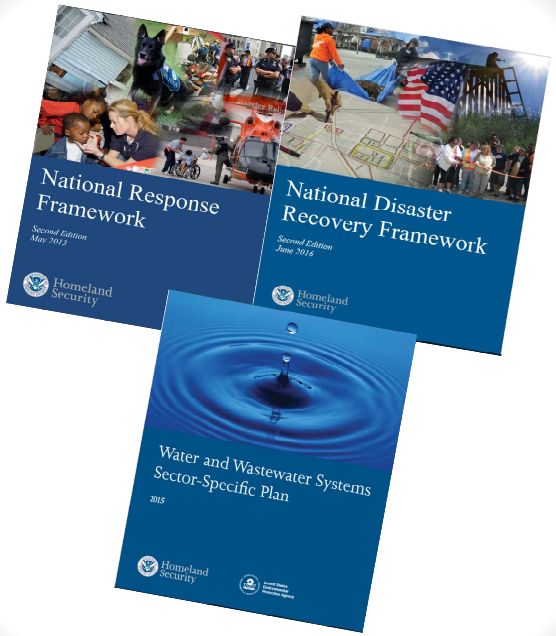
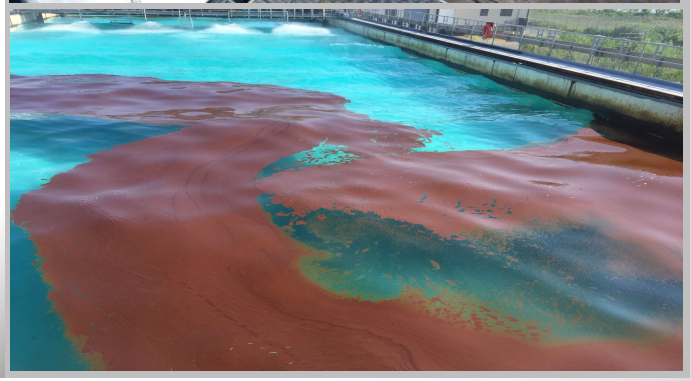
EPA Office of Research and Development

Homeland Security Research





Shawn Ryan and Sang Don Lee
Homeland Security Research Program

Homeland Security Research Program

Vision

Federal, state, tribal, and local decision makers have timely access to information and the tools they need to ensure community resilience to catastrophes involving environmental contamination that threatens public health and welfare.

Program Objectives

Advance EPA's capabilities and those of our state, tribal, and local partners to respond to and recover from wide-area contamination incidents

Improve the ability of water utilities to prevent, prepare for, respond to and recover from water contamination incidents that threaten public health

HSRP Partners and Stakeholders

- **EPA Program Offices**
  - **Office of Water**
  - **Office of Land and Emergency Management**
  - Office of Chemical Safety and Pollution Prevention
  - Office of Homeland Security
- **EPA Regional Offices**
- **Other Federal Agencies and Departments**
  - DHS
  - USCG
  - HHS
  - USDA
  - DoD
  - NOAA
  - DOI
- **States, Locals, Tribes and Territories**
  - Associations of state emergency managers
  - Water utilities and associations
  - Public health associations
- **International Collaboration**

HS Research Needs ID Process

- DHS Threat Assessments
- Other Federal Department/Agency activities
- EPA Strategic Priorities
- Input from partners/stakeholders
  - EPA Program and Regional Offices
  - States, Locals, and Tribes
  - Critical Infrastructure Partnership Council

Program Office Leadership

Subject Matter Expert Work Group

Prioritized Needs List

HS Research Area Development

Needs

- Group needs
- Draft science questions

Research Areas

- Consolidate need groupings
- Clarify interconnections

Research Topics

- Organize research areas
- Communication

Contaminant characterization and consequence assessment

- Contaminant Fate, Transport and Exposure
- Contaminant Detection/Environmental Sampling and Analysis

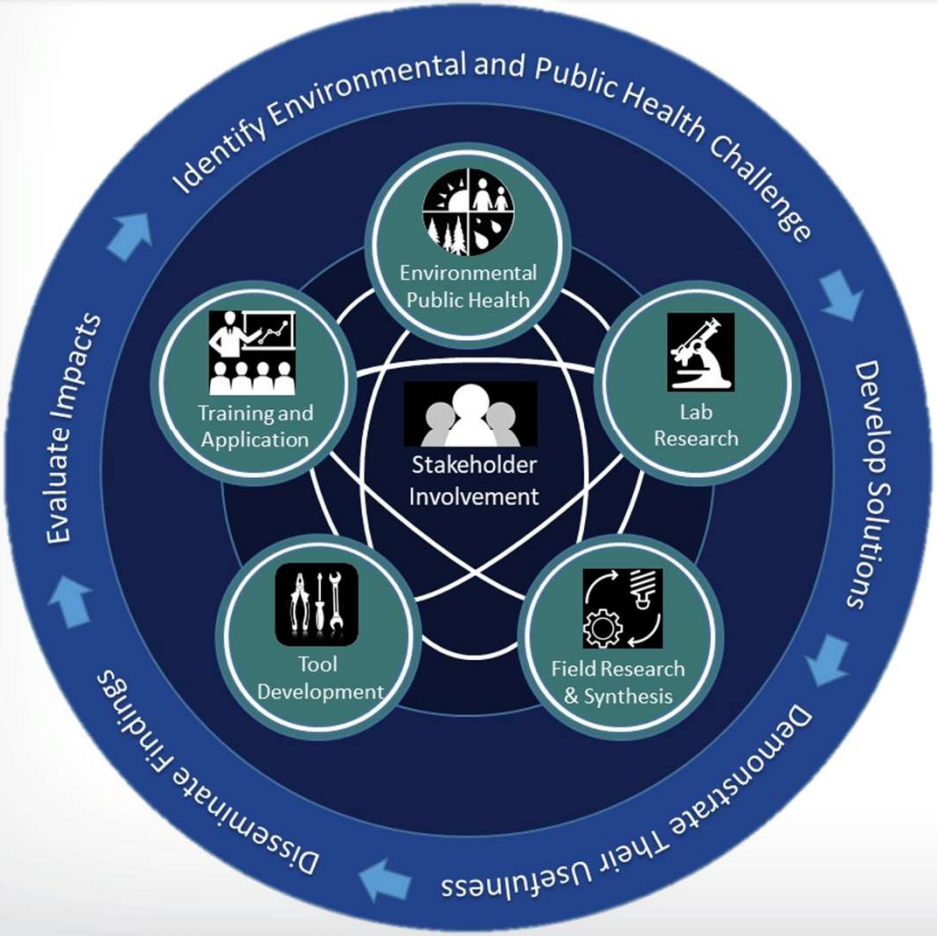
Environmental cleanup and infrastructure remediation

- Wide Area Decontamination
- Water Treatment and Infrastructure Decontamination
- Oil Spill Response
- Waste Management

System approaches to preparedness and response

- Tools to support systems-based decision making

Customer-driven Research



- Partner involvement throughout research life-cycle
  - Problem identification
  - Research planning
  - Product development
  - Capability transfer
- Ensures research is applicable and practical to partner needs
- Leads to advances in response and recovery capabilities

Threat Scenario Examples

Wide Area Dissemination	Wide Area Hot Spot Contamination	Water System Contamination	Oil Spill
• Anthrax release in an urban area • Dirty bomb in an urban center • Chemical warfare agent release • Nuclear disaster or improvised nuclear device	• Biotoxins (e.g., ricin) • Chemicals (including pesticides, opioids, warfare agents) • Radionuclides	• Direct contamination of drinking water and wastewater • Runoff from precipitation • Washdown and decon activities	• Diluted bitumen spill • Remote location spill (e.g., deep water, Arctic) • Land or water spill impacting protected natural resources or public health

Incident Response

Incident

Sampling & Analysis

Decontamination

Waste Management

Response Mission Support

How do we contain the contaminant?

How do we manage waste, both during response and long-term?

How do we characterize the contaminated area to inform public health decisions?

What tools and strategies are needed for clean-up of wide areas or water systems?

HSRP Facilities and Assets

Idaho National Lab
Water Security Test Bed

Cincinnati, OH (headquarters)
Test & Evaluation Facility
Biological Containment Suite (BSL-2)
Secure Access Facility

Washington, DC
Offices

Research Triangle Park
Aerosol Test Facility
Testing chambers
Decontamination equipment
COMMANDER
Biological Safety Lab (BSL-2)

Research Approach

Modeling

- Inform decisions makers
- Parameterization
- Design of experiments
- EPA, contractor and partner capabilities

Bench-scale

- Actual agents
- Simulant and surrogates
- Many parameters
- Proof of concept
- EPA and contractor labs

Pilot-scale

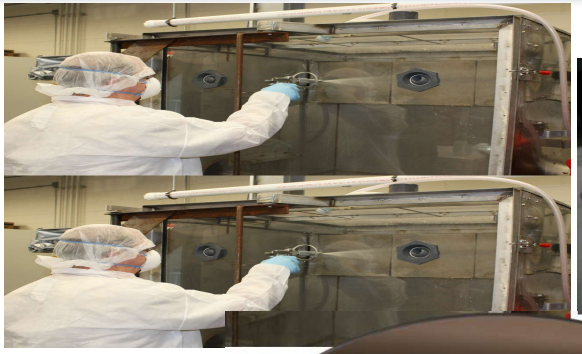
- Simulants and surrogates
- Operational relationship and parameters
- EPA facilities and partnerships

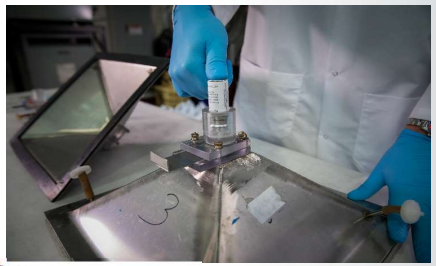
Full-scale

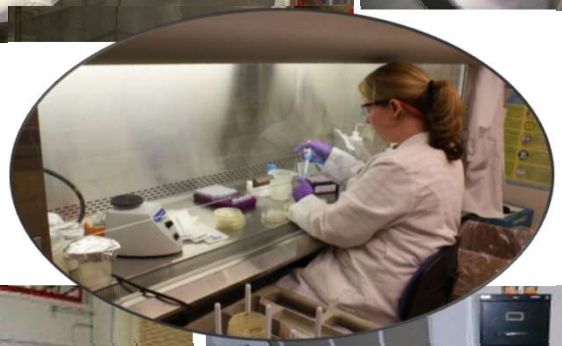
- Simulants and surrogates
- Operational and logistics
- Transfer to customers
- Interagency partnership

Specialized Chambers

- Environmental sampling and decontamination studies
  - Chemical, Radiological, and Biological capabilities
  - Adaptable, scalable – supports operational assessment
    - Spray chambers – operational assessment of spray-based decontamination methods
    - Fumigation chambers
    - COMMANDER – room size chamber supporting sampling, spray and fumigation
  - Controlled aerosol release and deposition of contaminants (e.g., *B. anthracis* surrogate spores)
  - On-site microbiology lab (BSL-2)

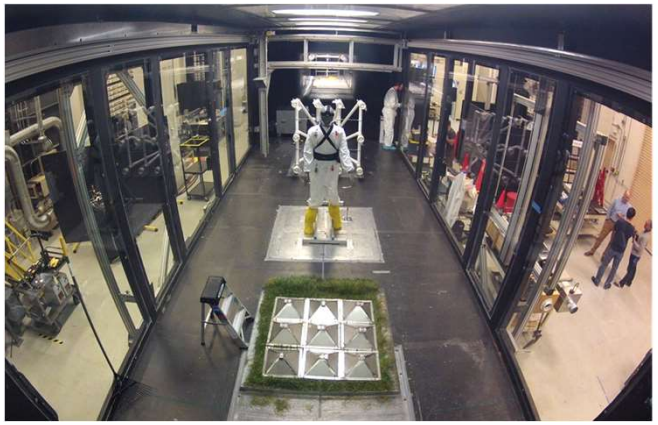






Aerosol and Meteorological Wind Tunnel

- **EPA's Aerosol Wind Tunnel**
  - Recirculating tunnel designed for aerosol studies
  - Current studies: release of *B. anthracis* surrogates
    - Exposure due to human activities
    - Activity-based sampling methods and air sampling method development/assessment
    - Reaerosolization
    - Evaluation/identification of simulants for field tests



- **EPA's Meteorological Wind Tunnel**
  - Simulate contaminant dispersion and wind interaction with obstacles (e.g., buildings in a city)
  - Simulation of various contaminant release scenarios
  - Support for response decision making and air monitoring
    (e.g., sampler placement/grid)

Research to End Users – Field Tests & Demo

Bio Operational Testing and Evaluation (BOTE)

- Whole building bio cleanup
- HSRP, CMAD, Regions, DHS, CDC, DoD

Rad Mitigation

- Building surface, gross decon demo
- HSRP, CMAD, Regions, DHS, locals

Underground Transport

- Railcar and subway station cleanup
- CMAD, HSRP, Regions, DHS

More Information

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Sang Don Lee, Principal Associate Director, Homeland Security Research Program
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https://www.epa.gov/homeland-security-research

Videos of HSRP

- Water Security Testbed
- Underground Transportation Restoration Project
- Toolbox of technologies – rad demo
- Bio-Response Operational Testing and Evaluation (BOTE) Project
- Incident Waste Management Support Tool (I-Waste)
- Environmental Sampling & Analytical Methods (ESAM) Instructional Video

CQ1: Sampling and Analysis Research

Overview of Sampling and Analysis Research

Sarah Taft, Ph.D.

Board of Scientific Counselors
Homeland Security Subcommittee Virtual Meeting
Day 1, May 17, 2021

Overview: Sampling and Analysis Research

- Why? – Need to know where it is and how much.
- How? – Developing methods, protocols, and tools.
- What? – Publishing "How to's" on-line for field samplers and laboratories.

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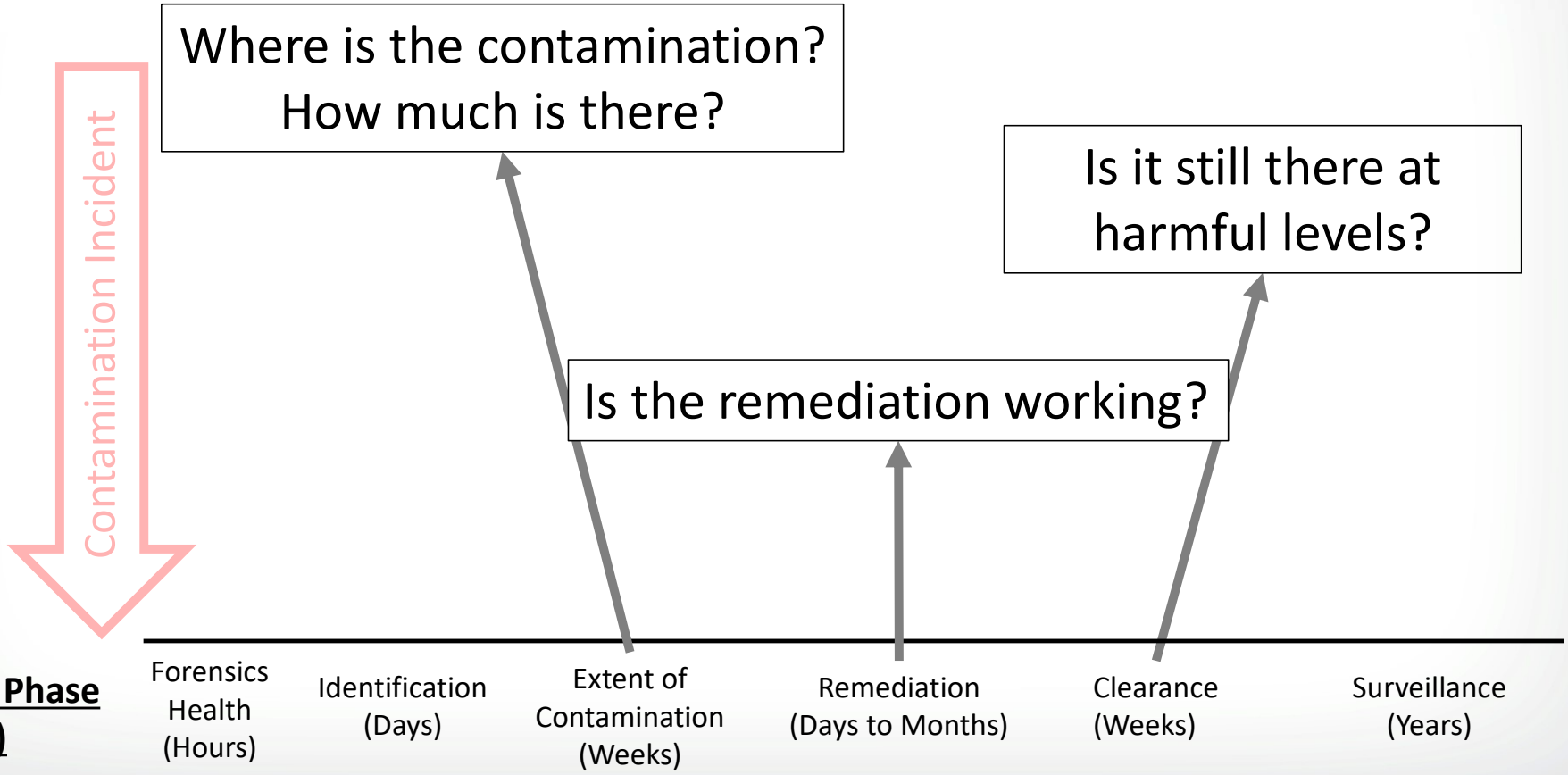
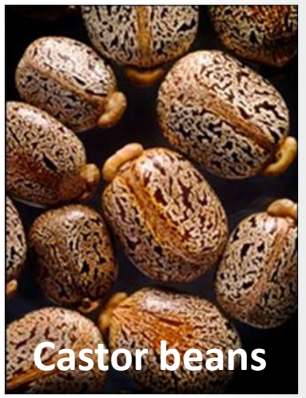
Why are EPA responders sampling?

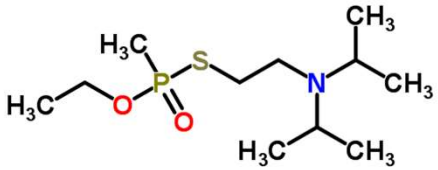


What are EPA responders sampling for?

- **Biological agents (includes Biotoxins) (50)**
  - *Bacillus anthracis*
  - *Yersinia pestis*
  - Ricin
  - Botulinum neurotoxins



- **Chemical agents (145)**
  - Sarin
  - Fentanyl
  - VX

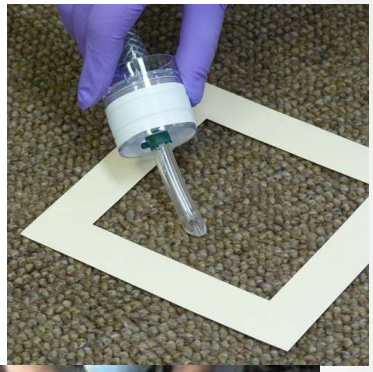


EA-2192, VX Degradation product

- **Radiochemical agents (36)**
  - Cesium-137
  - Plutonium-238/239
  - Strontium-90

Where are EPA responders sampling in wide areas?

- **Wide Areas:**
  - Surfaces
    - Indoor – non-porous (laminate, steel), porous (carpet, wood)
    - Outdoor – concrete, asphalt, brick
  - Vegetation
    - Soil
    - Grass/Leaves
  - Air
  - Solid waste



Overview: Sampling and Analysis Research

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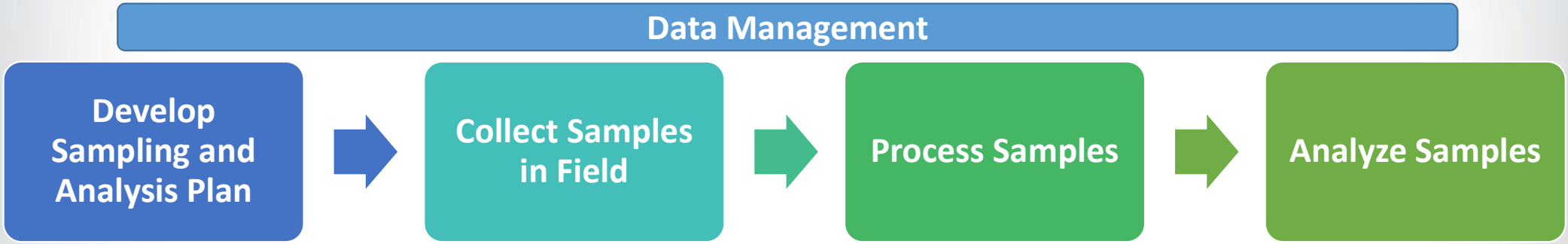
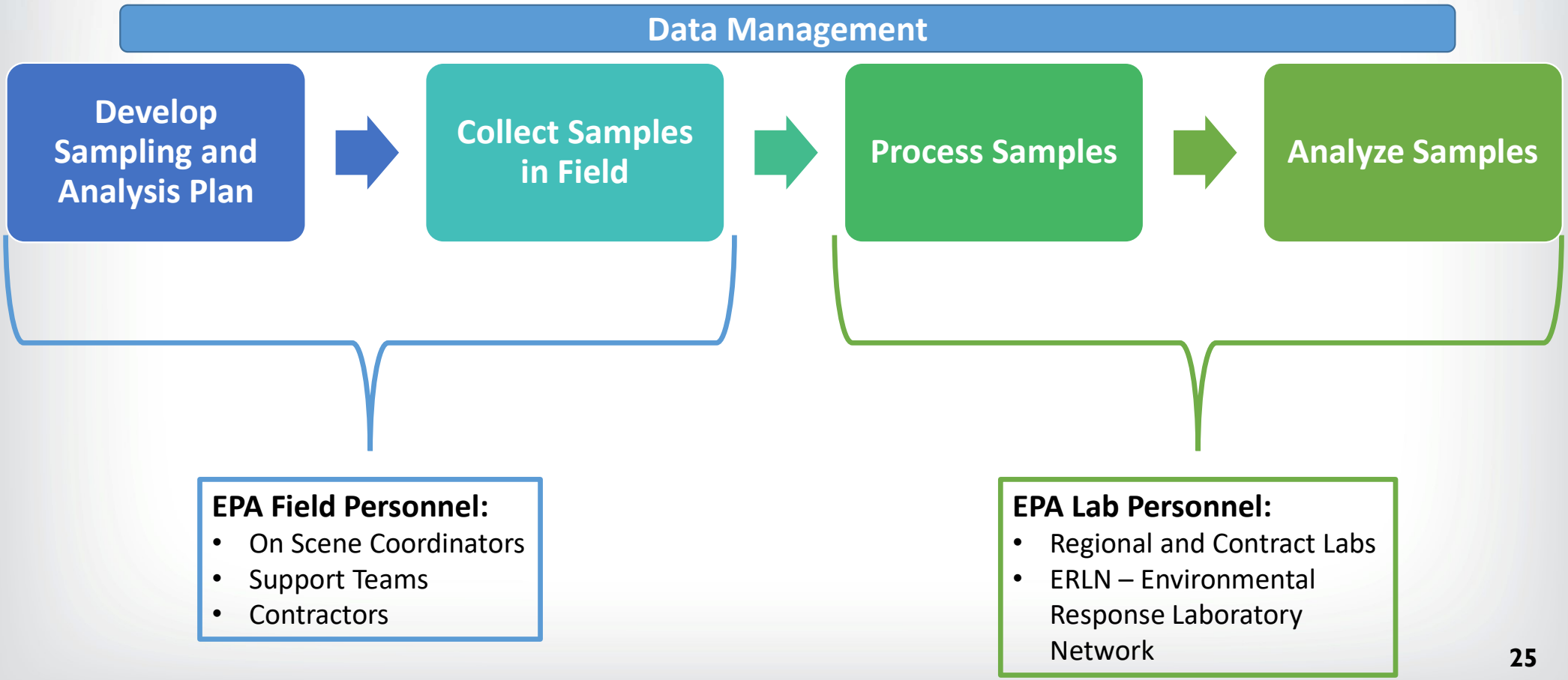
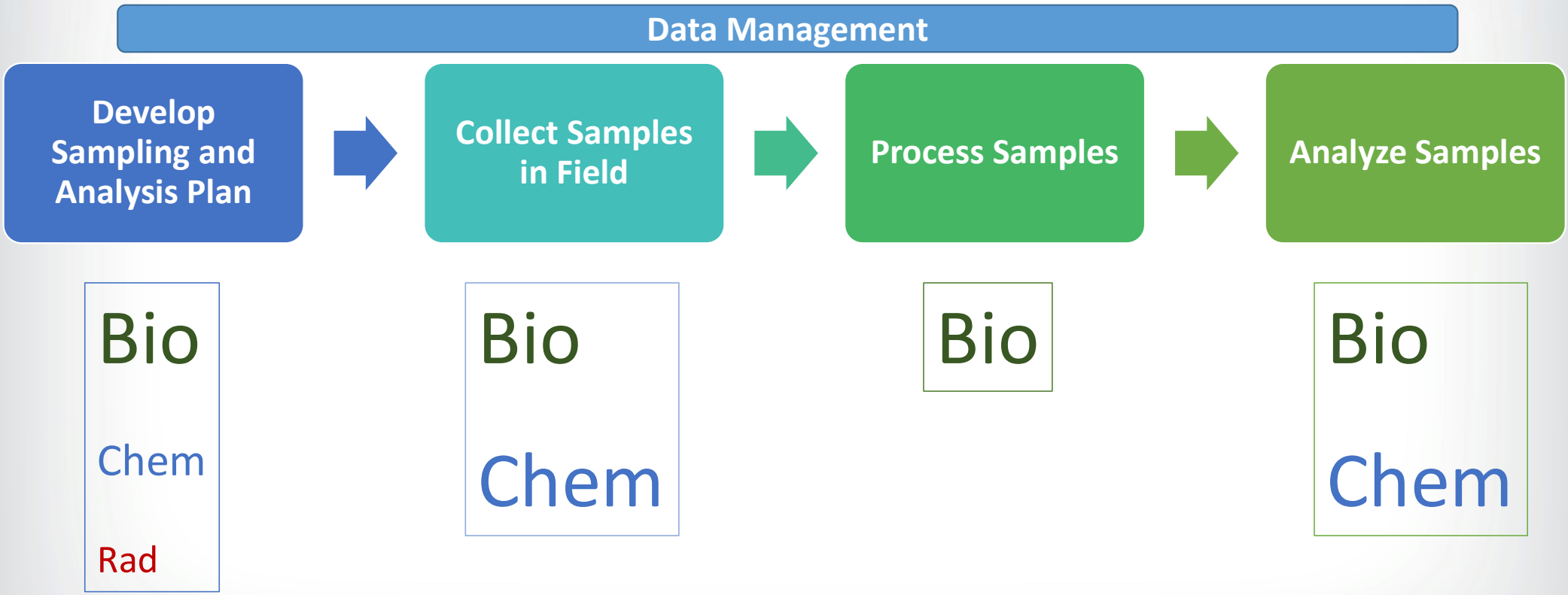
How is EPA sampling?



