natural attenuation.
- Techniques to enhance attenuation in low permeability lithology.

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U.S. Army Corps of Engineers: Innovation Challenges

USACE is committed to providing the best available technologies & solutions.

THIS REQUIRES:

Data Quality. New standards = new technologies.
- Technologies need quality system requirements.

Reproducibility.
- Site trials or pilot studies.
- Peer Reviews.
- Validated by outside entities (DoD EDQW, FRTR, SERDP ESTCP, etc).

Availability. Prefer commercially availability to meet demands of numerous programs sites.

Communication. Communication forums, such as FRTR, to distribute lessons learned.

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U.S. Army Corps of Engineers: Future Research Needs

Support for Climate Change Initiatives.

→ **Incorporating Accountability and Techniques for Greenhouse Gas Reductions.**
- Carbon sequestration techniques in remediation.
- **Reporting / accounting** to support greenhouse gas reductions during remediation.

→ **Championing Environmental Justice (EJ) Initiatives.**

→ **Utilizing Nature-Based Solutions.**

Anticipate Future Needs.

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U.S. Naval Facilities Engineering Command

U.S. Naval Facilities Engineering Command Perspective: Remediation Challenges Over the Next Decade

Rob Sadorra, P.E.

Director, Environmental Restoration Division, Naval Facilities Engineering Command HQ

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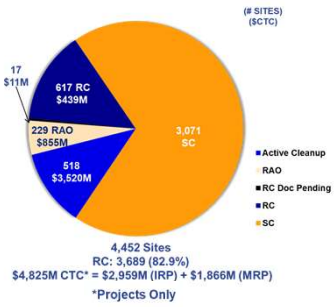
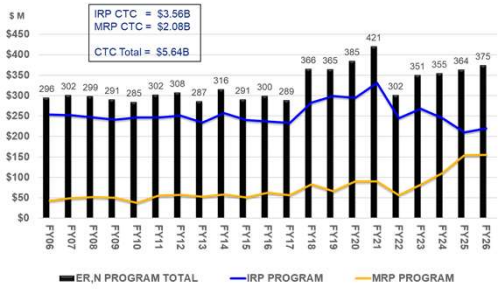
U.S. Naval Facilities Engineering System Command

DON Active Installations Environmental Restoration Program Landscape





- 229 Sites are in active remediation operation phase.
- 91 sites are projected to be active remediation operation phase in perpetuity (CTC $945M).
- 518 Sites (not including PFAS sites) will enter remediation operation phase.

RC Status	Current	Projection
TOTAL EOY21	82.9%	83.6%
OSD Goal: 95% sites RC		

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U.S. Naval Facilities Engineering System Command

Remediation Challenges:

- ❑ Emerging chemicals/concerns
  - ✓ PFAS (Characterization, risk assessment, and treatment technologies)
  - ✓ Vapor intrusion (OSHA vs. EPA short-term exposure criteria)
  - ✓ Low-level radiological (What is considered clean?)
- ❑ Complex sites
  - ✓ Recalcitrant groundwater plumes (Demonstrating progress of sites that cannot meet MCLs)
  - ✓ Munitions response (MR) sites (Classification and cleanup for water sites)
  - ✓ Sediment sites (Comingled with PCBs, munitions, and G-RAM)
- ❑ Low-risk sites
  - ✓ Petroleum sites (Continuous product extraction is not a solution)

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U.S. Naval Facilities Engineering System Command

Barriers for Implementing Innovative Technologies/Approaches:

- ❑ Timely Validation of Technologies
  - ✓ Need is now but validating technology field readiness takes 3 years or more
  - ✓ Relying on vendor/contractor data
- ❑ Technology Clearing House
  - ✓ FRTR to expand, maintain, and revamp the Technology Matrix as a clearing house for technologies and their performance at sites
- ❑ Stakeholders' Buy-in
  - ✓ Early engagement and partnership with stakeholders and regulators throughout technology development
  - ✓ Regulatory/stakeholder's buy-in is essential

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Air Force Civil Engineer Center

U.S. Air Force Perspectives: Remediation Challenges Over the Next Decade

Kent Glover, Ph.D.