Who in EPA is sampling?



HSRP Sampling FY19-22 Needs from Partners



Overview: Sampling and Analysis Research

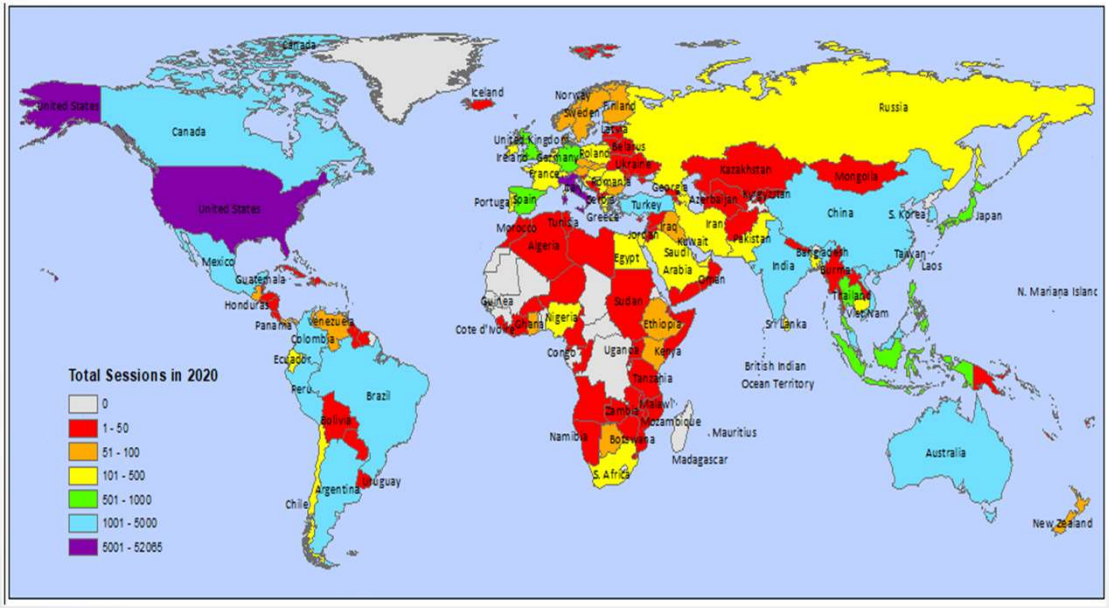
- Why? – Need to know where it is and how much.
- How? – Developing Methods, Protocols, and Tools.
- What? – Publishing "How to's" on-line for field samplers and laboratories.

Environmental Sampling and Analytical Methods (ESAM) Tool

- ESAM Tool = One-stop shop for anything sampling and analysis
  - Collection of field- and laboratory-ready documents and web-based tools developed for responders, laboratories and decision-makers
  - Provides single, best-available sample collection, handling, processing and analysis method to improve data evaluation and validation

IMPACTS: Environmental Sampling and Analytical Methods (ESAM) Tool

ESAM Statistics	2017	2018	2019	2020
Page Views	121,182	174,517	156,529	191,130
Downloaded Files (.pdf)	32,924	51,930	52,578	71,676

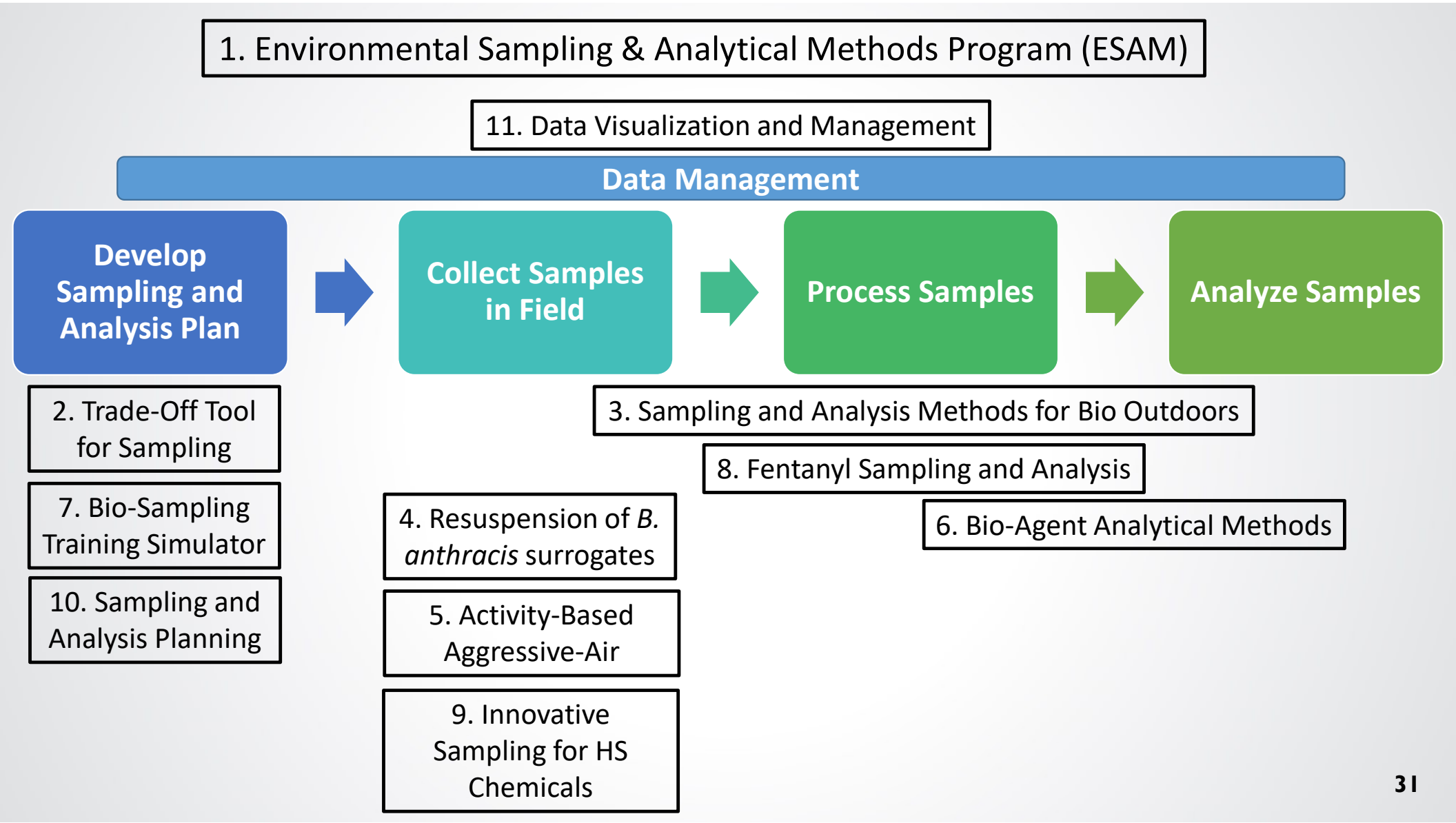


Over 160 countries using ESAM

www.epa.gov/esam

Sampling and Analysis Research…*Bottom Line*

- Need sampling and analysis strategies and methods to support EPA response, remediation, and recovery.
- Research moving forward focusing on wide-area contamination incidents.
- Publishing "How to's" methods, protocols, and tools on-line for easy access for field samplers and laboratories.


1. Environmental Sampling & Analytical Methods Program (ESAM)
11. Data Visualization and Management
Data Management
Develop Sampling and Analysis Plan
Collect Samples in Field
Process Samples
Analyze Samples
2. Trade-Off Tool for Sampling
7. Bio-Sampling Training Simulator
10. Sampling and Analysis Planning
3. Sampling and Analysis Methods for Bio Outdoors
8. Fentanyl Sampling and Analysis
6. Bio-Agent Analytical Methods
4. Resuspension of B. anthracis surrogates
5. Activity-Based Aggressive-Air
9. Innovative Sampling for HS Chemicals

Environmental Sampling and Analytical Methods Program (ESAM)

PI: Kathy Hall/Erin Silvestri

- **Need:** Support the response community with a comprehensive sampling and analysis program to facilitate a coordinated response to a contamination incident.
- **Scientific Approach:** Provide a user-friendly website to facilitate a coordinated response following a wide area contamination incident.
- **Impact:** ESAM website provides information that supports field and laboratory efforts to characterize contaminated sites and to aid remediation efforts.
- **Next Step:** Update of the *Selected Analytical Methods for Environmental Remediation and Recovery (SAM)* and SAM companion documents.

https://www.epa.gov/esam

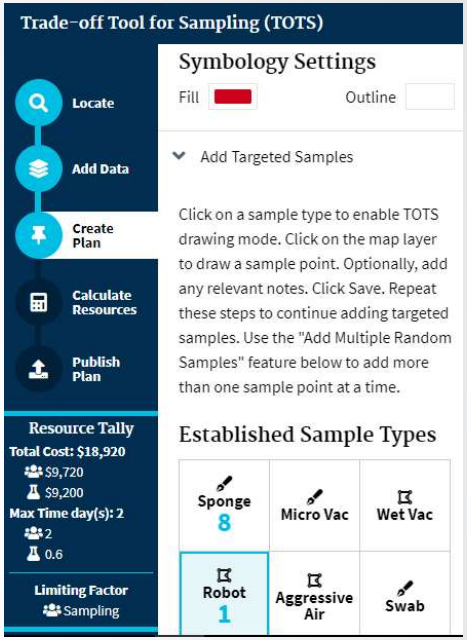
Trade-off Tool for Sampling (TOTS)

PI: Timothy Boe

- **Need:** A large-scale release can result in contamination of a wide area and would require significant time and resources for recovery. Responders need to select a sampling design that will address the site-specific objectives, meet the clearance goals, and not exceed the available resources (cost and time).

- **Scientific Approach:** Develop a web-based application that organizes the sample design process into a sequence of steps combined with a GIS-based graphical user interface for developing sampling plans.

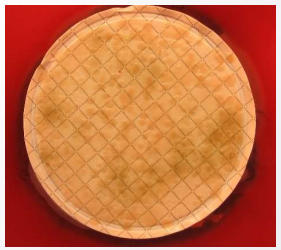
- **Impact:** TOTS allows users to create sampling designs and estimate the associated resource demand through interactive, point-and-click tools to visually develop sampling plans for biological contamination sampling.



Development of Sampling and Analysis Methods for Outdoor Environments

PIs: Worth Calfee, Sanjiv Shah, Anne Mikelonis, Erin Silvestri, Vince Gallardo, Sang Don Lee, Sarah Taft

- **Need:** Currently-available sample collection and analysis methods for *Bacillus anthracis* and other agents have unknown performance when applied to outdoor environments.
- **Scientific Approach:** Conduct laboratory experiments under outdoor conditions and conduct field testing to evaluate methods performance and identify areas for optimization.
- **Impact:** Optimized sampling and analysis methods will improve outdoor contamination characterization and help decision making during response.
- **Next Step:** Field sampling and analysis procedure development for outdoor characterization.



Resuspension of *B. anthracis* Surrogates on Underground Subway Surfaces (REBOUNDS)

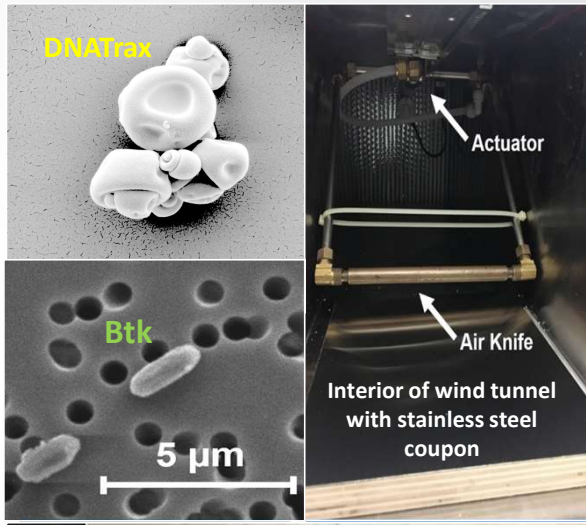
PI: John Archer

- **Need:** Understand behavior of threat agents and test response technologies under real environmental conditions. Identify proper surrogates for *B. anthracis* spores for resuspension and transport behavior.

- **Scientific Approach:** Compare resuspension of sugar-based DNA-tagged agent with established biological surrogate spores under realistic surface and environmental conditions using wind tunnel.

  Seed → Measure surface/air → Resuspend → Measure air → Calculate RF → Compare surrogates

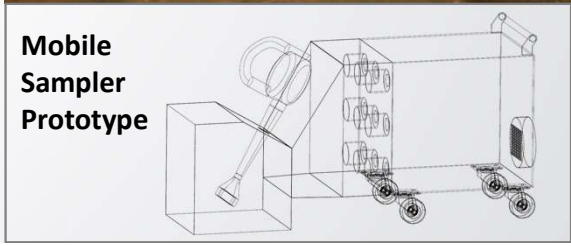
- **Impact:** Identified surrogates will be used in a field study to better understand fate and transport of *B. anthracis* spores in critical infrastructures.



Development of an Activity-Based Aggressive-Air Contained Sampling System (AACeSS)

PI: John Archer

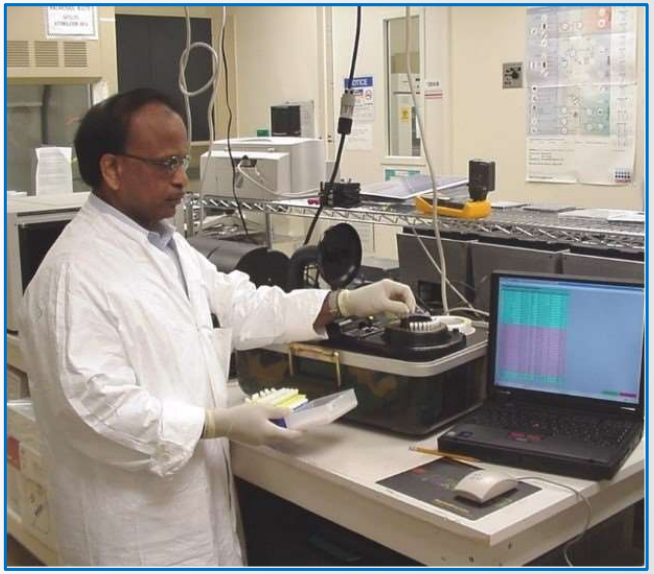
- **Need:** Develop air sampling protocols for resuspended bioaerosols to assist with exposure risk and characterization/clearance in a wide area bio release scenario.
- **Scientific Approach:** Modifying and adapting currently used asbestos air sampling protocols for outdoor bioaerosol sampling under containment.
  - Proof-of-concept → Pilot-scale → Field test/demonstration
- **Impact:** Provide responders with additional sampling tools following a wide area bio release to reduce sampling burden and provide additional data for risk-based decision making.
- **Next Step:** Conduct tests during AnCOR field demo and develop sampling protocols for partners.



Bio-Agent Analytical Methods Development

PI: Sanjiv R. Shah

- **Need:** Rapid, sensitive, and specific methods for environmental sample analysis to meet decontamination, cleanup, and reoccupancy goals in a timely manner during a response to a bio-agent contamination incident.
- **Scientific Approach:** Developing rapid, sensitive, specific, and high-throughput analytical methods to test different types of samples from a variety of surfaces and materials, like air filters (building and public transportation vehicles), water, soil, and vegetation for the presence of bio-agents, including biotoxins.
- **Impact:** These methods enhance the capability and capacity of the EPA Office of Emergency Management's Environmental Response Laboratory Network (ERLN) and the EPA Office of Water's Water Laboratory Alliance (WLA) for environmental sample analysis to respond to a bio-agent contamination incident.
- **Next Step:** Evaluate analytical methods during field demonstrations to ensure the methods work in a real-world bio-agent contamination incident.



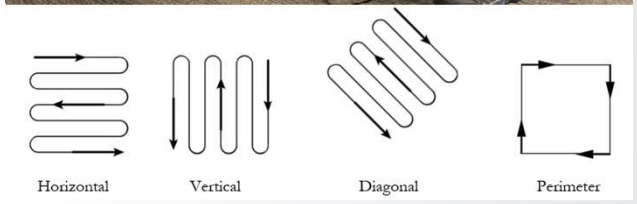
Bio-sampling Training Simulator (BTS)

PI: Timothy Boe

- **Need:** Training and disaster exercises are expensive, time consuming, difficult to organize, and can be limited in scope. Need to implement full-scale training with minimal resources and maximum control and quality.

- **Scientific Approach:** Simulator consists of three technologies:
  - Photogrammetry: used for mapping indoor/outdoor spaces
  - Modified game engine: for generating 3D environments
  - Virtual reality: for viewing and interacting with 3D environments

- **Impact:** Cost-effective training simulator capable of generating life-like visuals using commercial-off-the-shelf software and hardware to produce a "perfect practice" environment for improving training effectiveness and enhancing situational awareness.

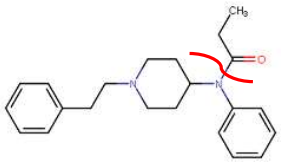


Fentanyl Sampling and Analysis

PI: Stuart Willison

- **Need:** Law enforcement and Hazmat teams have sought EPA technical support, analytical capabilities, and decontamination approaches at fentanyl contaminated sites.

Released May 22, 2018



- **Scientific Approach:** Investigate fentanyl surface contamination and evaluate sampling processes to inform wipe sampling and analytical methods.

- **Impact:**. Provide decision-makers with sampling and analytical capabilities to properly characterize and decontaminate affected areas to reduce environmental/public health concerns.

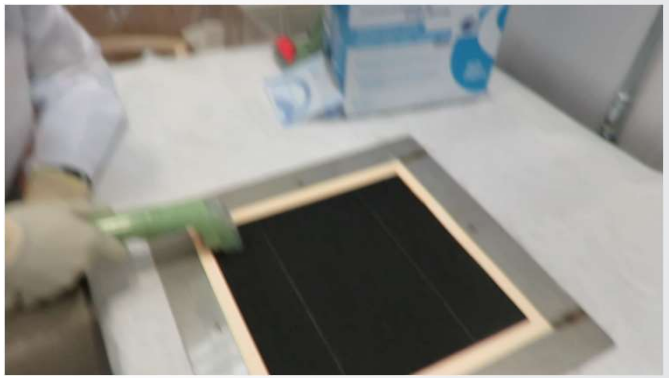
- **Next Step:** Update ESAM with analytical methods (fentanyl & analogs), provide sampling and analytical capabilities to EPA Program Offices, Regions, and Partners, and incorporate in EPA fentanyl fact sheet.

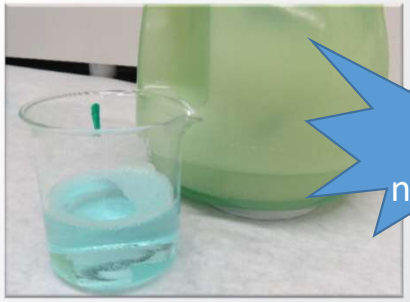
(https://www.epa.gov/emergency-response/fact-sheet-fentanyl-and-fentanyl-analogs)

Innovative Sampling Methods for HS Chemicals

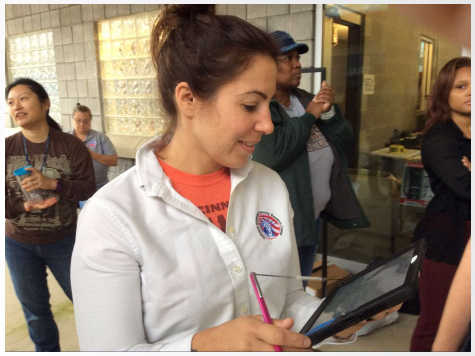
PI: Lukas Oudejans

- **Need:** Surface sampling approaches that sample larger areas are needed considering the limitations on the capacity to analyze specific samples.
- **Scientific Approach:** Assess efficiency of a wet-vacuum approach that could sample up to **180x** the traditional 10 x 10 cm area in one sample.
- **Impact:** Adding novel sampling approaches that can be used during a chemical incident response to reduce burden on analytical laboratories.
- **Next Step:** Use of the wet-vacuum sampling during the FY22 planned full scale technology demonstration (OTECRA; Day 4 of BOSC meeting).





Sampling and Analysis Plan (SAP) Resources



PI: Erin Silvestri

- **Need:** Well-defined and thorough SAP to collect quality data necessary to support remediation efforts following a microbiological contamination incident.

- **Scientific Approach:** Develop a user-friendly template for developing SAPs which incorporates the data quality objective process.

- **Impact:** Confidence in the data quality of results collected using the SAP templates.

- **Next Step:** Development of online or geoplatform-based, user-friendly template.

https://www.epa.gov/esam/sampling-and-analysis-plan-resources-pathogens

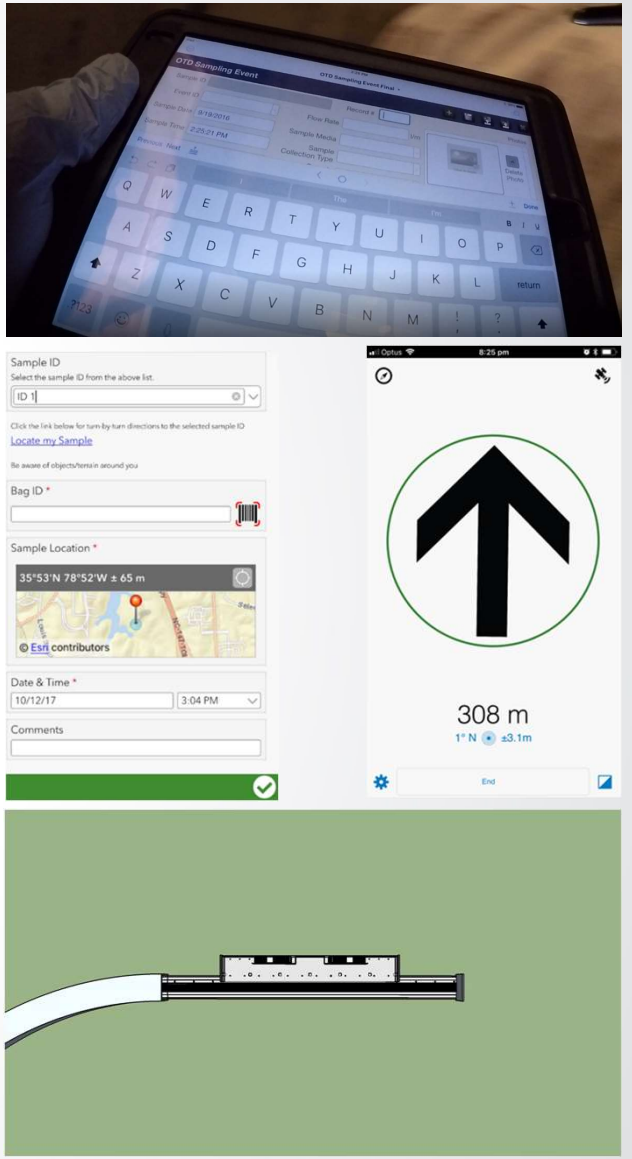
Data Management / Visualization

PI: Timothy Boe

- **Need:** Following a wide-area CBRN incident, during all phases of the response (from the initial characterization of the agent through clearance and waste disposal processes), a substantial amount of data will need to be collected, checked for quality, and maintained in order to advise decision-making.