Air Force Subject Matter Expert for Remediation Systems, Air Force Civil Engineer Center

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Air Force Civil Engineer Center

- Status of Cleanup Program
  - Installations with cleanup efforts through FY20
    Active 103 (8,337 sites) BRAC 35 (5,289 sites)
  - New sites identified in FY20
    Active 360 BRAC 7
  - Sites with response complete in FY20: 85.2%
    Remaining sites tend to have complex technical challenges, large costs and/or long estimated cleanup times
- Changing Focus: PFAS Remediation
  - Remedial Investigations
    114 active and BRAC installations, 75 ANG sites
    45 started
  - Current drinking water response actions: 33 installations
  - Sites expected to need PFAS remedial actions: TBD

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Air Force Civil Engineer Center

Grand Challenge

Legacy Contaminants at Complex Groundwater Sites

- Remediation progress at remaining sites is slow and costly
  - Complex hydrogeology and contaminant mixtures
  - Persistent sources
  - Large relatively dilute plumes
- AFCEC challenges at legacy sites
  - Develop sustainable/adaptable remedies
  - Optimize remedies to enhance progress
  - Leverage innovation to shorten cleanup times
  - Develop remediation strategies that balance cost with benefits of risk reduction and resource reuse

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Air Force Civil Engineer Center

Grand Challenge

Emerging Contaminants

- Increasing focus of policy, regulation and public concern
- Rapidly expanding portion of Air Force remediation liabilities
- AFCEC challenges at PFAS sites
  - Result from technical and regulatory uncertainty
  - Viable site-management strategies and remedial approaches in the face of evolving knowledge
  - New risk-management approaches for MILCON sites not currently requiring remediation
  - Effective on-site treatment of large PFAS source areas and plumes

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Air Force Civil Engineer Center

Innovative Technology and Tech Transfer Needs

- Complex groundwater sites
  - Cost-effective characterization
    - Contaminant mass distribution/accessibility in source areas
    - Migration pathways in highly heterogeneous matrices
  - Full-scale treatment technology
    - Low permeability and highly heterogeneous matrices
    - Tools to assess/optimize *in situ* remedies
- PFAS impacted sites
  - Characterization
    - Field-scale tools to observe/predict fate and transport
  - Proven treatment technologies at site, plume and source scales
    - On-site PFAS chemical destruction and *in situ* treatment
    - Efficient treatment of mixed PFAS-legacy contaminants

Air Force Civil Engineer Center

Technology Transfer, Outreach and Education

- Grand challenge
  - Build and sustain staff and contractor knowledge as science evolves
  - Build public and stakeholder understanding of increasingly complex remediation problems and confidence in solutions
- Technology transfer needs
  - Better ways to foster upscaling and commercialization of innovative technology
  - Cost-performance data at source/plume/site scales
  - Long-term optimization case studies at complex sites
  - Best practices for use of models in remedy decisions
  - Tech transfer strategies and materials for public outreach

U.S. Department of Energy

U.S. Department of Energy Perspectives: Remediation Challenges Over the Next Decade

Mark Gilbertson

Associate Principal Deputy Assistant Secretary for Regulatory & Policy Affairs, Office of Environmental Management, U.S. Department of Energy

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Strategic Vision 2021-2031

DOE Office of Environmental Management

- Tank Waste
- Demolishing contaminated buildings
- Remediating contaminated soil and groundwater
- Shrinking remaining cleanup footprint over the next decade

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Grand Challenges

Artificial Intelligence

✓ **Assist Decision Makers with the Use of Science-Based Artificial Intelligence and Machine Learning to Predict:**

- Climate resiliency
- Contaminant movement and long-term remediation success
- Long-term monitoring needs
- Exit strategies for pump-and-treat systems

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Grand Challenges

Decisions in Totality

- Framework for systems approach
- Limited resources demand the elimination of actions that do not reduce risk
- Regulatory framework does not match pollution movement

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Technology Needs and Research Gaps

Emerging Contaminants

- Interim guidelines
- Better coordination among agencies
- Development of data/sensors for artificial intelligence and machine learning use

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Technology Needs and Research Gaps

DOE National Laboratory Technology Review

- Complex wide
- Identify strengths, weaknesses, and gaps
- Establish priority for issues, challenges, and risks

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U.S. Nuclear Regulatory Commission

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

U.S. Nuclear Regulatory Commission Perspectives: Remediation Challenges Over the Next Decade

Mark Thaggard

**Director, Division of Risk Analysis,
Office of Nuclear Regulatory Research,
U.S. Nuclear Regulatory Commission**

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U.S. Nuclear Regulatory Commission

Mission

The **U.S. NRC** licenses and regulates the Nation's civilian use of radioactive materials to provide reasonable assurance of adequate protection of public health and safety and to promote the common defense and security and to protect the environment.

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U.S. Nuclear Regulatory Commission

Challenges

- Application of new technologies
- Adoption of an agency-wide survey approach
- Long-term performance of remediation program
- Establishment of consensus-based guidance
- Collaboration and coordination with other agencies

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U.S. Nuclear Regulatory Commission

Appreciation

- Collaborative work of FRTR Steering Committee
- Technical partnership with DOE
- Future efforts in identifying and applying innovative technologies

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U.S. Geological Survey

U.S. Geological Survey Perspectives: Remediation Challenges Over the Next Decade

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U.S. Department of the Interior
U.S. Geological Survey

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U.S. Geological Survey

Mission

Processing Emerging-Contaminants in a Bed-Sediment Sample

(Credit: Connie Loper, U.S. Geological Survey. Public domain.)

The U.S. Geological Survey (USGS) provides non-regulatory, non-advocacy, science and scientific information to inform policy- and decision-making on a wide range of complex challenges facing the Nation.

Our interdisciplinary earth and biological system science works to describe, measure, understand, and model:

- The Earth, its ecosystems, and the environment, and their interactions with humans
- The Nation's water, biological, energy, and mineral resources
- Natural hazards, in order to protect life and property, reduce risks, and enhance preparedness, response, and resilience

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U.S. Geological Survey

Mission Areas and Priorities

Core Science Systems - Conducts detailed surveys and develops high quality geospatial data and maps — topography, geology, hydrography, biology, ecology.

Ecosystems - Provides science to help America achieve sustainable management and conservation of its biological resources. Also provides science on environmental contaminants and pathogens, their impacts on fish and wildlife, and their implications for human health.

Energy and Minerals - Assesses and conducts targeted research on the location, quantity, and quality of mineral and energy resources, including the economic and environmental effects of resource extraction and use.

Natural Hazards - Monitors, assesses, and conducts targeted research on a wide range of natural hazards to enhance preparedness, response, and resilience.

Water - Monitors, assesses, conducts targeted research, and delivers information on water resources and conditions including streamflow, groundwater, water quantity and quality, water use and availability.

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U.S. Geological Survey

Challenges

Analytical and Field Methods

- Emerging "yet to be discovered" contaminants and pathogens
- Real-time monitoring of remediation efficacy

Abandoned Mines and Industrial Legacy Sites

- Establishing environmental baselines
- Transformation product of contaminants in the environment
- Cumulative effects of low levels of persistent contaminants

Remediation

- Characterizing and understanding sites with complex hydrogeology and geochemistry that are difficult to remediate
- Understanding and remediating contamination in a watershed context
- Understanding potential impacts of climate change on remedies
- Cost of application and simplification of remedy operations
- Waters contaminated with multiple contaminant classes (radiological, biological, inorganic, organic, neutral compounds)

Watersheds with abandoned mines often have multiple mine sites that degrade water quality as well as large areas of unmined mineralized rocks that can also contribute naturally to degraded water quality. Understanding the relative contributions of individual mine sites and unmined areas, as well as pre-mining environmental baselines, is key to establishing realistic cleanup goals and effective remediation strategies.

Red Mountain Pass, Colorado, 1962. Photo by R. Plumlee

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U.S. Geological Survey

Technology Needs and Research Gaps

Technology Needs

- Cost effective separation technology for neutral valent compounds, pesticides, and pharmaceuticals
- Reliable *in situ* and remote advanced sensor technologies to detect multiple classes of contaminants and pathogens in real time
- Comprehensive treatment schemes for multiple classes of contaminants

Research Gaps

- Identifying PFAS-degrading microbes
- Combining remote sensing with machine learning/artificial intelligence (AI) tools
- Improving conceptual site models integrating field data, advanced groundwater age dating, geophysical methods, 3-D geologic mapping, and hydrologic modeling
- Sampling and laboratory / field analytical methods for emerging contaminants
- Better predictive models of plausible impacts of a range of future climate conditions on sites being remediated

Soil sampling near the Kanab North uranium mine site in Arizona

(Credit: Katie Walton-Day, U.S. Geological Survey. Public domain.)

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U.S. Geological Survey

USGS science for a changing world

Thank you!

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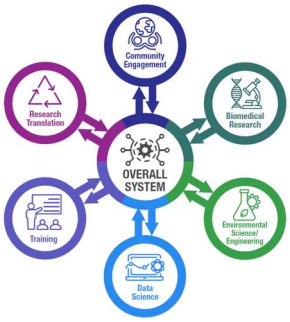
NIEHS Superfund Research Program

National Institute of Environmental Health Sciences
Superfund Research Program



NIEHS Superfund Research Program:

Multi-Disciplinary Systems Approach to Remediation Challenges

William A. Suk, PhD, MPH

Director, Superfund Research Program, National Institute of Environmental Health Sciences