- **Scientific Approach:** Understand how these processes and tools are connected and work together. Evaluate the usability of available technologies and software tools for data management.

- **Impact:** Applications/framework for collecting, storing, visualizing, and analyzing field and laboratory data in support of decision making.



CQ2: Wide Area Decontamination Research

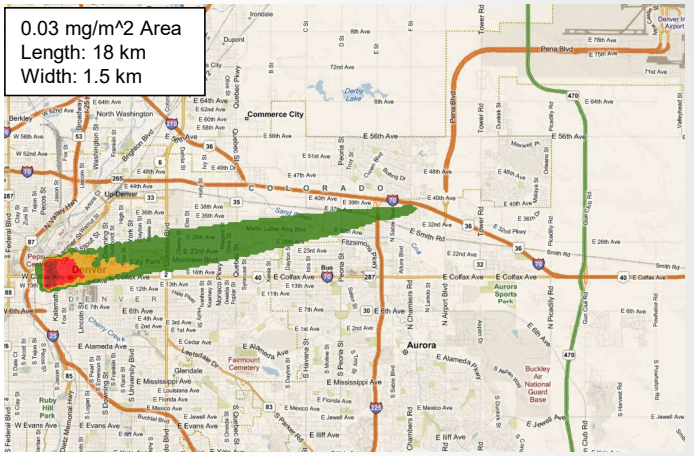
Overview of Wide-Area Decontamination

Lance Brooks

Board of Scientific Counselors
Homeland Security Subcommittee Virtual Meeting
Day 2, May 18th, 2021

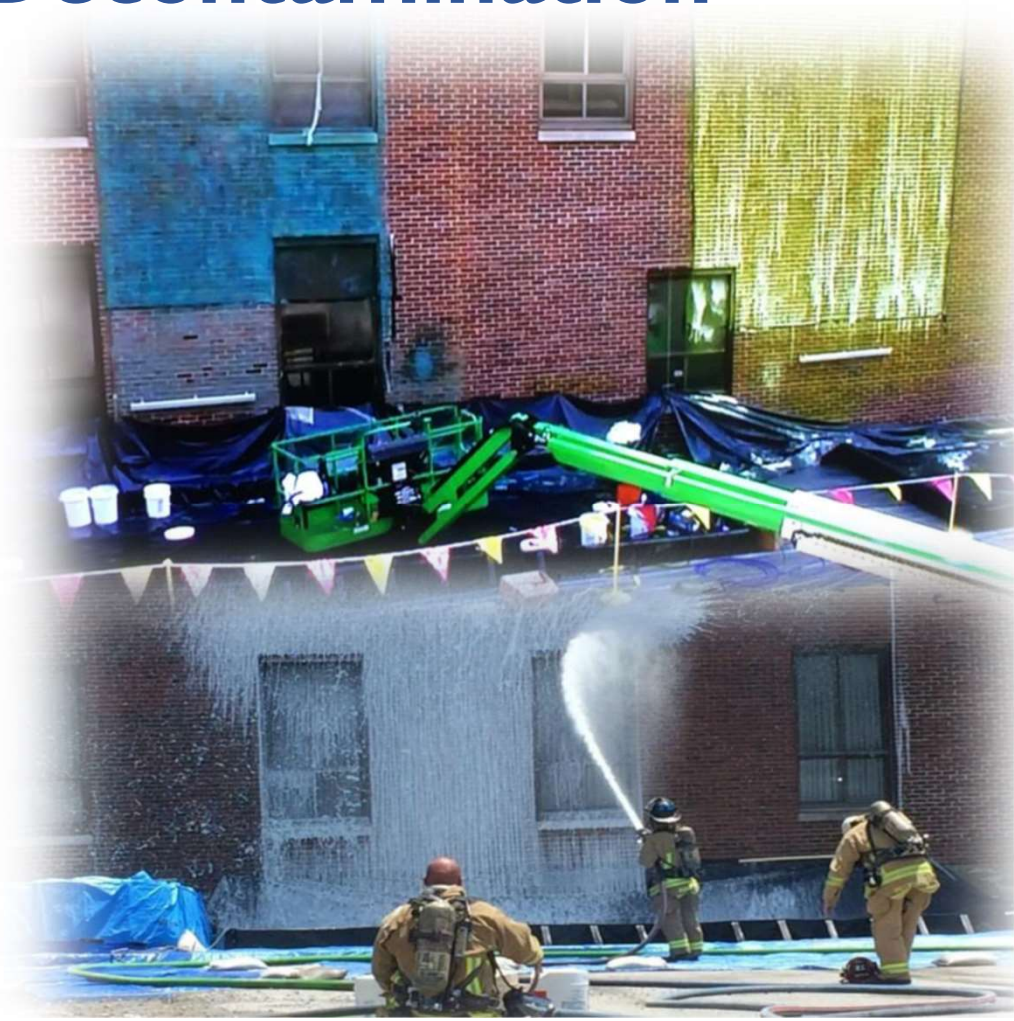
Wide-Area Incident

- Wide-area decontamination challenges:
  - Large scale
  - Dynamic nature and complexity
  - Unknowns
- Wide-area incidents may impact all or multiple of the following areas:
  - Residential/Commercial, Critical Infrastructure, Industrial, Agricultural, Natural, and Other Areas
- EPA will assist local and state government develop the decontamination strategy and/or directly decontaminate the impacted areas.



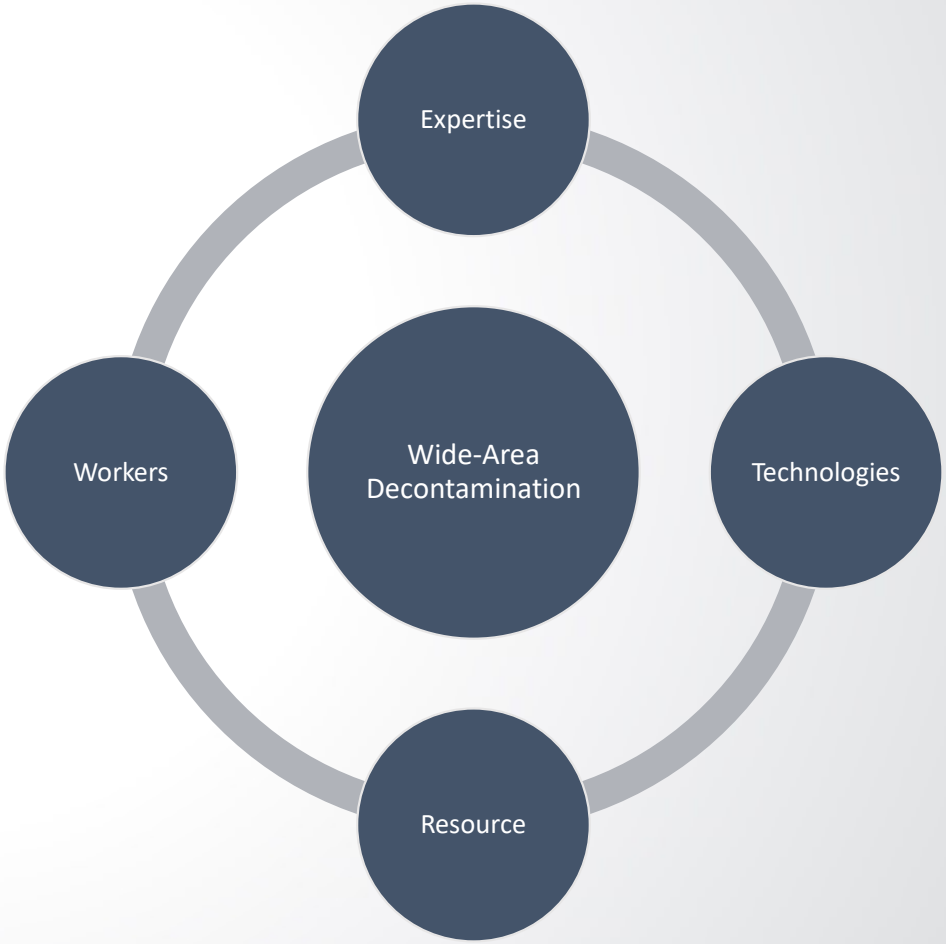
Wide-Area Decontamination

- Decontamination removes or inactivates the contaminants from the impacted area and can also stop the spread of contaminants.
- Each area might require different decontamination approaches due to urgency, future use, contamination level, surface/media types, etc.
- Wide-area decontamination requires comprehensive and systematic remediation capabilities to help impacted communities recover rapidly and safely.



Capabilities for Effective Wide-Area Decontamination

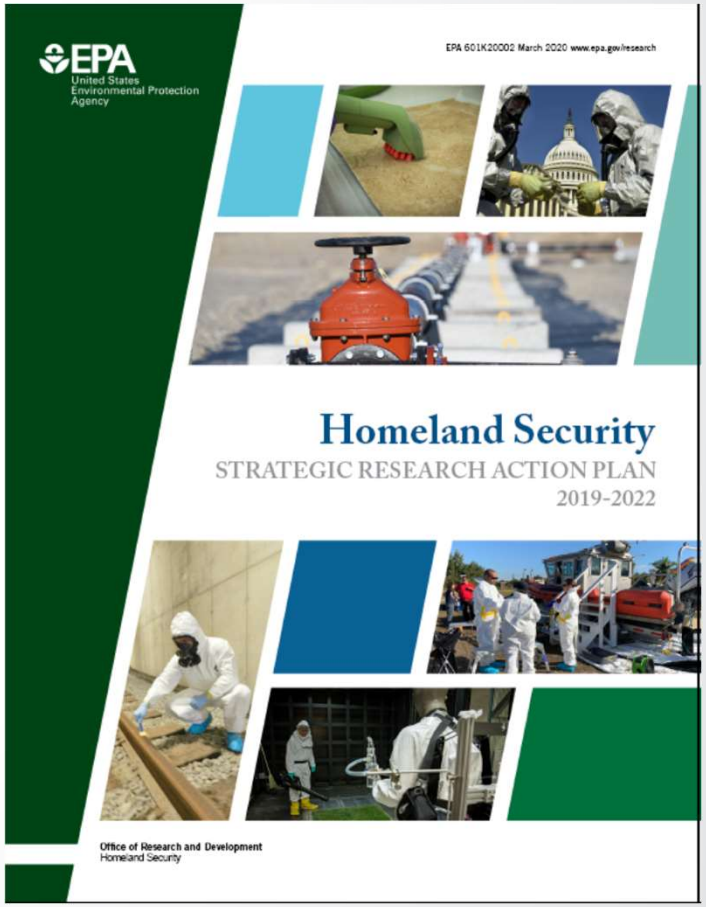
- **Expertise:** Knowledge of decontamination/mitigation options, characteristics of contaminants in the environment.
- **Methods/Technologies:** Technical and operational information of applicable and efficacious decontamination methods.
- **Resource:** Required equipment, material, utilities, and their amount and availability.
- **Workers:** Required skillset and level of efforts, availability, and worker's health and safety.



Wide-Area Decontamination Needs

Partner Needs from 2019-2022 StRAP:

- Data on wide-area, outdoor decontamination efficacy and application parameters for anthrax and non-anthrax biological agents.
- Decontamination and waste volume reduction methods for wide-area remediation.
- Self-help decontamination and/or risk reduction measures/tools/practices.
- Effective decontamination methods for porous or permeable materials for chemical warfare agents and other HS chemicals of concern.
- Nondestructive and operational decontamination methods for chemical warfare agents and toxic industrial chemicals on sensitive equipment, rolling stock, valuable items, and records.



Decontamination Method Development Approaches

- Repurposing the existing capabilities and methods
- Municipal and Commercial Equipment
- Low-tech Decontamination Methods

Method ID
- Literature review
- Stakeholder communication
- Market research

Bench Testing
- Proof of concept,
- Efficacy,
- Material impact,
- Material compatibility

Pilot Testing
- Cost/time,
- Scalability,
- Level of effort,
- Resource,
- Waste generation

Field Testing
- Capacity (Availability),
- Environmental impact,
- Challenges
- Lessons learned

Incident Response Use
- Lessons learned
- Revision of methods

Applicability of Wide-area Decontamination Research

- Researcher expertise has been improved by participating in actual incident responses, research learning, exercises and workgroups, and frequent communication and collaboration with customers.
  - Actual Incidents: Anthrax, Ebola, Pesticides, Opioids, Fukushima, UK incident
  - Field Studies: BOTE, UTR, AnCOR, Rad Demo
  - Exercises: Liberty RadEx, Gotham Shield, Northern Lights
- Experience and expertise has been applied to relevant and applicable products, guidance, technical support, and collaborations.
- Experience also ensures that products are developed within a systems approach.

Evaluation of Decontamination Options for Non-Spore-Forming Agents in Soil

PIs: Worth Calfee, Joe Wood, Shannon Serre

- **Need:** Effective decontamination approaches for soil contaminated with non-spore-forming agents.
- **Scientific Approach:** Conduct laboratory experiments with several soil types (clay, sand, loam), and several agents (VEE, B.p., Y.p.), to identify effective chemistry and conditions.
- **Impact:** Develop effective decontamination method, ahead of an incident, so that remediation can proceed without delay.
- **Next Step:** Conduct testing in large scale and develop operating procedures for field-use.

Material Compatibility of Sporicides

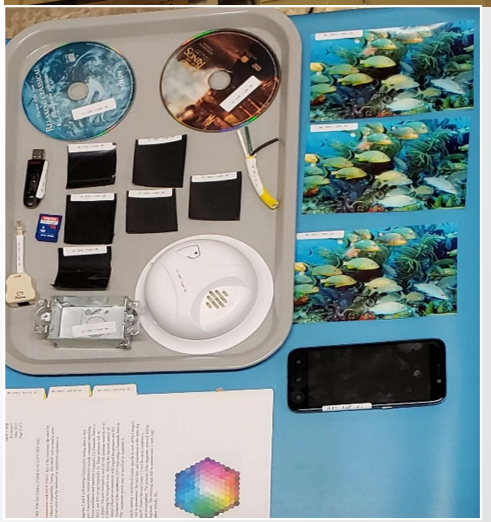
PI: Joseph Wood

- **Need:** Understand impacts that decontaminants (those determined to be effective in inactivating *B. anthracis* spores) might have on various types of equipment and materials, such as computers, other electronics, and metals.

- **Scientific Approach:** Expose materials/equipment to decontaminants at the conditions known to inactivate spores, and then monitor for corrosion and other visible degradation, and test for functionality issues over several months.

- **Impact:** In the event of an anthrax release, these studies will inform decisions about which sporicidal decontaminants to use for various materials and equipment.

- **Next Step:** Evaluate impacts of liquid sporicides such as pH-adjusted bleach, dichlor, and peracetic acid.



Neutralization of Ricin Toxin

PI: Joseph Wood

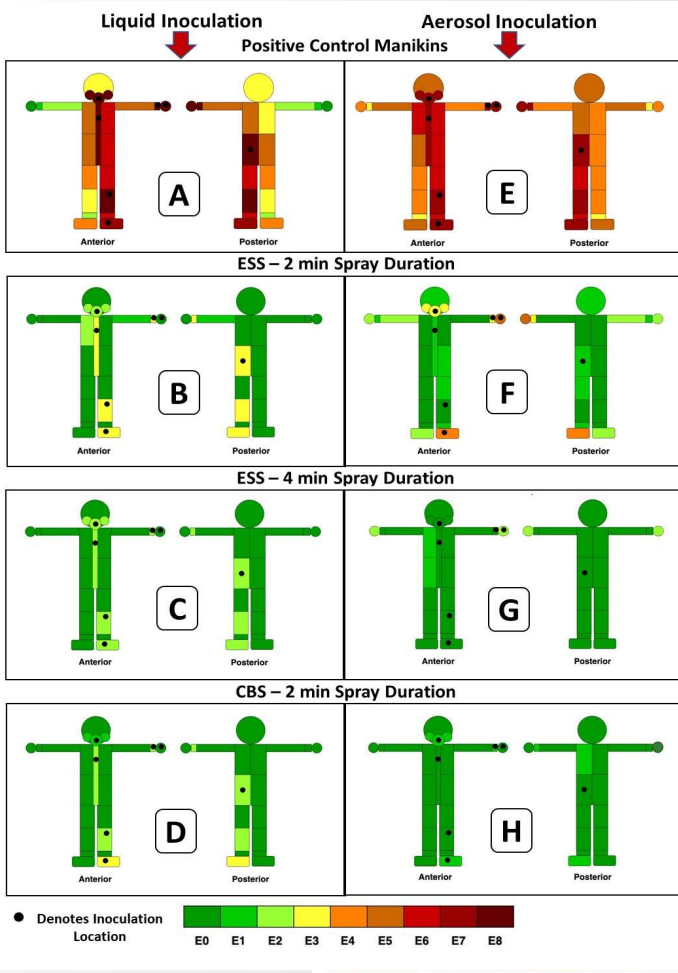
- **Need:** Evaluate the efficacy of methods to decontaminate materials contaminated with ricin and other biotoxins.
- **Scientific Approach:** Various types of materials are inoculated with the toxin (crude or pure form) and then exposed to the decontaminant. Following the contact time of the decontaminant, any remaining ricin is recovered from the materials and quantified using a cytotoxicity assay.
- **Impact:** Inform decisions about which decontaminants to use in the event of a ricin contamination incident.
- **Next Step:** Evaluate the use of liquid decontaminants such as bleach, and the use of low concentration hydrogen peroxide vapor.

Sample collection Oshkosh, WI
From OSC webpage

Personnel Decontamination Line Sprayer Options for BIO Contamination Incident Response

PI: John Archer

- **Needs:** Scientific basis for data-driven decisions regarding personnel decontamination for responders
- **Scientific Approach:** Determine decontamination efficacy, reaerosolization potential and optimized operational parameters using controlled spore inoculations
- **Impacts:** Provide EPA and other responders with scientific data on conventional and innovative options (sprayers/decontaminants) for conducting personnel decon for biological agent response
- **Next Steps:** Scale up, optimization and automation of personnel decon process



Personnel Chemical Decontamination Line Options for the Responder

PIs: Lukas Oudejans and John Archer

- **Needs:**
  1) Evaluation of responder **Wipe-Spray-Wipe (W-S-W)** personnel decon process.
  2) I*n situ* degradation options for **fentanyl** on responder PPE.

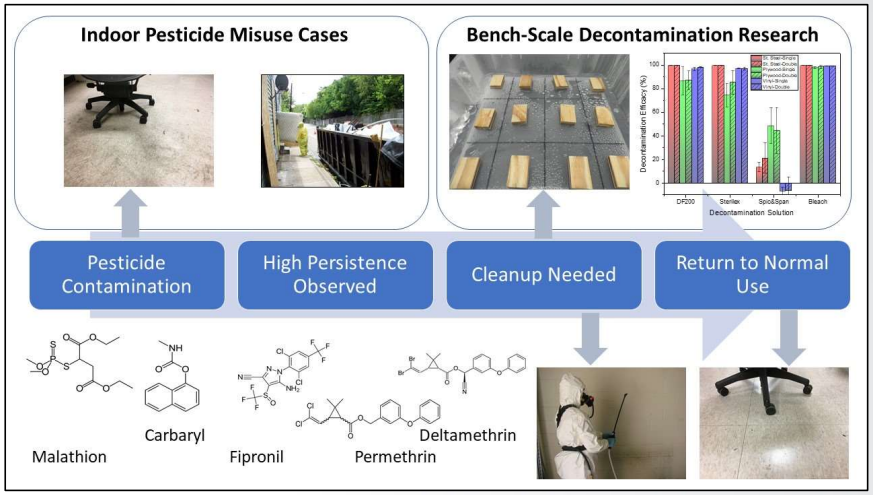
- **Scientific Approach:**
  1) Assess efficacy of **W-S-W** decon for chem/bio through degradation or physical removal from PPE.
  2) Assess efficacy and application of various decontaminants with a short (5 min or less) dwell time for **fentanyl** on PPE related materials.

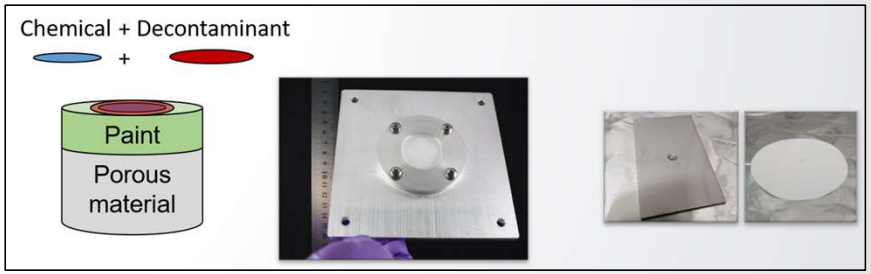
- **Impact:**
  1) Provide FBI and responders evaluation of effectiveness for in-use **W-S-W** personnel decon process.
  2) Identification of effective decontaminants for **fentanyl** that reduce exposure risks and minimize cross contamination.

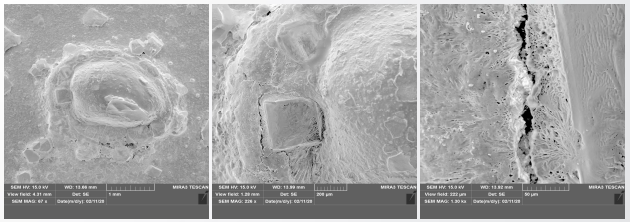
Surface Decontamination Methods for Pesticides

PI: Lukas Oudejans and Katherine Ratliff

- **Need:** Pesticide mis- and overuse continues to occur (e.g., bedbug infestation remediation attempts) leading to contaminated properties that require cleanup.
- **Scientific Approach:** Assess efficacy of decontaminants that degrade relevant pesticides on indoor building materials.
- **Impact:** Identify effective decontaminants that degrade pesticides on surfaces.
- **Next Step:** Assess effective decontamination approaches for pesticides that have transferred into permeable materials.



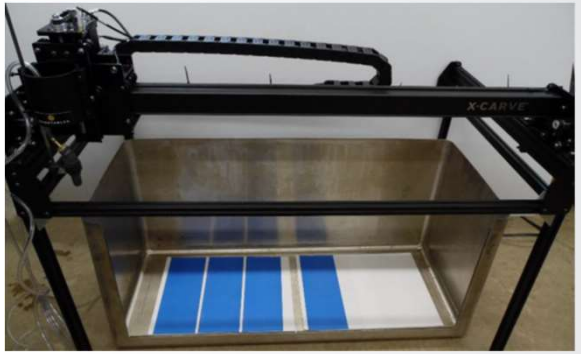


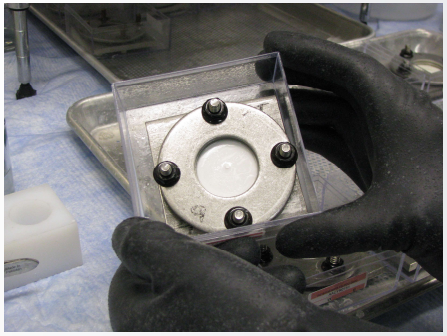


Decontamination of Materials Contaminated with Persistent Chemical Warfare Agents (CWAs)

PI: Lukas Oudejans

- **Need:** Decontaminants for sensitive equipment and approaches for permeable/porous materials contaminated with persistent CWAs are lacking.
- **Scientific Approach:** Assess efficacy of decontaminants that do not degrade sensitive material/equipment and approaches that can degrade a permeated persistent CWA.
- **Impact:** Identification of effective decontaminants to improve decontamination strategies.
- **Next Step:** Implementation during OTECRA; incorporation of outcomes in Decontamination Strategy and Technology Selection Tool (DeconST).





Homeland Security Science and Technology

Sandia National Laboratories

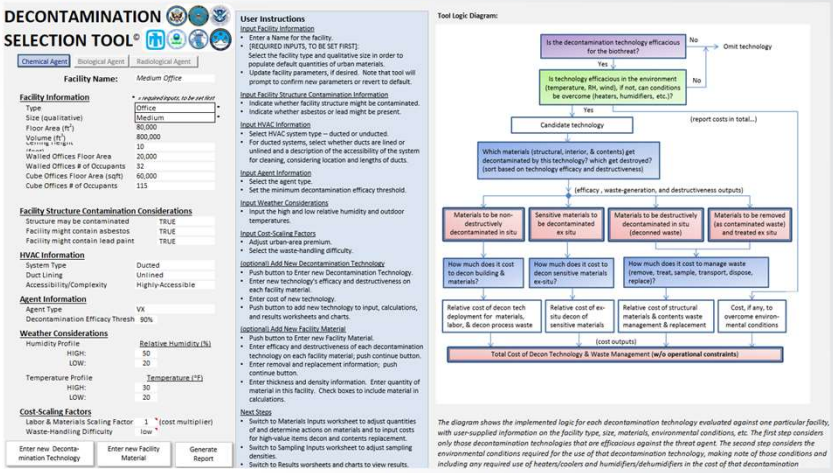
Decontamination Strategy and Technology Selection Tool

DeconST

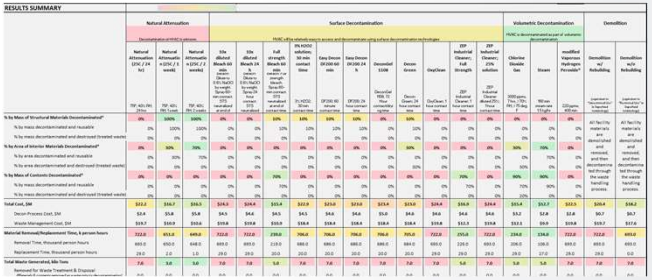
PI: Lukas Oudejans and Paul Lemieux

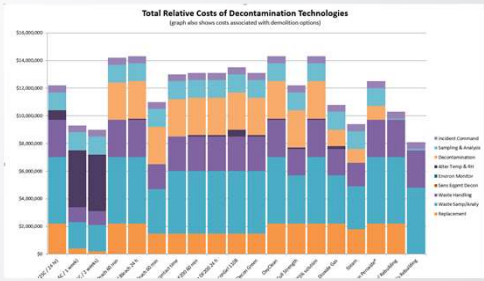
- **Need:** Development of facility-specific, efficient, and effective remediation approaches following contamination with a chem agent.
- **Scientific Approach:** Development of a comprehensive, data-rich framework considering decontamination options.
- **Impact:** Tool for use by a technical working group to provide recommendations to the intelligence community on decontamination tactical approaches.
- **Next Step:** Expansion to other persistent chemicals of concern pending availability of efficacy data.

User Input:



Outputs:





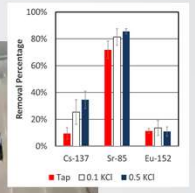
Integrated Wash-Aid, Treatment, and Emergency Reuse System (IWATERS)

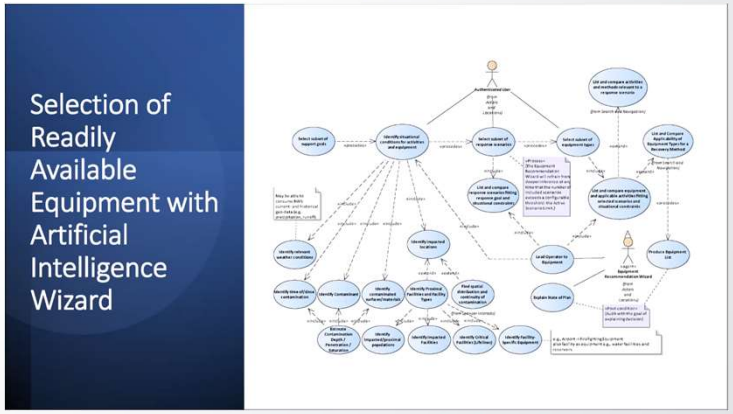
PI: Matthew Magnuson

- **Need:** Develop an on-site approach to re-use water for washing buildings, vehicles, and paved surfaces, including wash water containment and treatment.

- **Scientific Approach:** Evaluate equipment and supplies which are readily available. Optimize logistics of technology planning and implementation.

- **Impact:** Reduce exposure to first responders, emergency workers, and population near contaminated sites. Eliminates the need to dispose of potentially billions of gallons of rad-contaminated wash water.

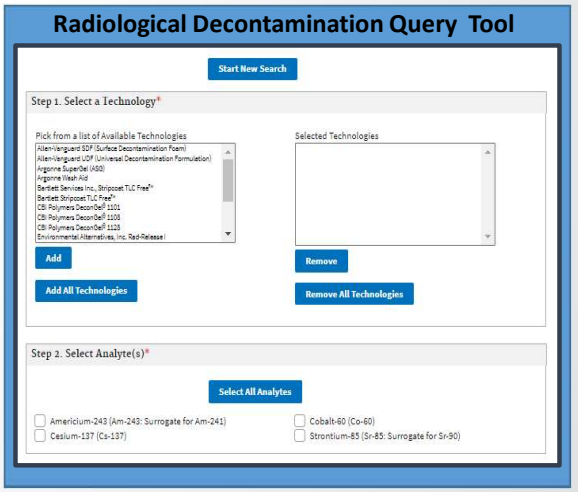




Assessment of Non-Destructive Decontamination Methodologies for Contaminated Roofing Material Surfaces

PI: Kathy Hall

- **Need:** Reliable data for decontamination technologies to determine their ability to remove radioactive contamination from urban surfaces.
- **Scientific Approach:** Perform technology evaluations obtaining radiological contamination removal and operational data supporting decision-makers in the selection and use of roofing material decontamination technologies.
- **Impact:** This research will be usable by decision-makers after a radiological incident in determining whether technologies tested can be used in their communities to clean up contaminated roofs.
- **Next Step:**
  - Add roofing research results to the Radiological Decontamination Query Tool (https://www.epa.gov/emergency-response-research/radiological-decontamination-query-tool)
  - Research planning for decontamination of Urban High Value Interiors



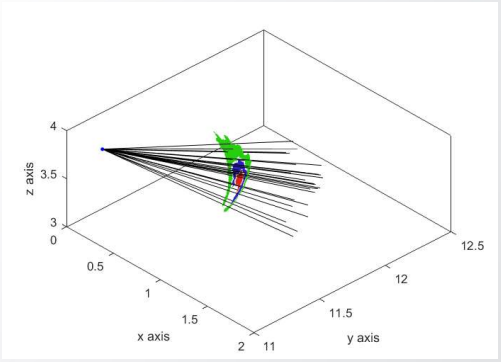
Integrated Rad Remediation Decision Support Tool

PI: Timothy Boe

- **Need:** System to help responders perform radiation field surveys in support of contamination assessments, compliance for environmental release, or a national security response. The volume of data, range of operator experience, interface, and data integration from these field surveys are challenges for first responders.

- **Scientific Approach:** Develop system capable of importing/ingesting composite gamma-optical 2D images and facilitating accurate spatial contamination area calculations.

- **Impact:** Streamline the processing of the 2D gamma-ray imagery and improve estimates for informing remediation strategies.



Washdown Research

PIs: Worth Calfee, John Hall, Anne Mikelonis, Katherine Ratliff

- **Need:** Understand the efficacy of wash-aids for decontaminating outdoor surfaces after a biological incident.
- **Scientific Approach:** Garden hose and pressure washer experiments (lab and outdoor tests) measuring the removal of Bg spores from parking lots using:
  - Tap Water
  - NaCl (1 mM)
  - Instant Ocean Salt Water
  - Tween 20 (0.01 %)
  - SDS (0.01 %)
- **Impact:** Dataset to aid emergency responders faced with site needing spore removal.
- **Next Step:** Flushing study of permeable pavement and bioswales.

Test cells for wash-aid experiments

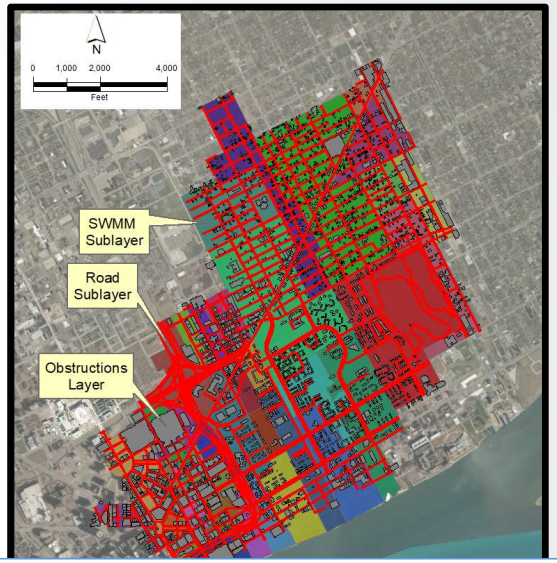
Stormwater Research for Emergency Response

PIs: Jim Goodrich, John Hall, Anne Mikelonis, Katherine Ratliff

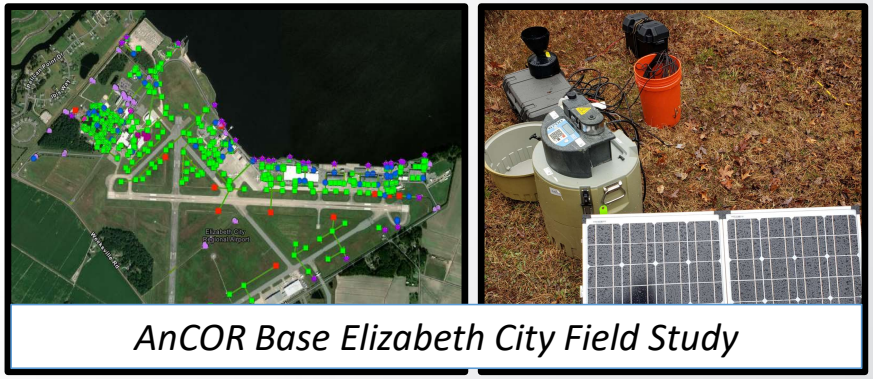
- **Need:** Predictions of contaminant fate and transport during emergency response and recovery efforts.

- **Scientific Approach:** Thru modeling and lab/field studies, develop new capabilities with stormwater modeling tools to support flexible contamination mapping. Including development of:
  - Stormwater Emergency Response Framework (SERF)
  - Stormwater decontamination website
  - Table-top exercise development & modeling case studies
  - Field studies with tracers to develop model parameters
  - Coupling of optimization algorithms with stormwater models for resource placement

- **Impact:** Flexible mapping support for site characterization, sampling, decontamination, and waste staging.



Stormwater Modeling Case Studies



AnCOR Base Elizabeth City Field Study

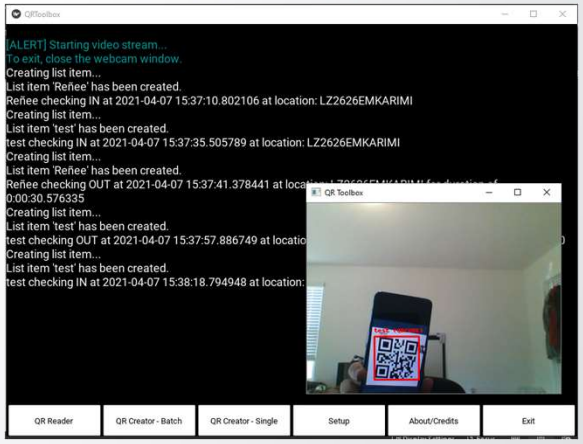
Quick Read Toolbox

PI: Timothy Boe

- **Need:** A process to track equipment and resources, including responders. For large-scale incidents, the response can often require tracking thousands of records across a large geographical area.

- **Scientific Approach:** Developed a system using commercial off-the-shelf webcams and open-source software for generating or scanning quick response (QR) codes as a means for recognizing, recording, and sharing the location, duration, and status of resources.

- **Impact:** The system can easily be networked and communicate with satellite locations, maintaining a centralized database of records. The QR Toolbox serves as a free-to-use, customizable, and easily deployable solution capable for tracking assets in the field during emergency responses.



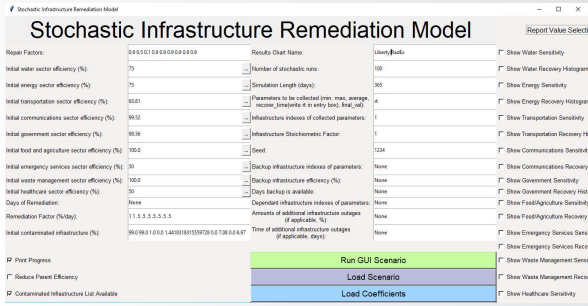
Critical Infrastructure Modeling

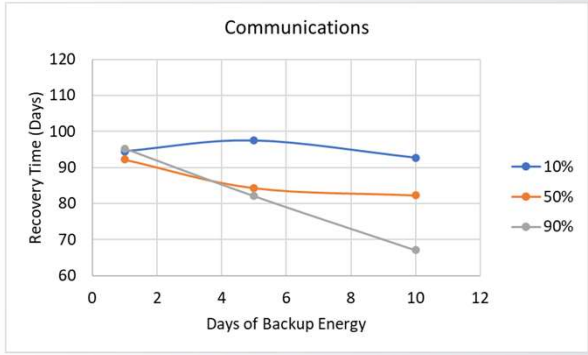
PI: Timothy Boe

- **Need:** Large-scale CBRN incidents have the potential to damage core infrastructure assets. In order to more effectively respond to and remediate following such events, information about interconnected infrastructure systems is necessary to bring services back online as quickly as possible.

- **Scientific Approach:** Simulating interconnected infrastructure systems using a stochastic modeling process to obtain information regarding infrastructure relationships and influence.

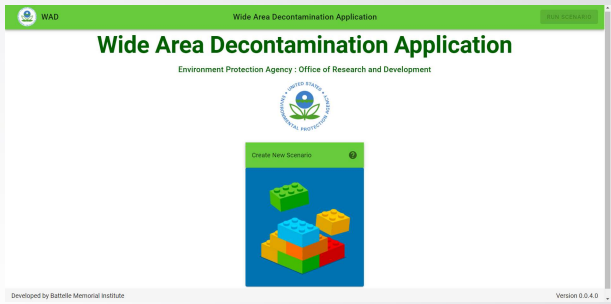
- **Impact:** This approach can assist in emergency response and decision making in several ways:
  - The estimated time to recovery can be assessed based on the initial scenario parameters and can be adjusted and recalculated as new information becomes available.
  - The repair factors can also be adjusted to model the prioritization of infrastructure recovery by setting infrastructures that are more prioritized with higher relative repair factors.
  - The benefits of adding backups can be assessed for decision making with initial incidents – deciding which infrastructures would benefit the most from backups can be assessed.

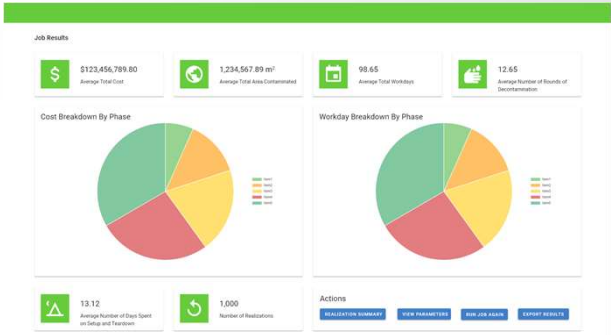


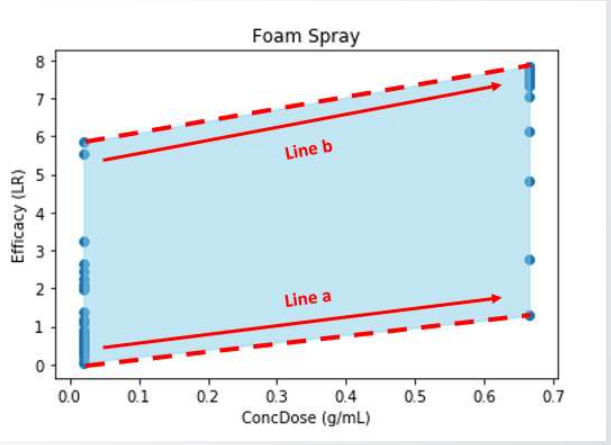


Infrastructure Sector	Recovery Time (days)
Energy	99.94
Water and Wastewater Systems	99.79
Healthcare	68.72
Emergency Services	35.99
Transportation Systems	35.21
Government Facilities	15.81
Communications	11.14
Food and Agriculture	0.0
Waste Management	0.0

Wide-Area Decon Modeling







PI: Timothy Boe

- **Need:** It is important to estimate the demands associated with a wide-area biological event in order to better prepare for future incidents. As such, a modeling tool was needed to characterize wide-area indoor, outdoor, and underground biological incidents and estimate the cost, time, and resources associated with the decontamination of these site areas.

- **Scientific Approach:** Probabilistic model for estimating cost, time, and resource demands for a wide-area biological incident. Define a series of equations to characterize each step of the decontamination process, including the sampling of surfaces to define initial contaminant levels, removal of waste from the site area, and the decontamination of actual surfaces.

- **Impact:** The ability to estimate the cost of decontaminating such an incident, as well as the time and resources required to do so, is critical to being sufficiently prepared for a wide-area decontamination effort.

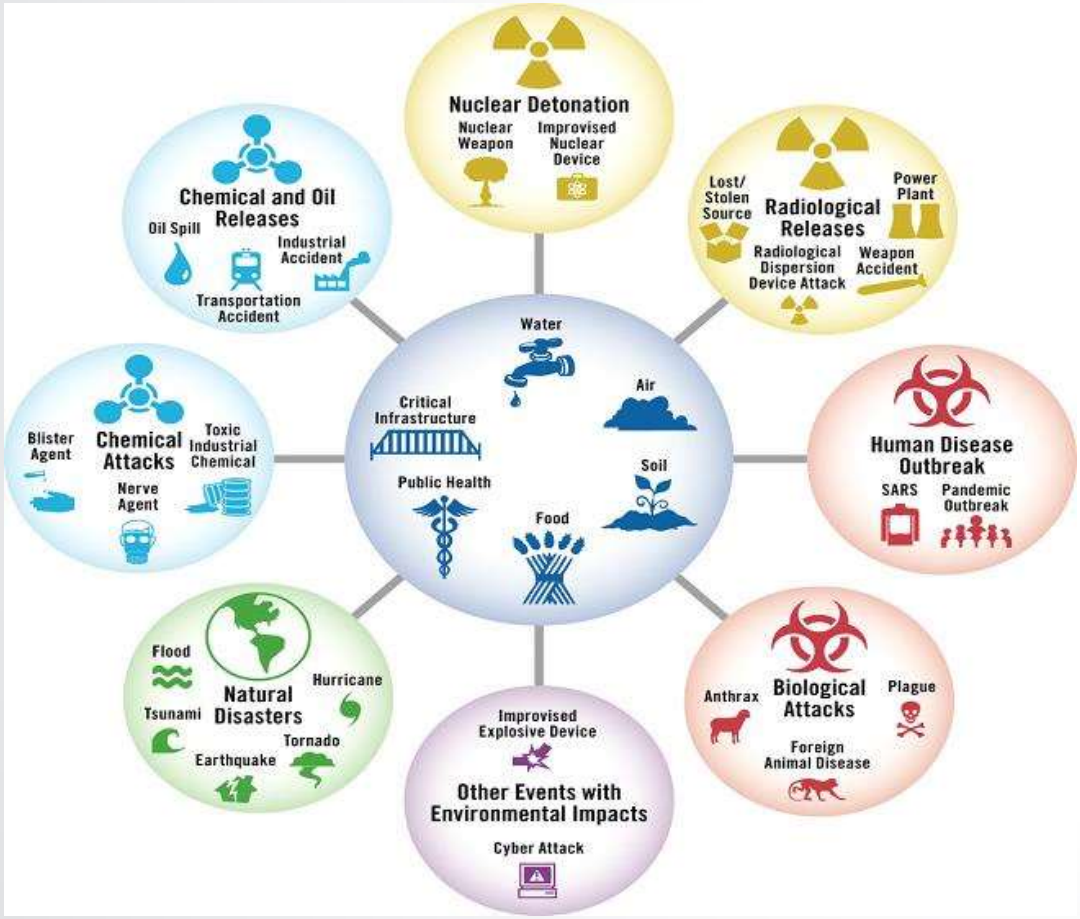
CQ3: Waste Management Research

Overview of Waste Management Research

Emily Snyder

Board of Scientific Counselors
Homeland Security Subcommittee Virtual Meeting
Day 3, May 19, 2021

Waste and Materials Management Challenges



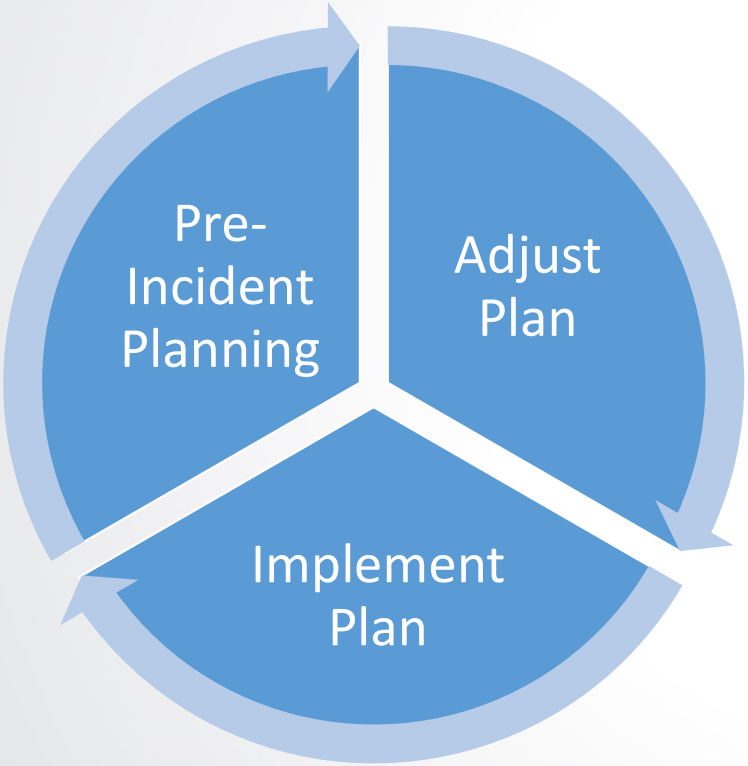
Tomioka Town Park – Temporary Storage Facility

Waste Management Research Needs

- Waste Minimization and On-Site Waste Treatment
- Waste Characterization
- Waste Staging/ Transportation
- Off-site Treatment and Disposal

Pictures of large-scale demonstrations illustrating examples of processes where waste is generated.

Waste & Materials Management Planning



Flooding in Ellicott City over Memorial Day weekend of 2018. Image by Baltimore Magazine licensed under Creative Commons.

Soccer field being used as a landfill in Puerto Rico Courtesy José Jiménez-Tirado for NPR

Benefits of Pre-Incident Planning

- Saves valuable time and resources during an incident.
- Allows more efficient and effective waste management decision-making during an incident.
- Encourages stakeholders to work together before an incident occurs - helps agencies identify relevant stakeholders.
- Boosts the community's resilience.
- Aligns with the response & recovery efforts.
- It has been shown that pre-incident planning is essential in helping communities more quickly respond to natural disasters.
- Due to the complexity of wide area CBR incidents, it is even more important to create pre-incident waste management plans.