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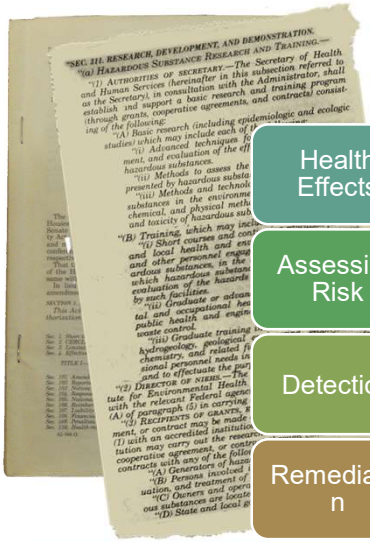
SRP Mandates under SARA



University-based basic research program established in 1986 under Superfund Amendments Reauthorization Act (SARA)

Health Effects	• Advanced techniques for the detection, assessment, and evaluation of the human health effects of hazardous substances
Assessing Risk	• Methods to assess the risks to human health presented by hazardous substances
Detection	• Methods and technologies to detect hazardous substances in the environment
Remediation	• Basic biological, chemical, and physical methods to reduce the amount and toxicity of hazardous substances

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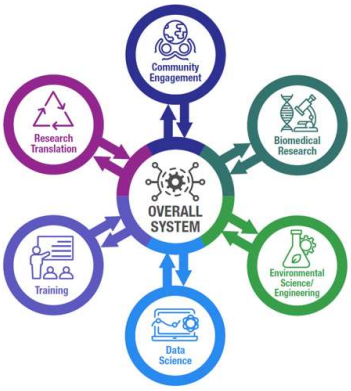
NIEHS Superfund Research Program (SRP)

Mission: Provide practical science-based solutions to protect human health

NIH peer-reviewed, competitively awarded grants to Universities and small businesses (Over 150 Grants)

Unique "systems" team-science approach

- **Systems Approach:** brings together diverse disciplines: health researchers, engineers, biologists, ecologists, earth scientists, data experts, and social scientists (highlighted in 2020 Strategic Plan)
- **Research Translation:** Works closely with industry, government, tribal, and business partners to deliver practical solutions



SRP Strategic Plan 2020-2025 Emphasizes a Systems Approach

https://www.niehs.nih.gov/research/supported/centers/srp/about/strat_plan/index.cfm

SRP-Funded Research Across the Country

SRP Map: https://tools.niehs.nih.gov/srp/sites/www.cfm

Multi-Project Centers: Health Effects, Risk, Detection & Remediation Research; Community and Stakeholder Outreach (23)

Individual Research Projects: Utilizing innovative materials science approaches to enhance bioremediation (10)

Small Business Research: Phase I and II grants for Remediation & detection (15)

Occupational Training Grants: Emerging issues in EHS training (4)

Successes and Future Challenges

- **Outcomes:**
  - Conducted work at 217 hazardous waste sites
  - Produced approximately 8105 peer-reviewed publications and 98 patents
  - Supports over 1400 professionals and more than 680 trainees involved in research
  - Supported more than 2,350 trainees over the years
  - More than $100 million in cost savings from innovative remediation technologies (Suk et al. 2018)
- **Challenges for Remediation:**
  - Environmental Justice and Environmental Health Disparities
  - Climate Change
  - Multiple Stressors (aka "mixtures")
  - Emerging Contaminants
  - Data Sharing
  - Overcoming the "Valley of Death" for new, promising technologies

Sites Where We Work: https://tools.niehs.nih.gov/srp/sites/www.cfm

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Thank you!

Please Visit: www.niehs.nih.gov/srp

Ask to join our listservs:
SRPInfo@mail.nih.gov

- **Science Digest:** Quarterly compilation of research, activities, and updates
- **Research Briefs:** Monthly research publication highlight
- **Risk e-Learning:** Regular CLU-IN webinar series highlighting SRP research
- **Who We Fund:** Includes lists of all currently funded grantees for each grant mechanism

SRP Staff:
William A. Suk, Director
Heather Henry (FRTR Representative), Sara Amolegbe, Danielle Carlin, Michelle Heacock, Brittany Trottier

Risk e-Learning: Enhancing Integration, Interoperability, and Reuse of Data
May 17, 2021, 1-3 PM EDT
June 3, 2021, 2-4 PM EDT
June 18, 2021, 1-3 PM EDT

Request for Information (RFI) "NOT-ES-21-006: Drinking Water Contaminants of Emerging Concern for National Emerging Contaminant Research Initiative." **Respond by June 2, 2021.**

SRP Risk Communication Strategies to Reduce Exposures and Improve Health
June 21-22, 2021, 11AM-5 PM EDT
Virtual Workshop

Save the Date: 2021 SRP 35th Anniversary Annual Meeting
Dec 15-17, 2021, Raleigh, NC and Virtual Options

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