Waste Management Research

Outreach to Stakeholders

Effective Management of Waste and Materials

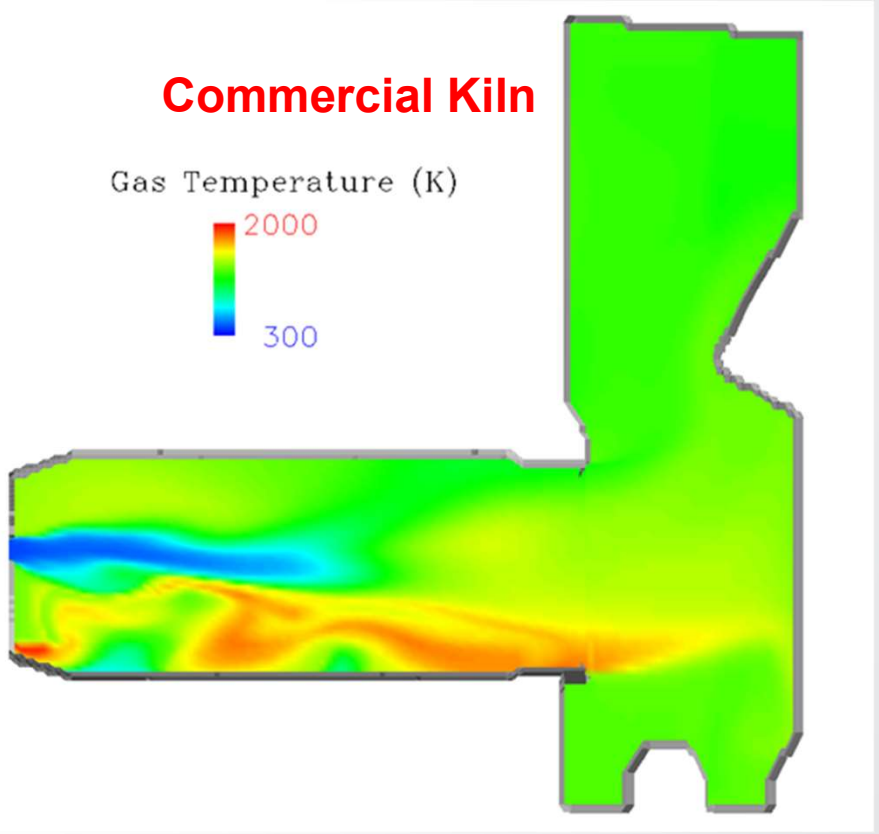
Social Science Considerations for Waste and Materials Management (WMM)

- Disaster waste and materials management is time-consuming, costly and essential to community recovery and resilience.
- There are stories from the field about implementation challenges- "social acceptance".
- See Lighting Talk "Social Considerations for Disaster Waste Management" by Keely Maxwell, Ph.D.

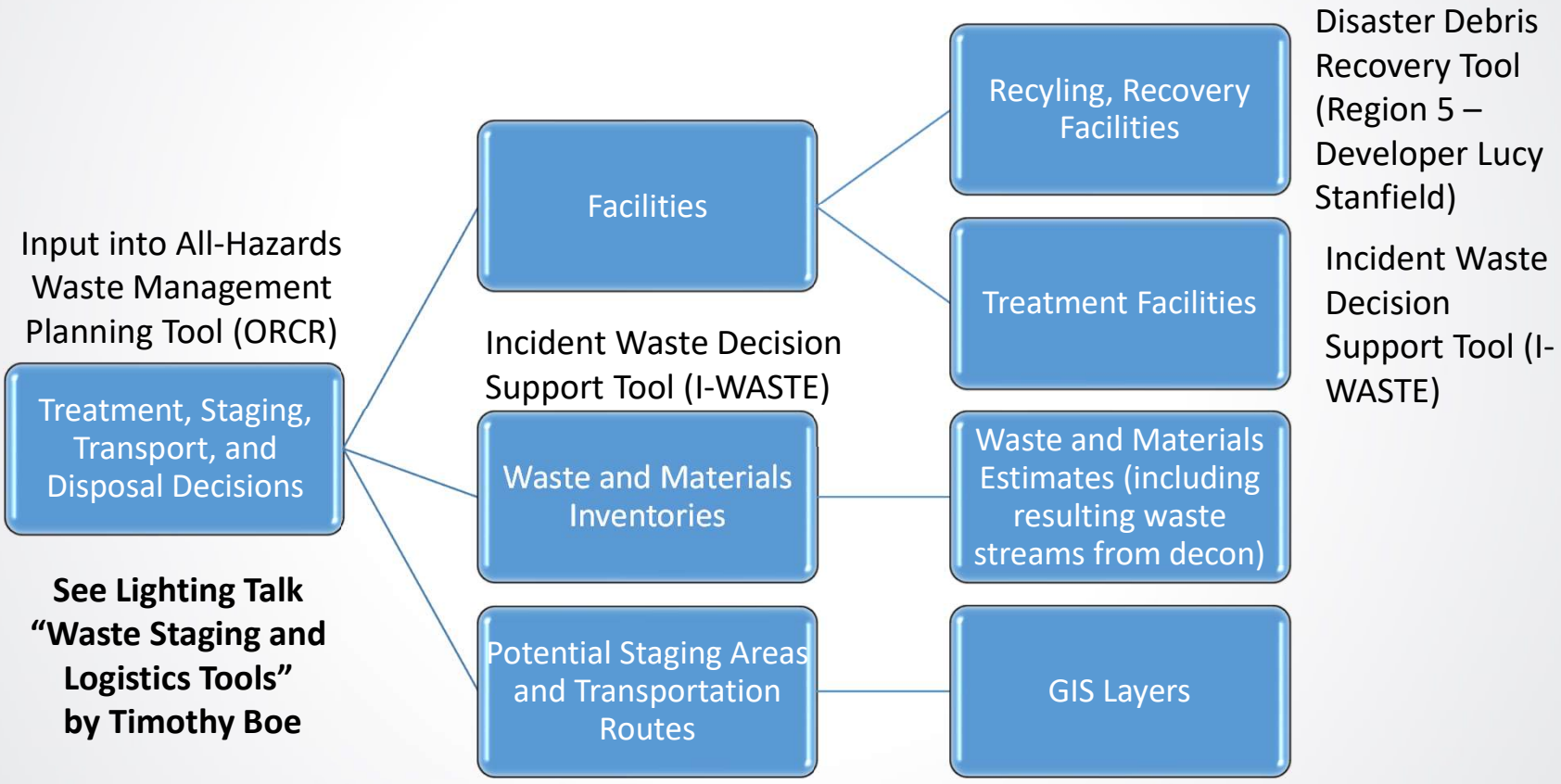
Hurricane Katrina damages courtesy Paul Signer USA today

Waste Management Approaches

- Assesses methods for treatment of chemically and biologically-contaminated materials through:
  - Modelling
  - Lab Studies
  - Field Studies
- Develop and assess methods for management of carcasses. (Collaborative effort with USDA)
- See Lightning Talks by Paul Lemieux, Ph.D.
  - Configured Fireside Simulator
  - AnCOR – Waste Management
  - Assessment of the Biosecurity of Animal Mortality Size Reduction Using Horizontal Grinders Prior to On-Farm Composting



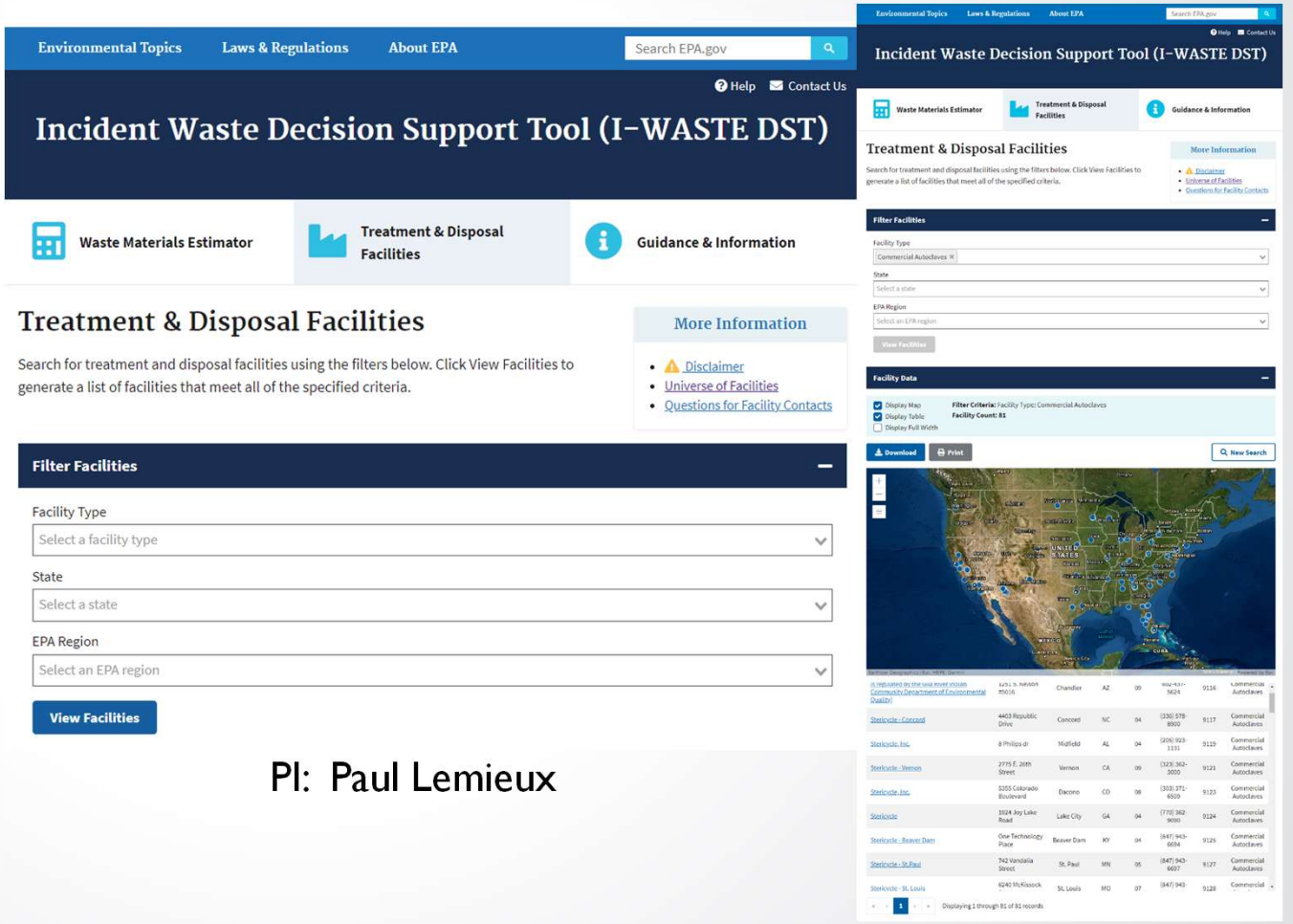
WMM Decision Making



Incident Waste Decision Support Tool (I-WASTE)

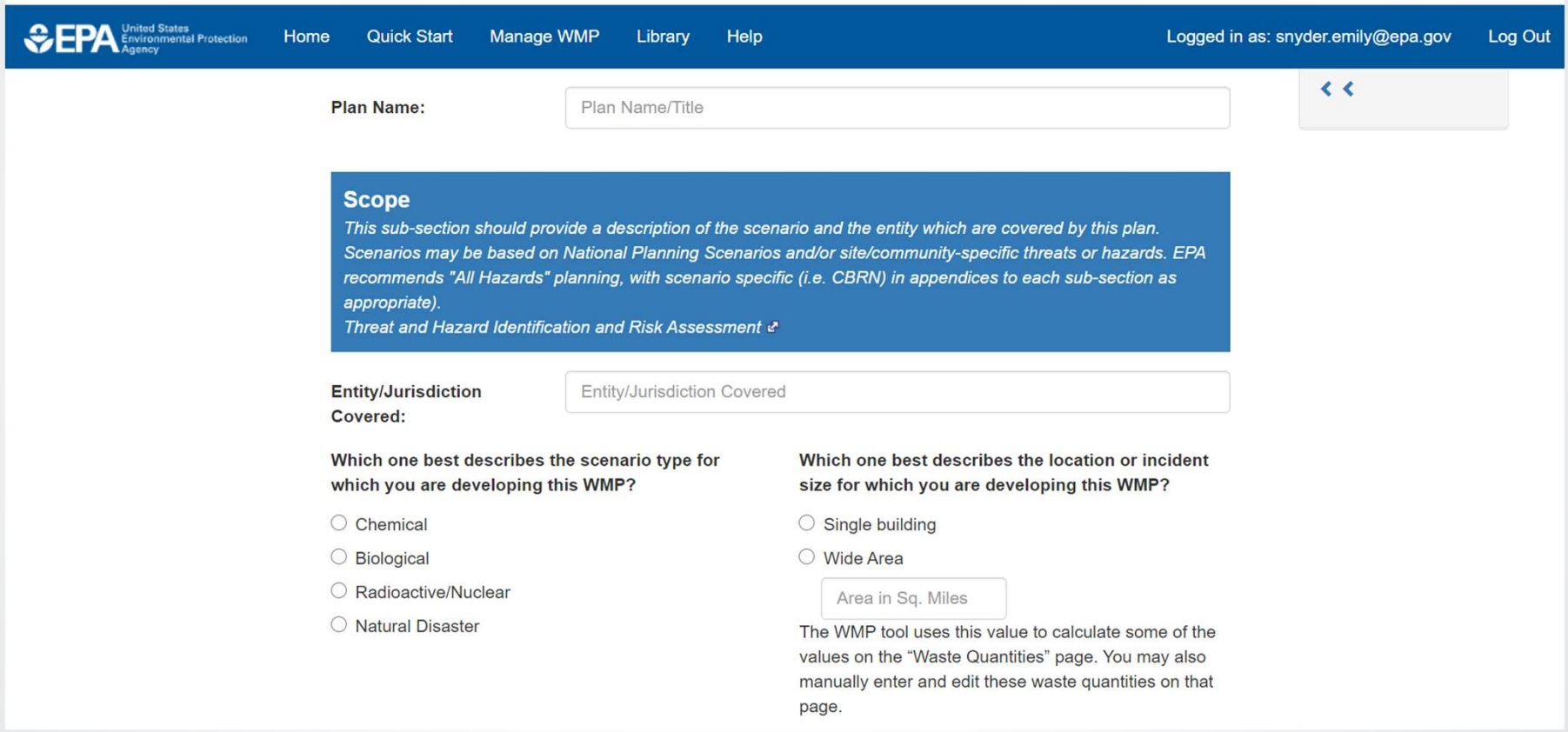
Disposal & Treatment Facilities, Relevant Waste Management Guidance & Info, I-WASTE:

- Web-based tool
- Database of treatment/disposal facilities (location, technical information, permits, geolocation)
- Access to contaminant and decontaminant information
- Guidance for worker safety, packaging and storage, and transportation
- Linked to other pre-planning tools (e.g., ORCR AHWMPT)



PI: Paul Lemieux

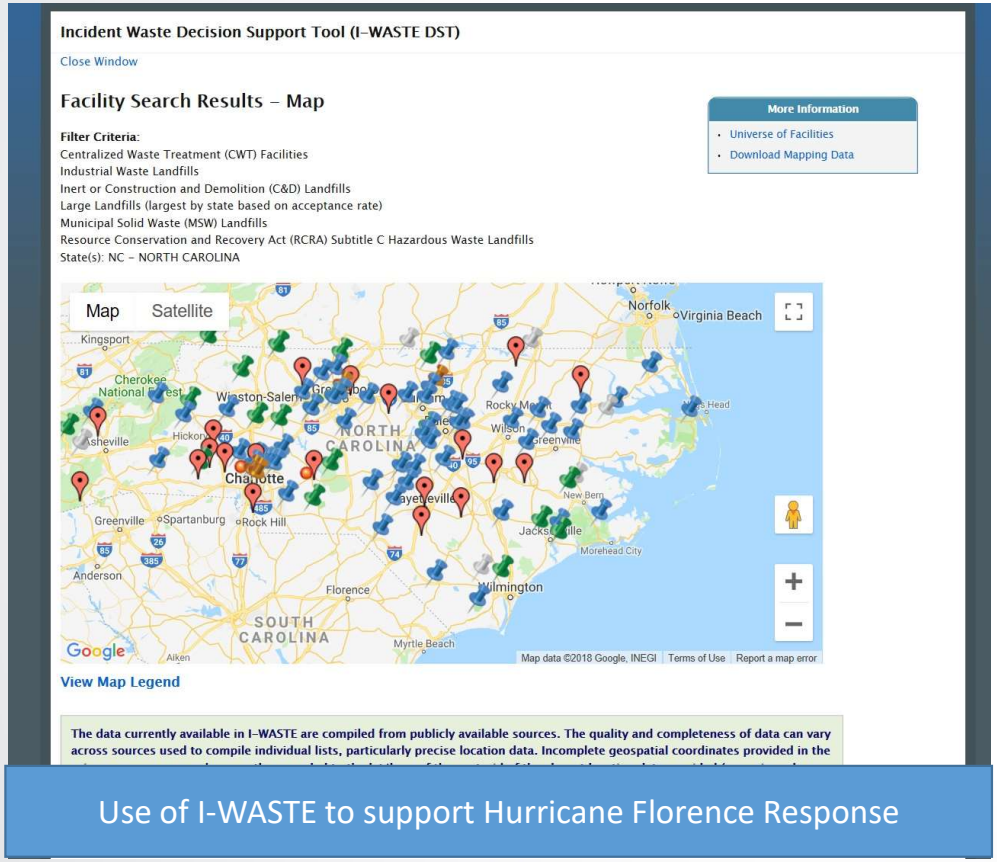
All-Hazards Waste Management Planning Tool [AHWMPT] (ORCR)



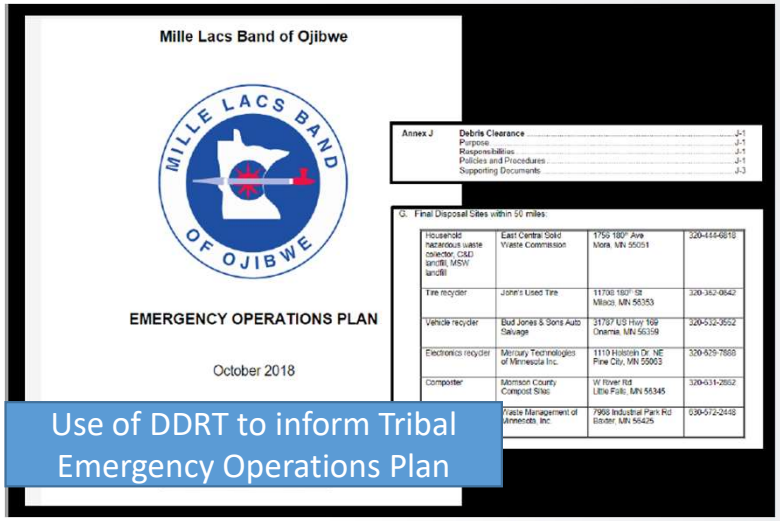
Developer: Anna Tschursin

Integration of WMM Tools

Tool Use in Disaster Planning, Exercises and Responses

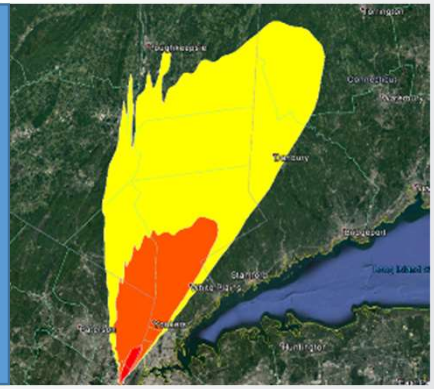


Use of I-WASTE to support Hurricane Florence Response



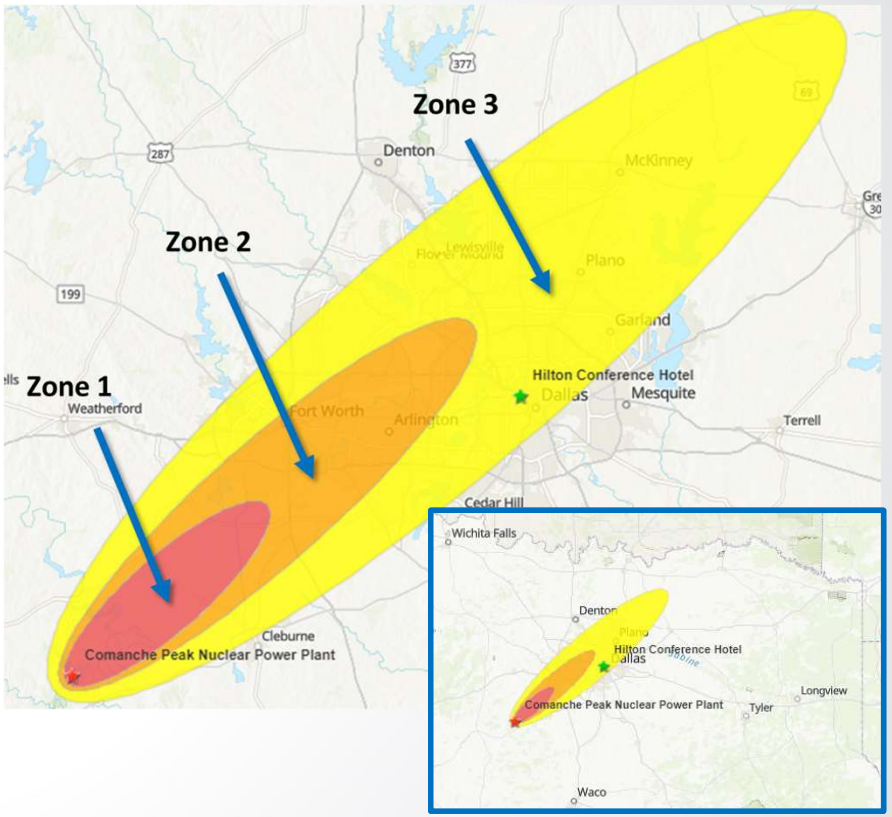
Use of DDRT to inform Tribal Emergency Operations Plan

Use of WEST to provide waste quantity estimations for the Gotham Shield Exercise, response to an Improvised Nuclear Device in NYC



WMM Outreach Activities

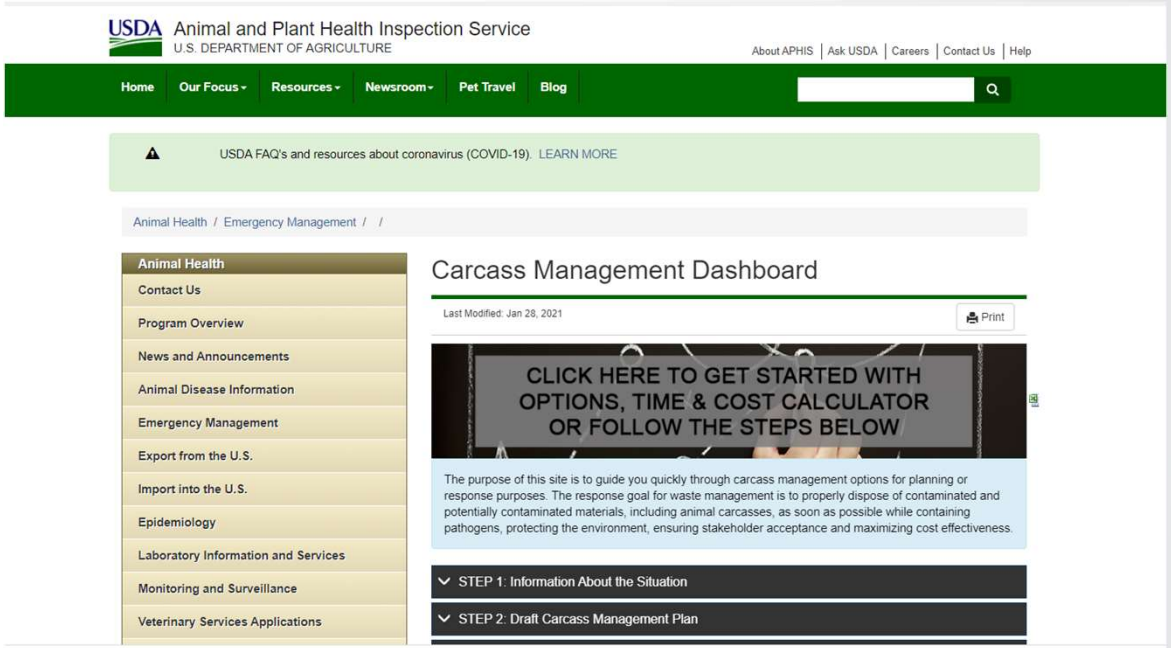
- For the tools, we are (in collaboration with ORCR and Region 5):
  - Working with states on tool development and collaborating with international organizations to expand their use.
  - Developing case studies where we show what information can be gleaned from the tools and how it can be used for decision making.
  - Presenting an interactive framework to key stakeholders.
  - Promoting use of tools in exercises.



Case Study Scenario: Nuclear Power Plant Accident in Dallas, TX metro area.

WMM Outreach Activities

- Including treatment data and processes in guidance documents, CONOPS, and relevant tools.
- Use case studies to conduct outreach on social science considerations.



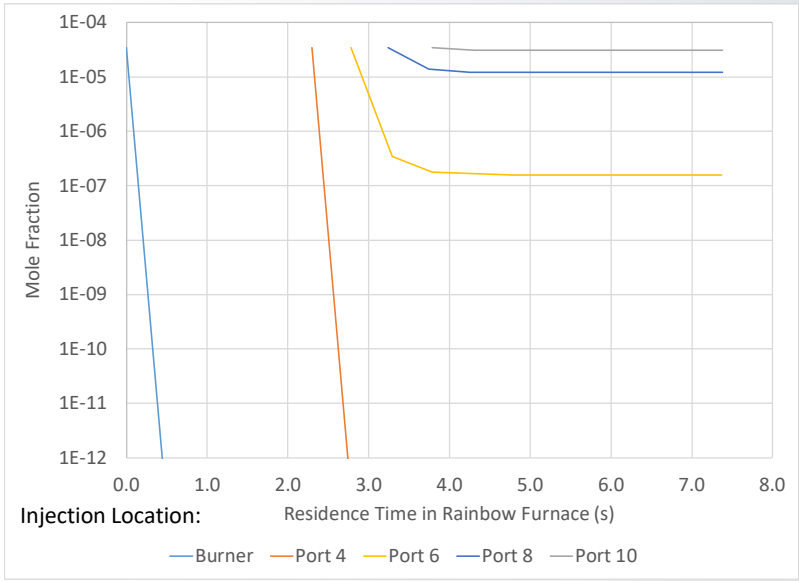
https://www.aphis.usda.gov/aphis/ourfocus/animalhealth/emergency-management/carcass-management/carcass

Configured Fireside Simulator

PI: Paul Lemieux

- **Need:** Waste treatment technologies for chemically and biologically-contaminated materials. RCRA permits are required for incineration – need to identify operating parameters for maximum destruction of contaminants and conditions that do not result in unacceptable levels of emissions.

- **Scientific Approach:** Adapted for EPA to run "what if" scenarios of waste streams contaminated with chem/bio agents. Utilizes innovative computational techniques to model 3D reacting flow on standard desktop PC. Destruction kinetics based on:
  - Mechanistic data for CWAs (GB, VX, HD, H, HT)
  - Bench- and pilot-scale test data for biological agents (*B. anthracis* surrogates)
  - NIST fluorinated chemical kinetics reaction set for C_1 C_2 PFAS



Example C_2F_6 Predictions (C_2F_6 Injection)

Configured Fireside Simulator

PI: Paul Lemieux

- **Impact:** Ability to explore operational methods and develop potential combustion modifications to maximize PFAS destruction, minimize by-product formation.

- **Next Step:** Exploring opportunities to: 1) perform PFAS field tests at full-scale facilities and compare model predictions to test data, 2) include more complex PFAS molecules in kinetic reaction set, 3) include mixed chloro- fluoro- species. Exploring potential opportunities for addressing software licensing issues to allow for greater distribution.

Biological Waste Treatment

PI: Paul Lemieux

- **Need:** Ability to sample CDC Category A pathogen-containing wastes (specifically *B. anthracis)* generated during a wide-area incident. Scalable method for on-site waste treatment of *B. anthracis* contaminated materials.
  - Generate samples that laboratories can process and analyze.
  - Treatment methods exist but difficult to scale and operationally difficult to implement for some waste streams.
  - Transportation problematic for Category A pathogen contaminated waste.

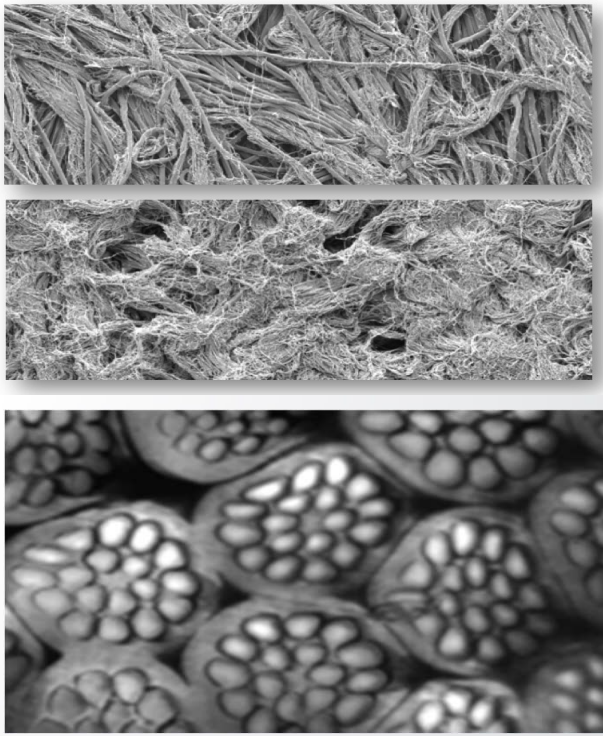
- **Scientific Approach:** Identify sample waste materials to be collected, review existing sampling strategies and protocols for applicability to solid wastes generated and recommend potential modifications to make current methods applicable. Evaluate modified methods in laboratory bench-scale testing. Develop semi-permeable waste bag material (fumigants can get in; spores can't get out). Bench-scale tests to verify effectiveness of concept.

Biological Waste Treatment

PI: Paul Lemieux

- **Impact:** On-site treatment of waste that contains CDC Category A pathogens would greatly reduce waste management cost for wide-area biological incident. Ability to treat and sample waste after it has been bagged up will greatly simplify waste sampling efforts and minimize worker exposure.

- **Next Step:** Bench-scale tests started in March 2021 with AnCOR field test planned for May 2022. Develop a CONOPS for waste treatment upon completion of field tests.



Supporting Foreign Animal Disease Response Preparation: African Swine Fever Waste Size Reduction

PI: Paul Lemieux

- **Needs:** African Swine Fever virus (ASFv) outbreak ongoing in Asia. On-farm composting of ASFv infected carcasses is preferred; grinding pig carcasses will reduce composting time significantly, however, grinding process may cause potential for aerosol release of virus particles.

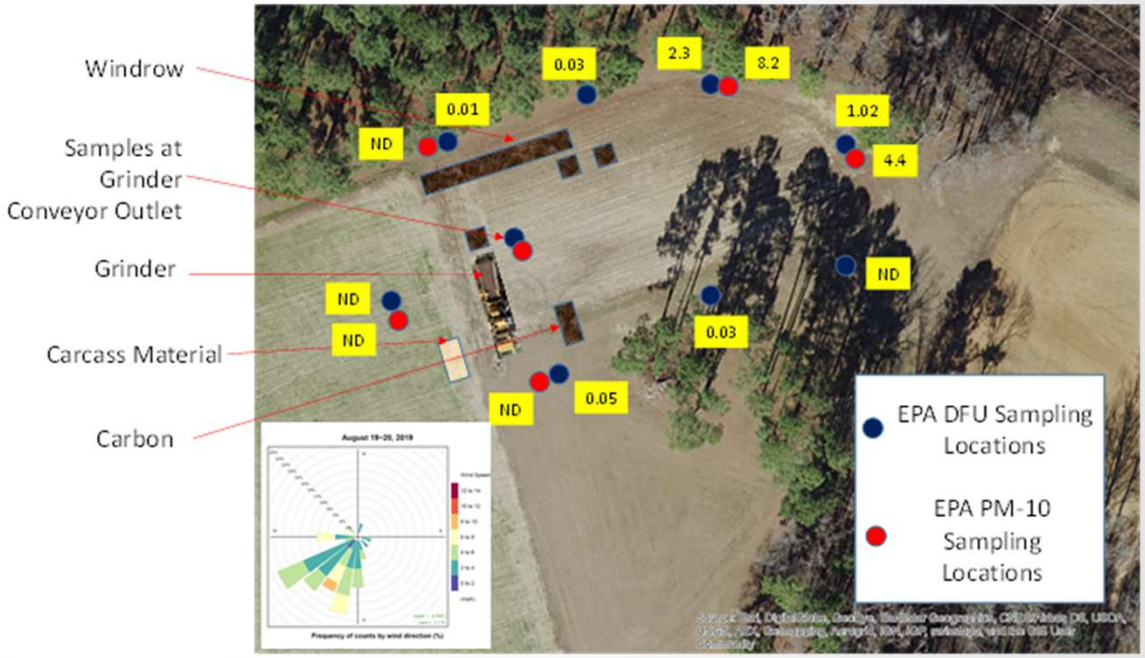
- **Scientific Approach:** Evaluate grinding method by measuring air emissions for risk modeling and cleaning and disinfection of equipment post-use in collaboration with US Department of Agriculture, states (NC and VA), and industry.

Supporting Foreign Animal Disease Response Preparation: African Swine Fever Waste Size Reduction

PI: Paul Lemieux

- **Impact:** Help USDA develop SOPs for the states, local government, and industry that include such considerations as minimum distance from fence line to set up grinding operations, and maximum wind and other ambient conditions that might preclude initiating grinding operations.

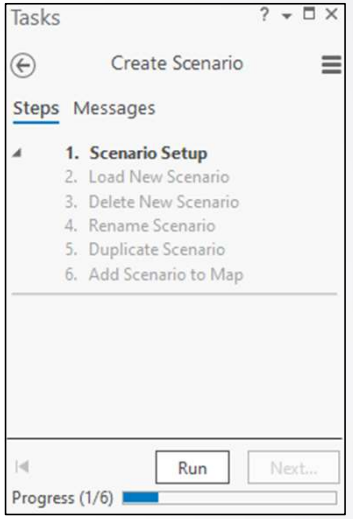
- **Next Step:** The grinding method can achieve 1.5M lb/day throughput in 750 HP grinder. Initial tests showed potentially high risk of transmission. Additional tests are needed to improve aerosol measurement and risk calculations and mitigate aerosol formation.

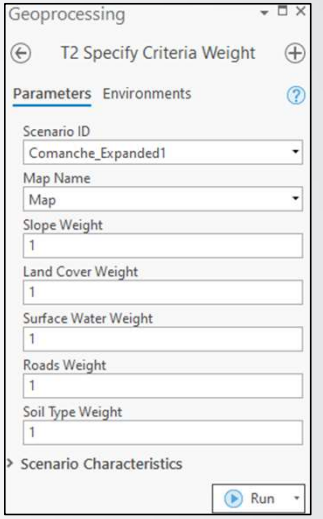


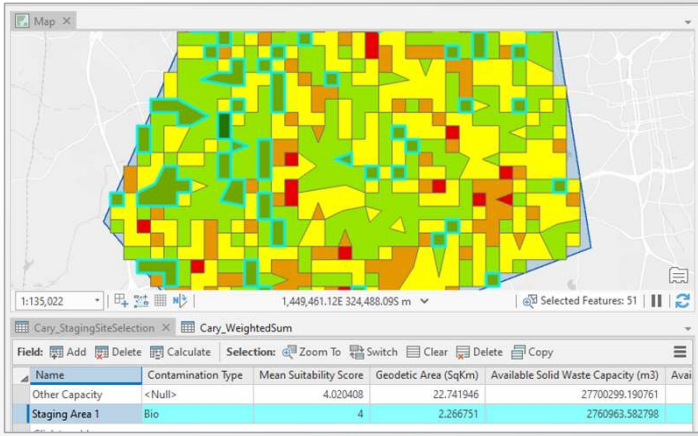
Waste Storage and Staging Site Selection Tool

PI: Timothy Boe

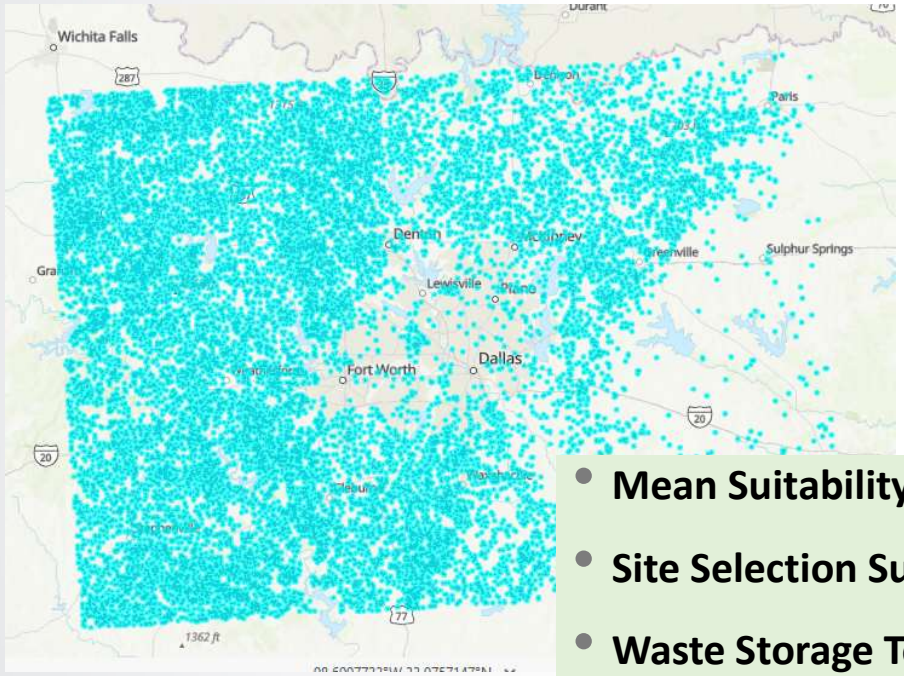
- **Need:** Identify candidate sites and their total available land surface areas for staging waste using environmental criteria.
- **Scientific Approach:** Develop GIS-based model that uses spatial information and analysis techniques to support suitability analysis to identify candidate staging areas for consideration.
- **Impact:** Tool provides decision makers better understanding and potential options for managing waste and to illuminate potential capacity constraints to inform increased preparedness.
- **Next Step:** Integration into HSRP's tool dashboard/RADAR; publish case study.

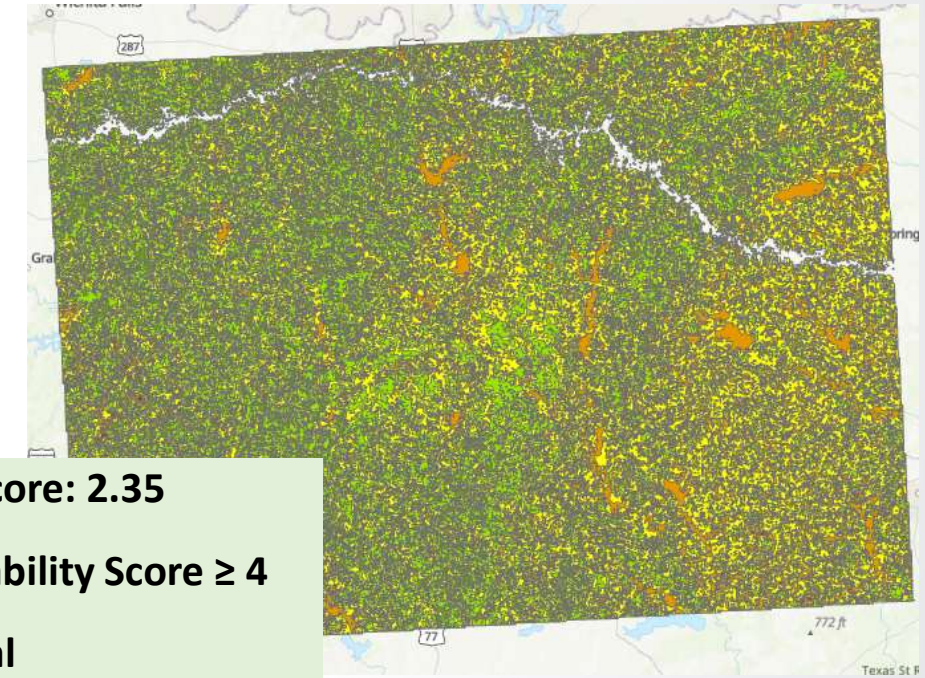






Storage and Staging Case Study



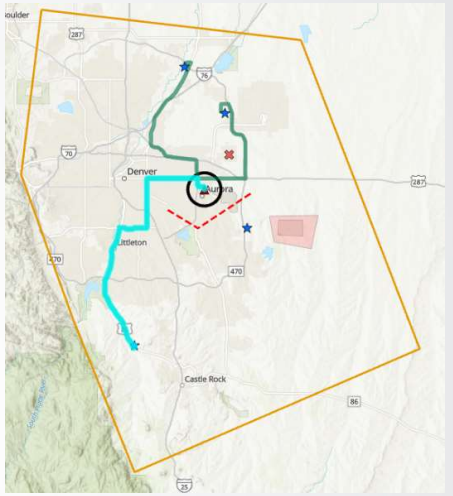


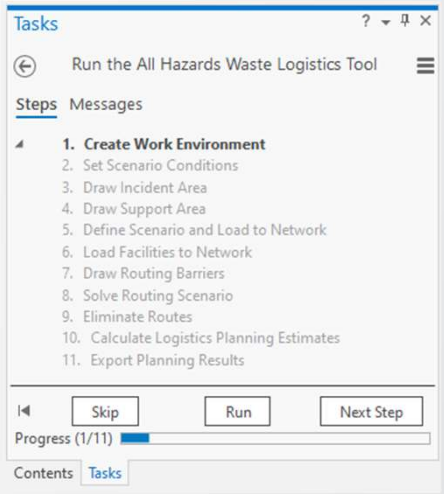
- **Mean Suitability Score: 2.35**
- **Site Selection Suitability Score ≥ 4**
- **Waste Storage Total**
  - **Solid Waste (m3): 6.28E+09**
  - **Aqueous Waste (m3): 9.84E+08**

All-Hazards Waste Logistics Tool

PI: Timothy Boe

- **Need:** Analyze resource demands and bottlenecks associated with transporting and disposing of large volumes of waste.
- **Scientific Approach:** Develop spatial model and analysis techniques to support evaluating resource demands associated with transporting waste.
- **Impacts:** Calculates the cost and time to manage a user-specified quantify of waste and allows users to run routing scenarios with user-defined destinations. Factors specific to waste type, hauling rates, and acceptance rates allow users to explore options and evaluate constraints to improve preparedness for managing large volumes of waste.
- **Next Step:** Integration into HSRP's tool dashboard/RADAR; publish case study.

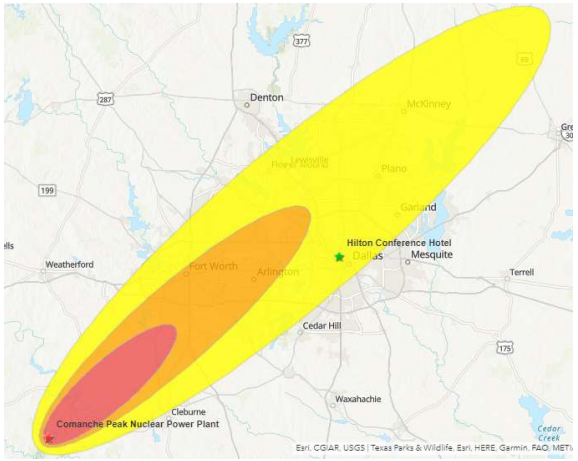


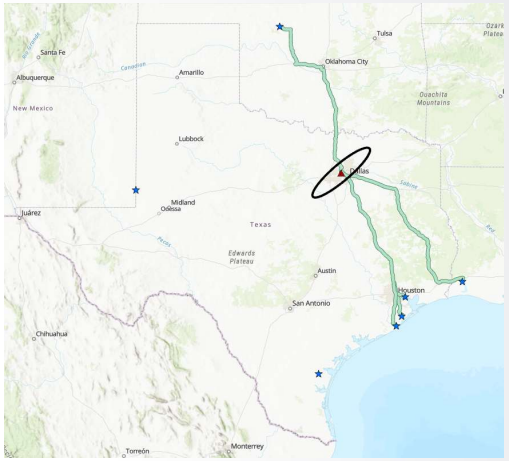


Logistics Case Study

Decon Method – Solid Waste

- Waste Amount: 2.33E+06 m^3
  - Allocated Qty: 100% (10% Z1)
- Total Number of Facilities: 5
- Total Number of Shipments: 128,699
- Total Cost ($): 302M
- Total Time Days (days): 910 or ~2.5 yrs





Decon Method – Aqueous Waste

- Waste Amount: 1.42E+09 L
  - Allocated Qty: 3%
- Total Number of Facilities: 23
- Total Number of Shipments: 2,300
- Total Cost ($): 11M
- Total Time Days (days): 17

Social Considerations in Disaster Waste and Materials Management (DWMM)

PI: Keely Maxwell

- **Need:** To safely dispose of disaster waste and materials in a way that does not further disadvantage overburdened populations, a logistically complex, emotional, and costly undertaking. EPA staff may need to navigate stakeholder conflicts about DWMM decisions, requiring insights into how and why these decisions are made.
- **Scientific Approach:** Review scientific literature to identify key social variables at play affecting decisions; comparative case studies of recent CBRN and other disasters, analyzing documents and holding interviews or focus groups to map DWMM decisions points and conflicts for different waste streams.
- **Impact:** Understanding the social drivers of DWMM will help identify useful points of intervention in preparedness, response, and recovery. EPA can use the results of this research to bring additional social considerations into its work in DWMM, build specific capacities at the state and local level, and navigate conflicts that may arise during a response.
- **Next Step:** Begin literature analysis; finalize case studies.

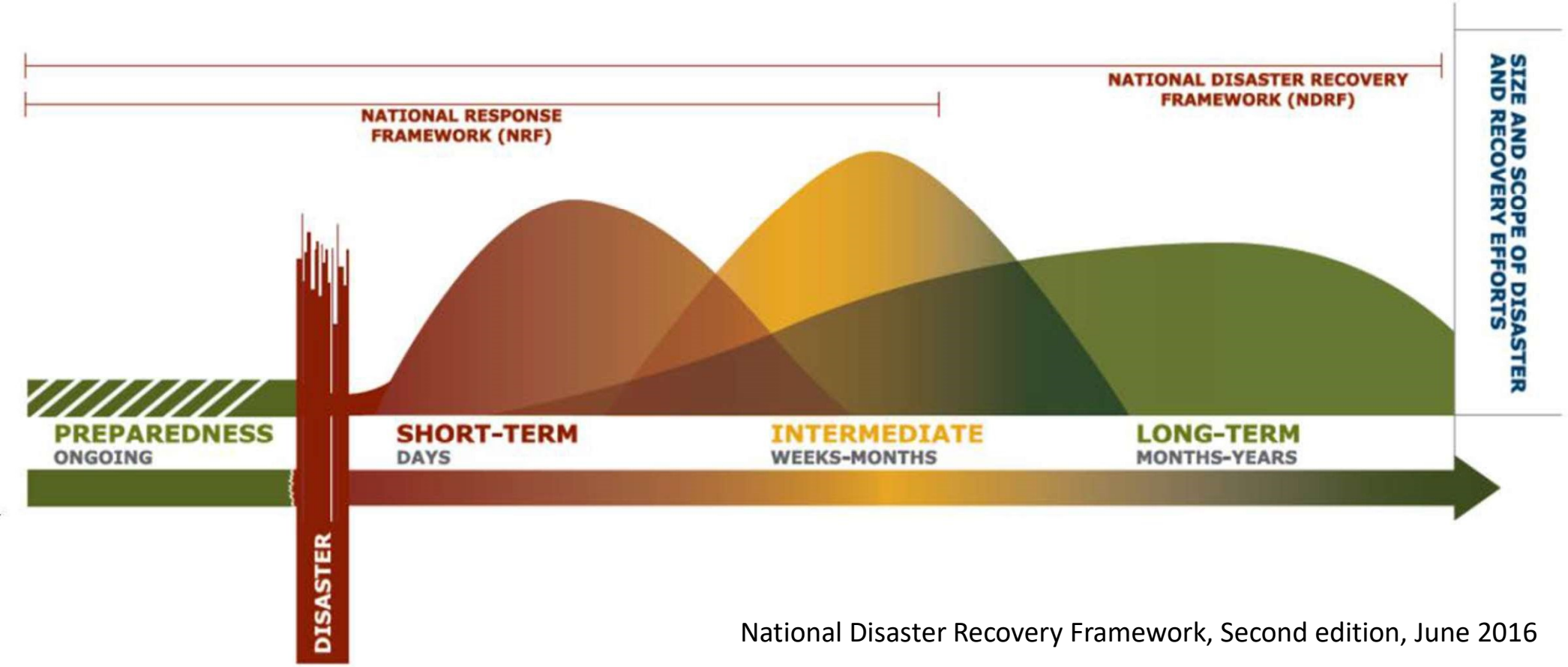
CQ4: HSRP Systems and Resilience Tools

Overview of HSRP Systems-Tools

Sang Don Lee

Board of Scientific Counselors Meeting
Homeland Security Subcommittee Virtual Meeting
Day 4, May 20, 2021

Disaster Recovery Continuum



National Disaster Recovery Framework, Second edition, June 2016

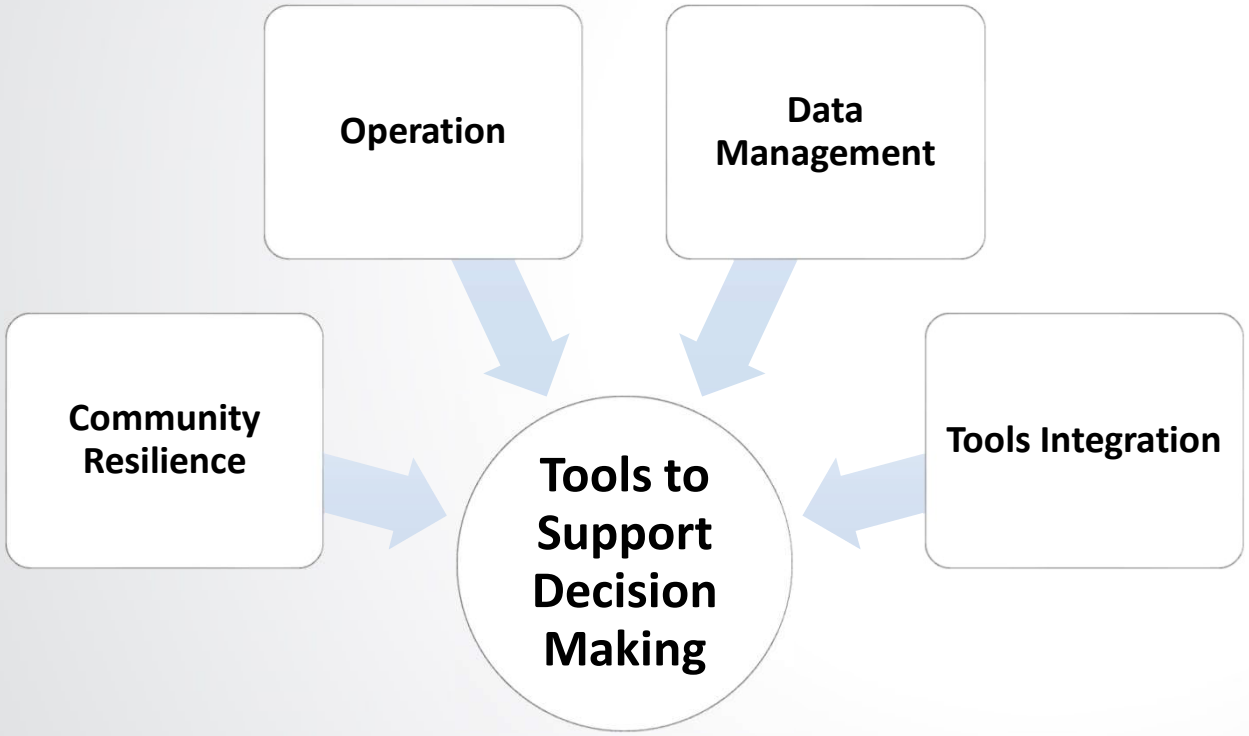
EPA Response and Recovery Activities

- Response
  - Weeks-to-months' timeframe for any large-scale events, and addresses immediate health and safety needs of the affected community.
  - Various response elements: Public water supply, Emergency Contamination Mitigation, Assessment & Monitoring, Environmental Cleanup, Operations Management, Waste Management, Worker Safety, Technology Verification, Field testing, Community Engagement, Public Self-Help Cleanup Support.
- Recovery
  - Sustainable and resilient community rebuilding for the long-term viability of regions' people, economies, and natural ecosystems.
  - EPA's activities: Preparedness to mitigate future events, Promote sustainable and resilient rebuilding, Apply EPA knowledge, Streamline federal action, Partner with environmental justice/disadvantaged communities.

Research Needs

- Decision makers need access to tools and information via a systems-approach for the connected response elements and recovery goals.
  - Capability to holistically assess response activities and provide quantitative estimations
  - Methods to collect and communicate data effectively during emergency response
  - Capability to assess and improve community environmental resilience to disasters

Systems and Resilience Tools Research Approaches



- Development of systems-based tools by pulling together the connected elements
- Ensuring that information is readily and easily accessible during an emergency

HSRP Research Projects for Systems and Resilience Tools

- **Systems Tools**
  - Simulation for Evaluating Decision Making Following a Large-Scale Incident
  - Evaluating the Use of Commercial-off-the-shelf (COTS) Three-dimensional (3D) Engines
  - Tool Integration/Dashboard
  - Remediation Data Repository

- **Resilience Tools**
  - Social science of decontamination & environmental cleanups
  - Environmental Resilience Tools Wizard
  - Equitable Resilience Builder

Impacts

HSRP tools will improve emergency response and recovery

- Response Decision making by assessing
  - Impact of selecting certain methods (decontamination, sampling, and waste treatment) on the overall remediation.
  - Bottlenecks in the remediation activities.
  - Resource availability and demand for remediation.
  - Testing of future decision-support-tool feasibility before development/deployment.
  - Testing of future methods/technologies before investment.
- Enhancing communication of information to decision makers, responders, and stakeholders.
- Self-assessment of community environmental resilience to disasters.
- Understanding social aspects of response and recovery.

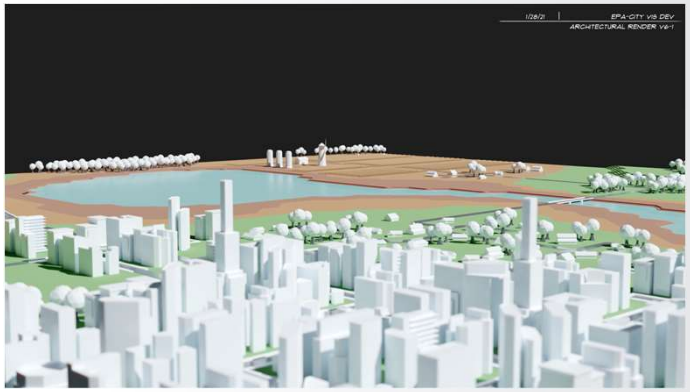
Simulation for Evaluating Decision Making Following a Large-Scale Incident

PI: Timothy Boe

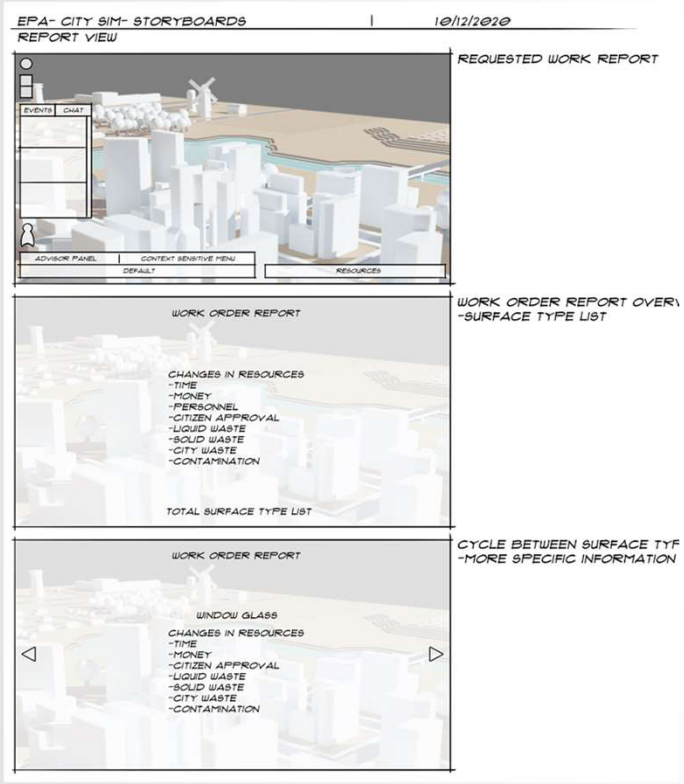
- **Needs:** Ability to implement full-scale exercises with minimal resources and maximum control and quality with the purpose of evaluating research/technology gaps and to support training of response personnel.

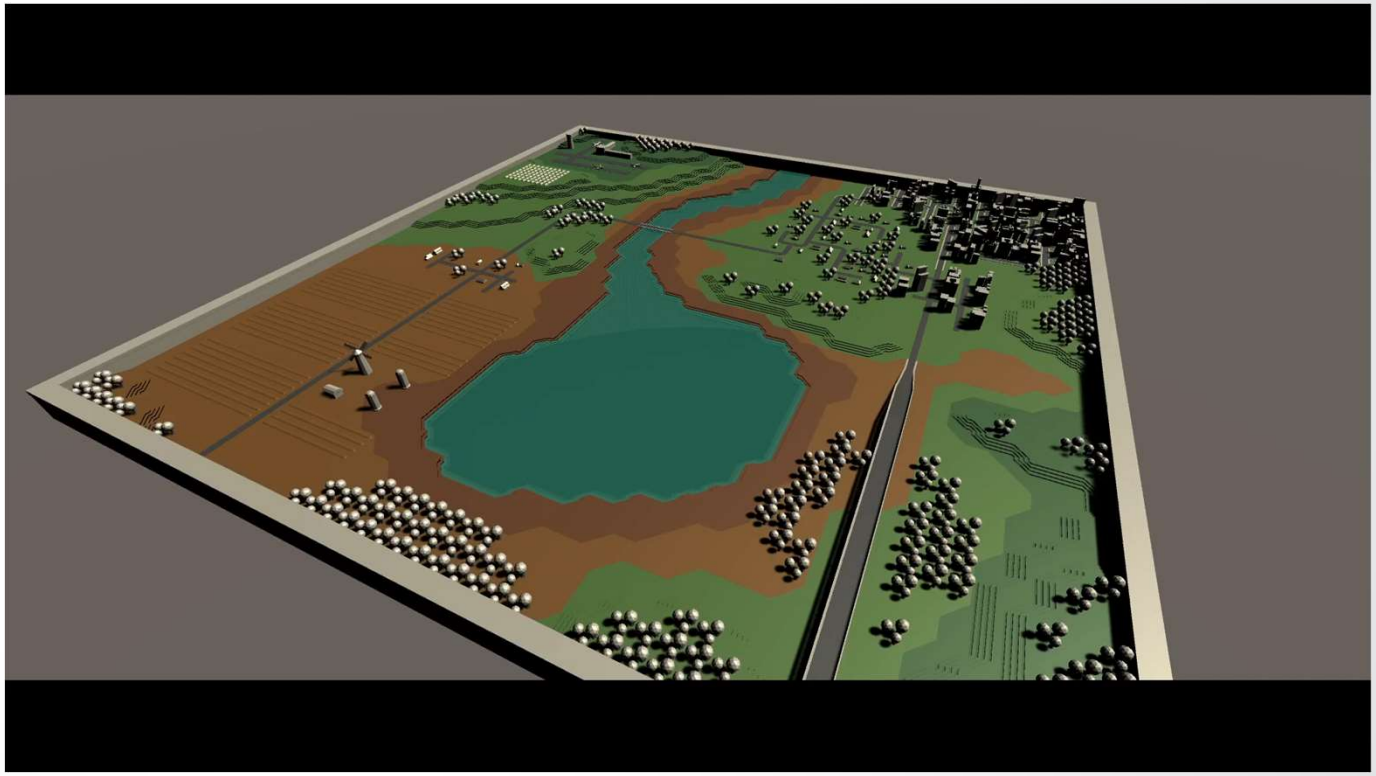
- **Scientific Approach:** Develop a tool that can simulate the remediation activities associated with a CBR wide area incident with a capability to dynamically incorporate resources, methods, technologies, temporal and spatial conditions using modified 3D game engine.

- **Impacts:** Technologies and strategies could be evaluated prior to being implemented in the field, computer assisted strategies could be developed with the use of AI to determine appropriate response, and personnel could be trained on the use of EPA modeling and decision support tools and frameworks.



Simulation for Evaluating Decision Making Following a Large-Scale Incident

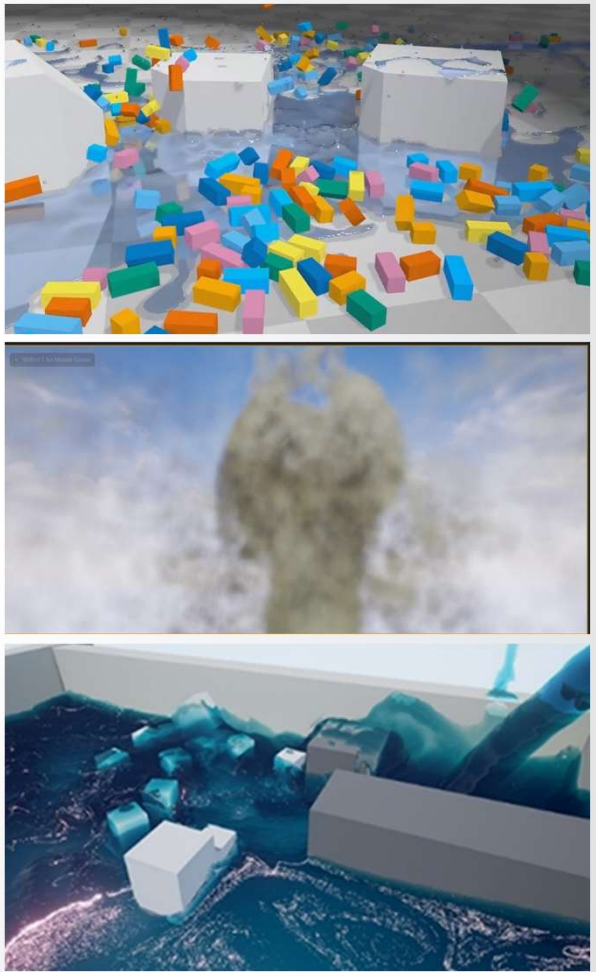




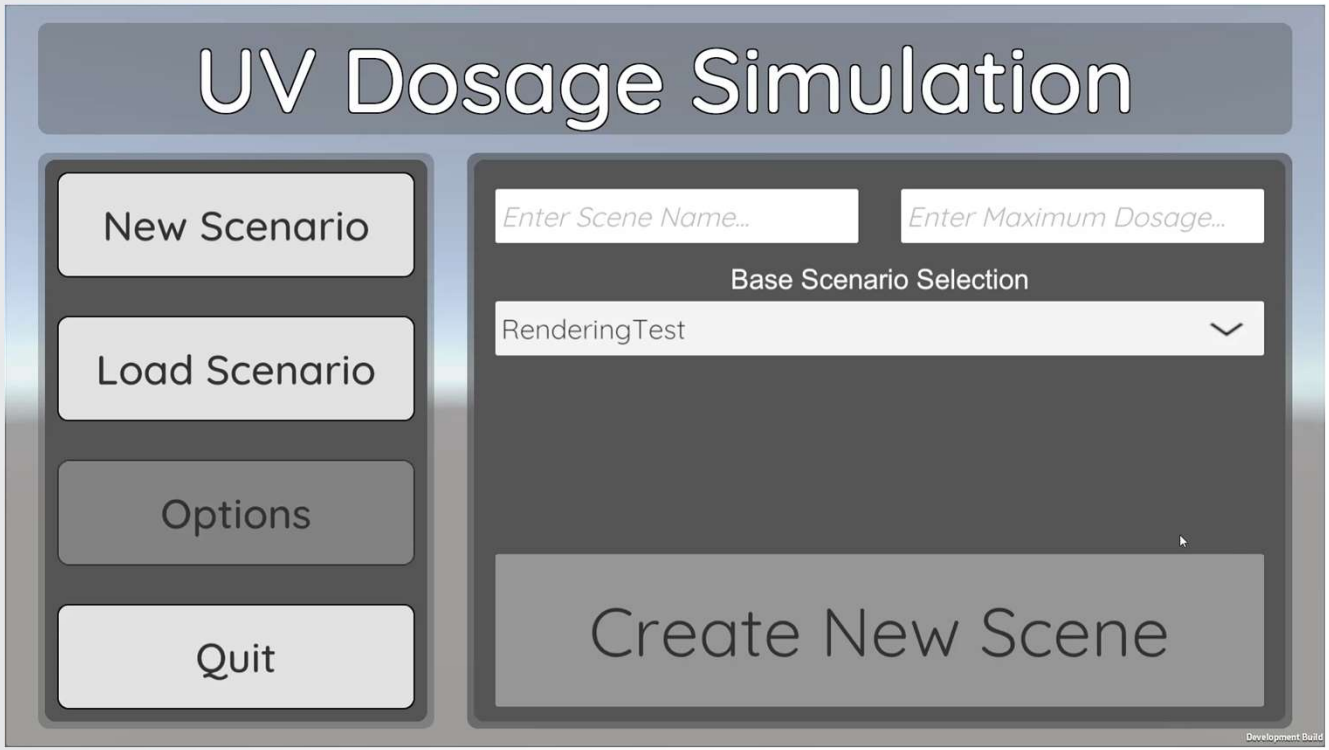
Evaluating the Use of Commercial-off-the-shelf (COTS) Three-dimensional (3D) Engines

PI: Timothy Boe

- **Needs:** New modeling platforms capable of advanced physics- or fluid-based simulations for future modeling applications.
- **Scientific Approach:** Evaluate the use of COTS 3D game engines for facilitating modeling efforts related to a CBRN event by simulating radiation attenuation, blast, fate and transport, and dispersion models.
- **Impacts:** Repurposed COTS 3D platforms would reduce R&D cost/time and allow for high-fidelity modeling solutions when compared to traditional approaches.



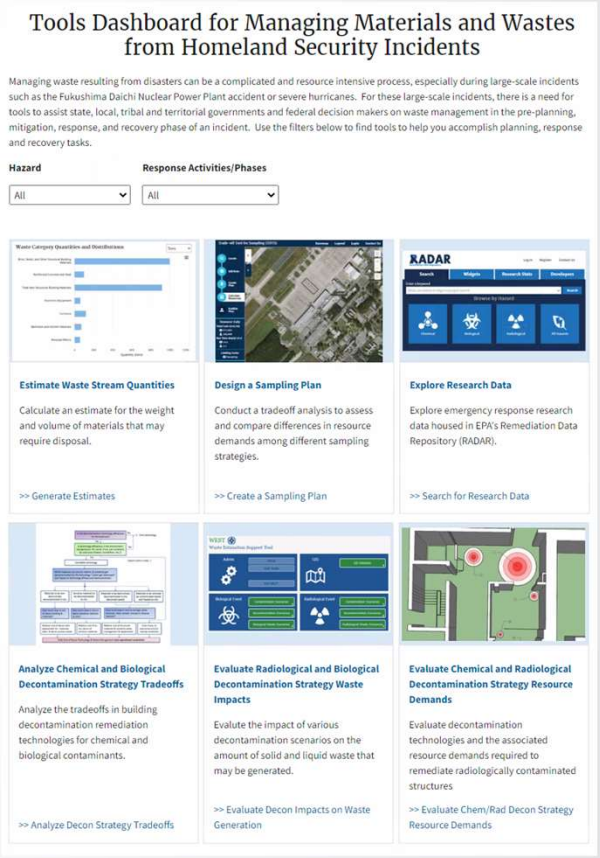
Evaluating the Use of Commercial-off-the-shelf (COTS) Three-dimensional (3D) Engines



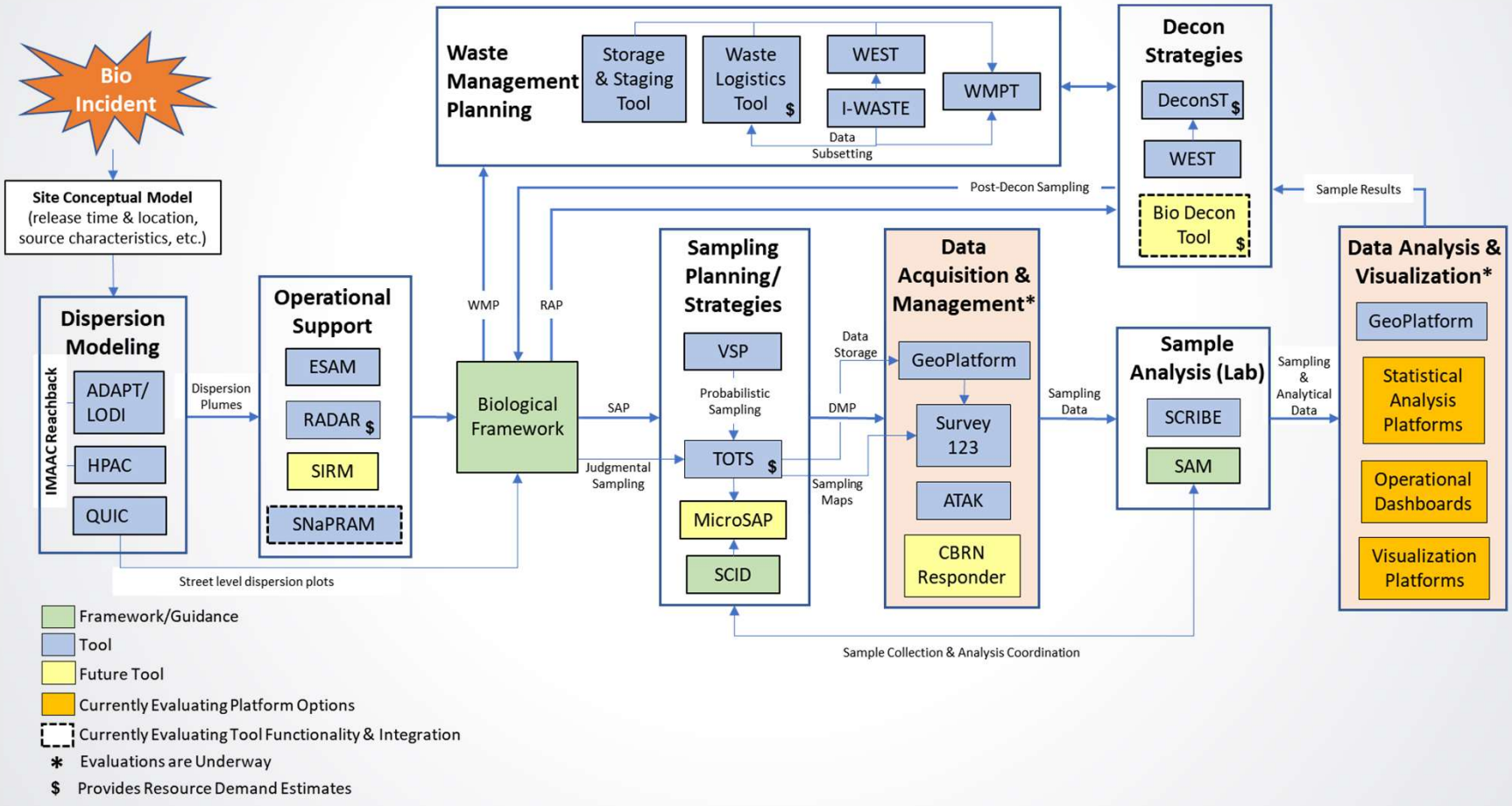
Tool Integration/Dashboard

PI: Timothy Boe

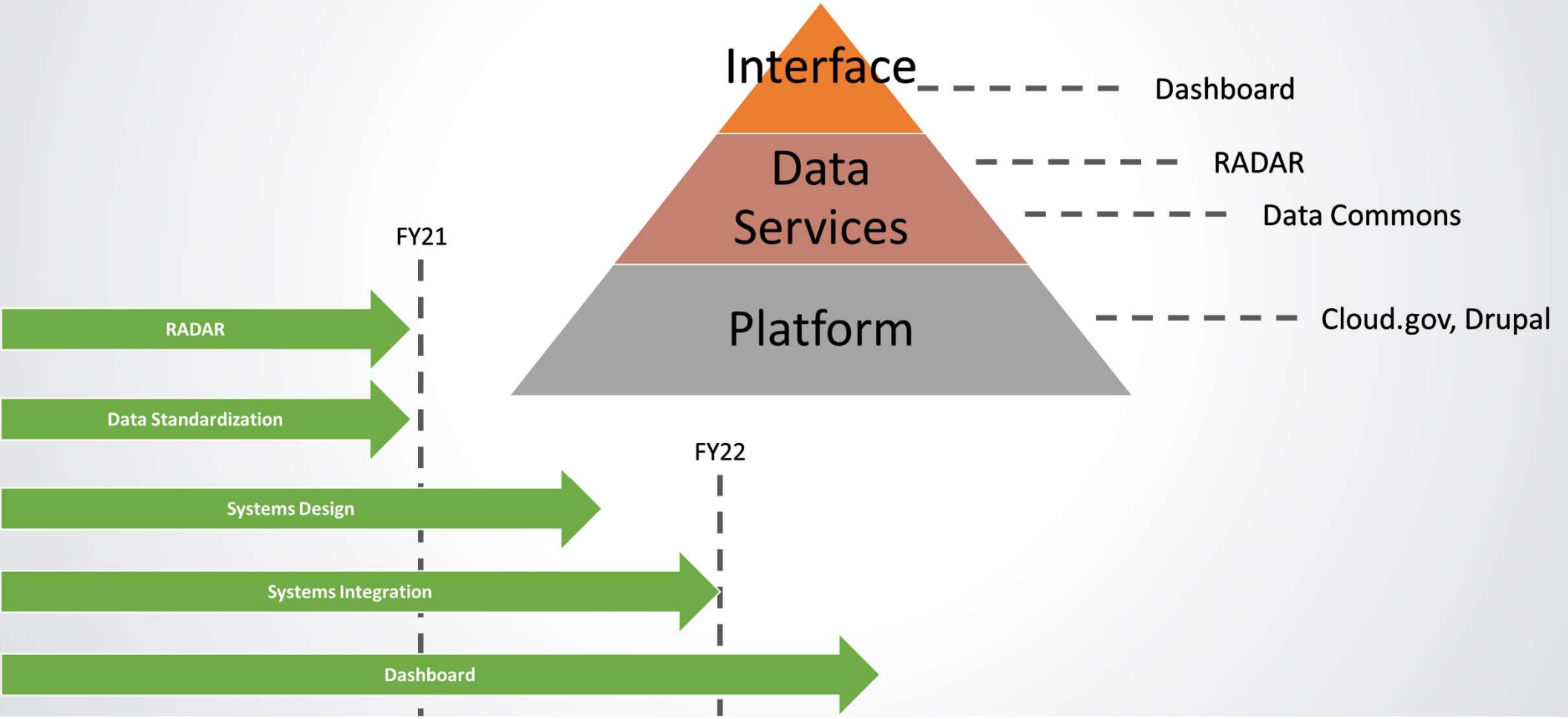
- **Need:** Web portal for accessing tools/models and aggregating data to create common operating picture.
- **Scientific Approach:** Develop web-based single access point for tools and dashboard for aggregating/visualizing results.
- **Impact:** Provide a centralized access point for tools, dashboard/visualization and system/tool integration for enhancing decision making.



Tool Integration/Dashboard



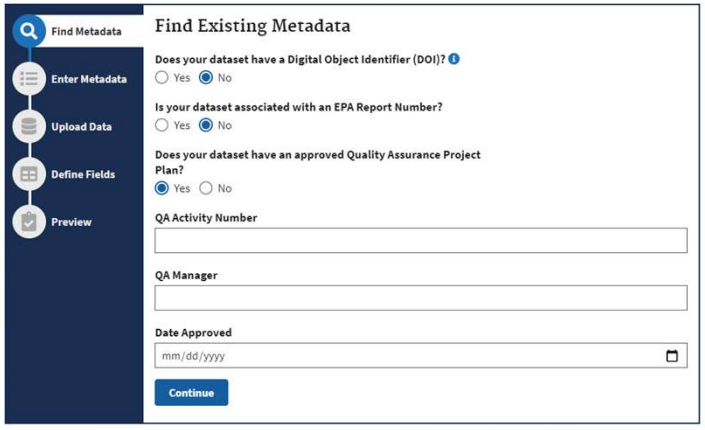
Tool Integration/Dashboard



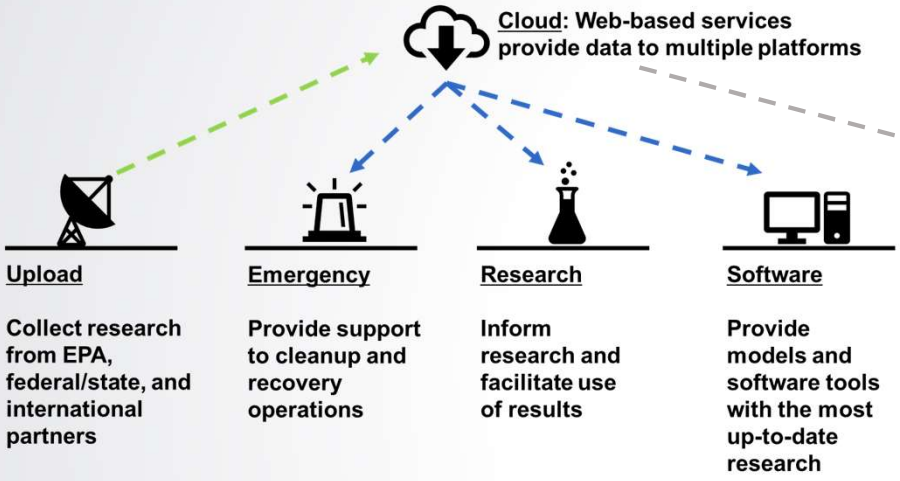
Remediation Data Repository (RADAR)

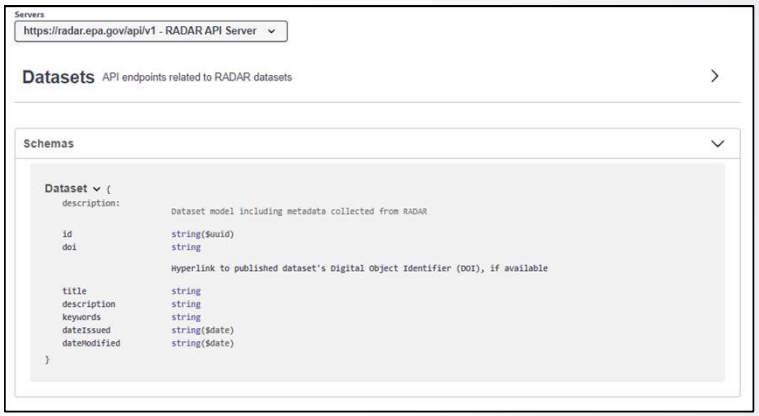
PI: Timothy Boe

- **Need:** An online service is needed to provide quick access to information and data to support emergency response efforts and future research.
- **Scientific Approach:** Develop web-based tool for seamlessly sharing data with stakeholders and software tools.
- **Impact:** Ability to upload and distribute up-to-date research and provide users access to data to support decision-making, to use in conjunction with future research, and to use as source data to support tools and models.

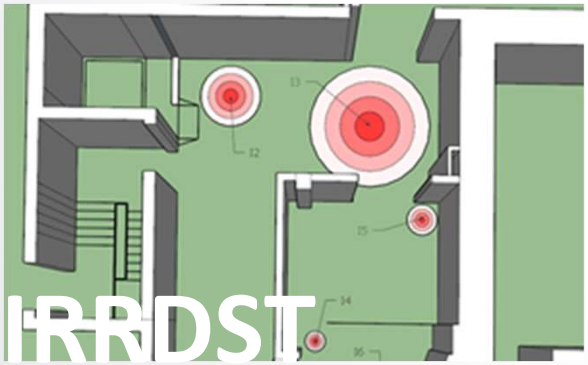


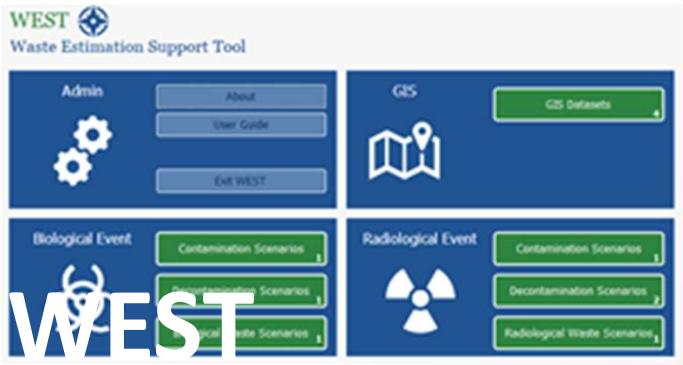
Remediation Data Repository (RADAR)

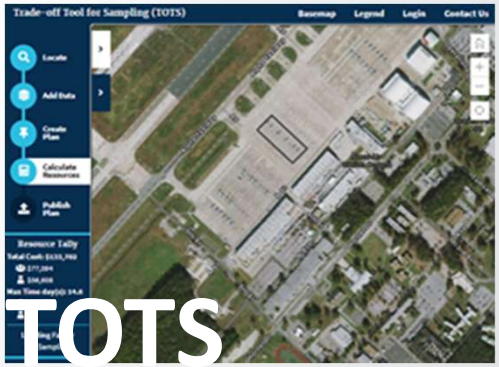




PRODUCTION







FY21 — FY21 — FY22 — FY22

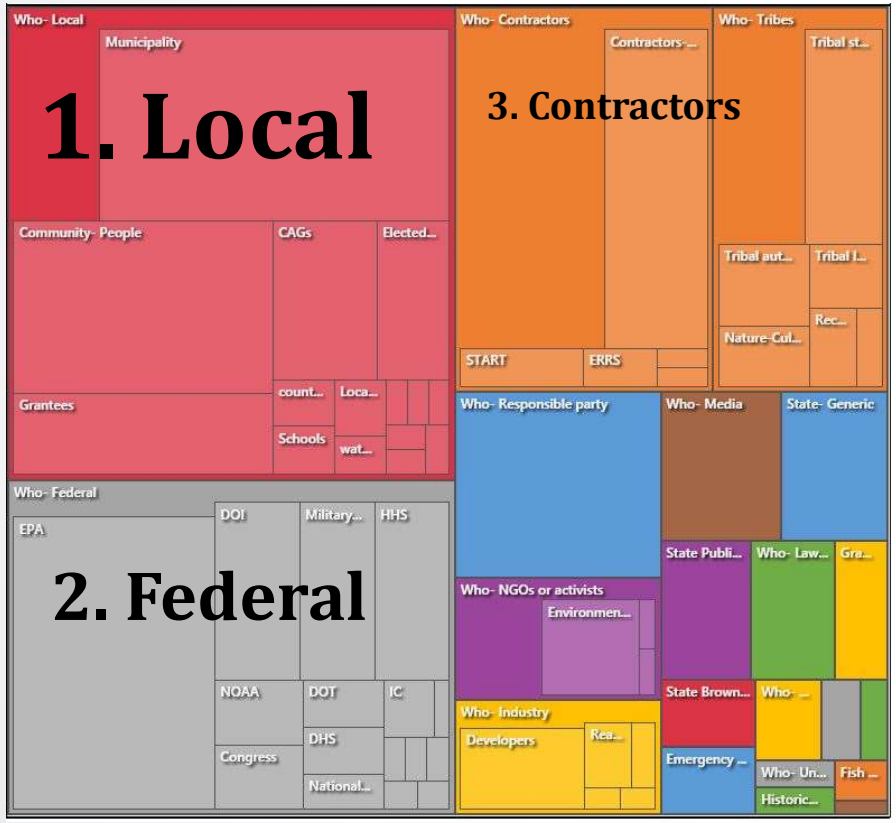
Social science of decontamination & environmental cleanups- Introduction

PI: Keely Maxwell, Brittany Kiessling

- **Need:** Social science research can enable EPA on-scene coordinators (OSCs) build trust and social relationships with communities and other social actors in different social and cultural contexts (e.g. urban, rural, tribal) and cleanup situations (e.g. oil spill, wide-area radiological incident, PAHs on residential properties).

- **Scientific Approach:** Review of social science literature; and interviews (n=25) and surveys (n=380) with EPA Regional staff has generated a novel dataset on current practices in getting to know communities, strategies for outreach and engagement, and related learning needs across cleanup types (e.g. Superfund, brownfields, RCRA sites, time-critical and non-time critical removals).

Interview Findings on Social Actors



- Identified 88 groups of social actors with whom EPA cleanup staff engage
- Most often mentioned
  1. <u>Local</u> → municipalities
  2. <u>Federal</u> → EPA offices, USACE, DOI, military, DOE
  3. <u>Contractors</u>
- Strongest relationships
  1. State counterparts

Survey Findings- How to Build Relationships

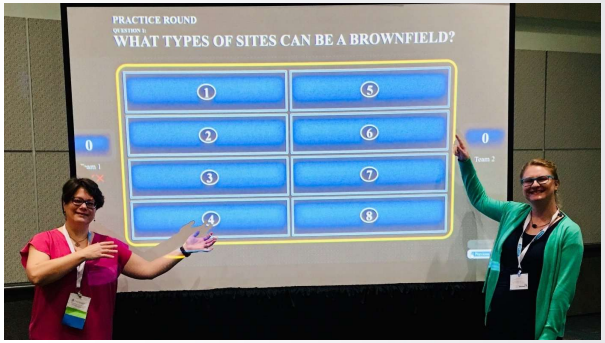
What advice would you give to a new colleague on how to build relationships with a business, agency, or organization? (Top 15 responses)	**Frequency**	**Percentage**
Listen to needs/concerns/goals	63	10.1
Communicate regularly and openly	61	9.8
Start early	56	9.0
Be honest, open, and transparent	49	7.9
Keep the community informed	37	5.9
Set clear and realistic expectations/goals/boundaries	37	5.9
Seek cooperation and collaboration	33	5.3
Make contact personal (face-to-face or phone)	32	5.1
Build relationships	28	4.5
Show interest in the community	26	4.2
Introduce yourself	23	3.7
Be responsive	20	3.2
Be patient	17	2.7
Illustrate commitment to follow-through	17	2.7
Make yourself available	16	2.6

Social science of decontamination & environmental cleanups- Impact

PI: Keely Maxwell

- **Impact:** We apply social science to develop resources for EPA staff on culture, engagement, and building trust. This work can help achieve positive social and environmental outcomes of time-critical and non-time critical removal actions, including decontamination during wide-area incidents.

- **Next Step:** Publish methodologies for "Figuring Out Who Lives Here" and "Building Trust with Communities and Other Stakeholders"; publish journal articles on survey and interview findings; do participatory design of a resource to foster peer-to-peer learning on this topic with OSCs and other EPA staff.



2019 National Brownfields Training Conference premiere of the "Brownfields Feud" game on culture and cleanups

Recent publications:
Editor's choice article: How clean is clean? https://doi.org/10.1088/1748-9326/aad74b
Sedimented social histories of environmental cleanups
https://doi.org/10.1016/j.jenvman.2020.111530

Small Resuspension
Wind Tunnel

Environmental Resilience Tools Wizard (ERTW)

PI: Keely Maxwell

- **Need:** EPA's resilience tools and resources are scattered across program websites. Regional staff need an easy way to share resources on addressing environmental concerns in disaster mitigation, preparedness, response, and recovery with their state and local counterparts in emergency management, public health, and environment.

- **Scientific Approach:** Inventoried EPA resilience resources. Developed an online "wizard" that allows users to search for environmental resilience tools and resources using keywords and filters to find what best meets their needs.

  Link to Demo

- **Impact:** Greater use of EPA resilience tools and resources; communities can build resilience before, during, or after an incident.

- **Next Step:** Public deployment; regular updates of the wizard to keep current.

Equitable Resilience Builder (ERB)*- Introduction

PI: Keely Maxwell

- **Need:** Regional staff are increasingly asked to help communities build resilience and need frameworks and tools to do so *holistically*. EPA responders would benefit from resources to address *equity* to "protect the health and environment of all Americans, including those historically marginalized, overburdened, underserved, and living with the legacy of structural racism" (Administrator Regan, 4/7/21).

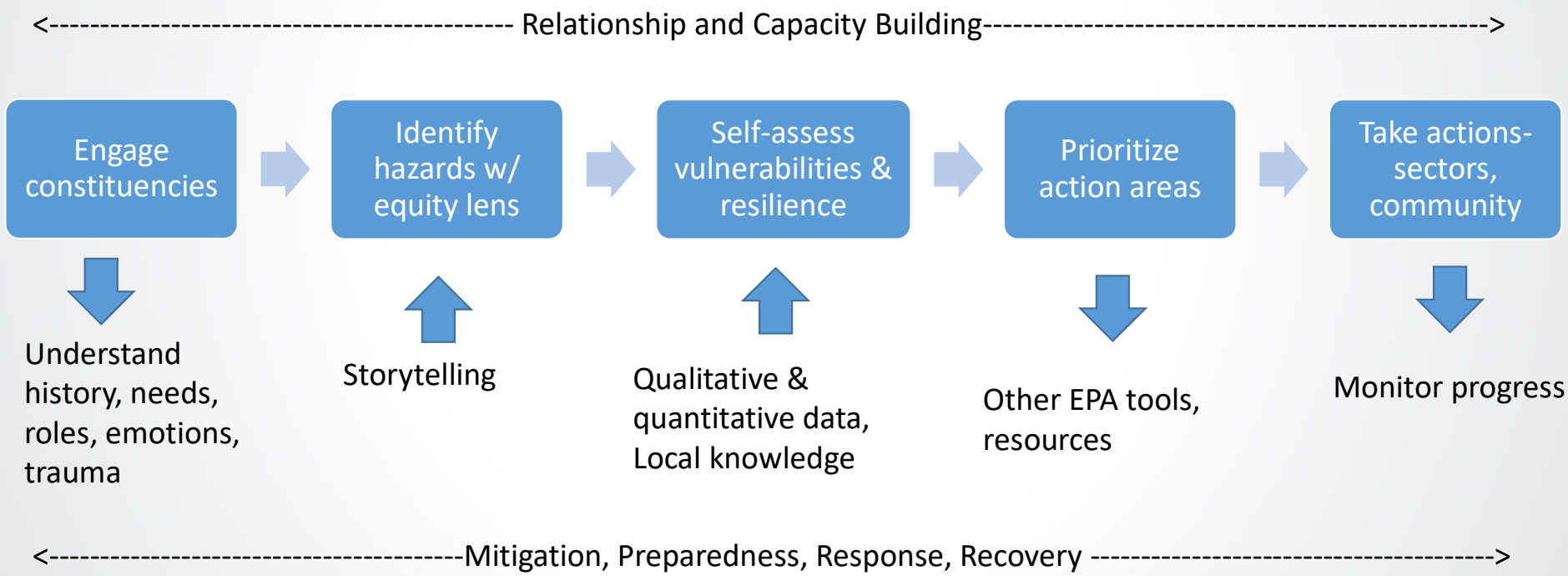
- **Scientific Approach:** Our team from HSRP and ORD's Sustainable & Healthy Communities Research Program is developing an *online tool* for communities to assess their resilience and vulnerability, and a *process* for using it inclusively. This project draws on robust social science on vulnerability and resilience, and on indicators science. We are using *human-centered design* to discover what local resilience planners need and design this tool to meet their needs.

*Formerly METRO-CERI

Project Team
B. Kiessling (HSRP)
M. Matsler (HSRP)
E. Eisenhauer, S. Julius, M. Fry (SHC)
J. Finley (Office of Water)

Partners & Collaborators:
SHC
Office of Water
Region 2 & Region 4
The Lab at Office of Personnel Management

How communities would use the Equitable Resilience Builder



Equitable Resilience Builder (ERB)- Impact

PI: Keely Maxwell

- **Impact:** *Communities* that are more resilient may experience fewer negative disaster impacts on critical social, natural, and built environment systems; and fewer negative, cascading outcomes for their most vulnerable. This tool can help *EPA staff* understand local needs and target equity interventions during preparedness, response, and recovery.

- **Next Step:** Short term: test "paper prototype" with communities; develop online tool and test usability. Long term: add features, basis for measuring recovery.

Upcoming Field Studies

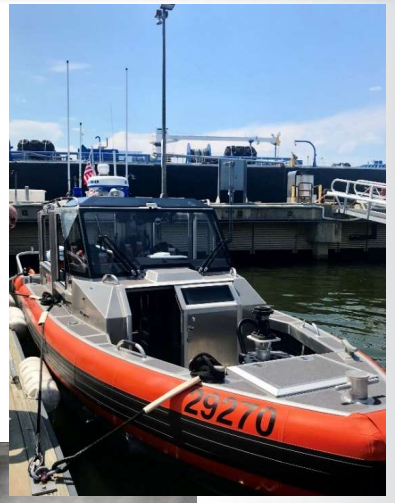
Analysis for Coastal Operational Resiliency
AnCOR

Worth Calfee – ORD CESER HSMMD

Shannon Serre – OLEM CBRN-CMAD

AnCOR Purpose

- Cross-Agency Coordination and Leverage:
  - EPA – NRF ESF #10, NCP
  - US Coast Guard – NRF ESF #10, ESF #9 SAR
  - DHS – Coordinating Agency for many ESF
- Develop and demonstrate capabilities for wide-area biological incident remediation.
- Bench- and pilot-scale studies, building to field-scale demonstration.
- Collaborative Team – EPA (HSRP, CMAD, OSCs, ERT, etc), DHS, USCG



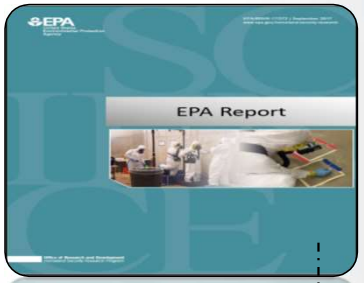
Timeline

Bench-Scale Projects **FY19**

Vessel Decon Demo **FY20**

Pilot-Scale Projects **FY21**

Wide-Area Demo **FY22**



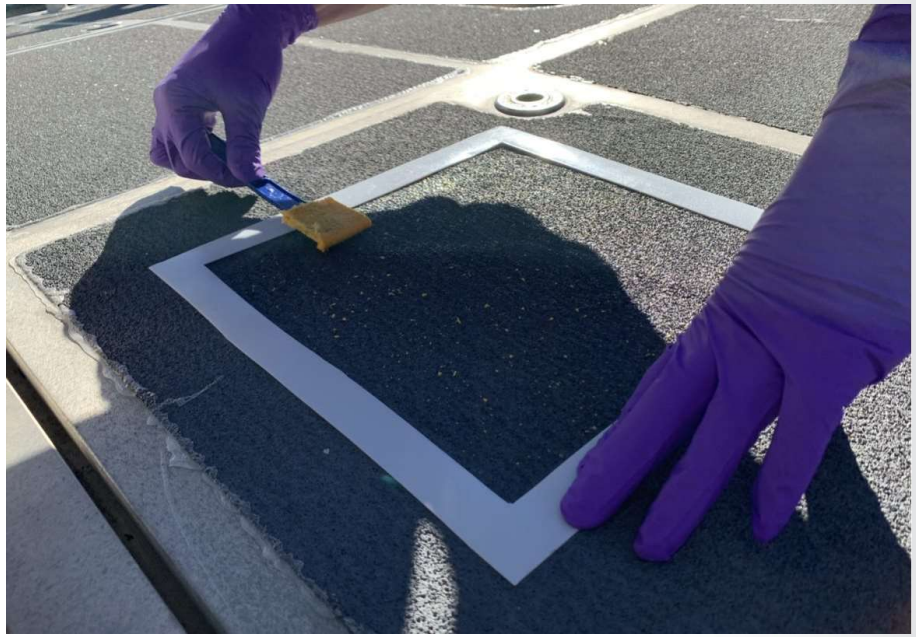
Guidance Documents & Tools **FY23**

Five major research foci :

1. Sampling and Analysis
2. Fate and Transport
3. Decontamination
4. Waste Management
5. Demonstrations/Field-Scale Projects

1) Sampling and Analysis

- Develop and evaluate air, surface, and waste sampling methods for large outdoor areas.
- Develop strategies and protocols for deploying sampling approaches in the field.
- Refine data management tools and methods for large numbers of samples.



1) Sampling and Analysis

Evaluate currently-recommended sampling methods and innovative (new) methods in USCG settings

- EPA/CDC-recommended sample collection methods evaluated on USCG surfaces.
- Developed new and innovative methods for quickly and easily collecting larger (composite) samples.
- Collected 'real-world' samples from USCG assets and bases, to determine analytical compatibility with current detection methods.

1) Sampling and Analysis

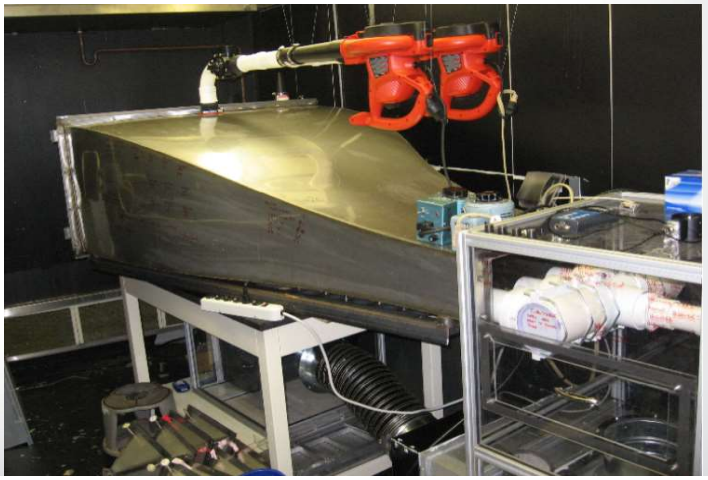
Develop an Activity-based Air Sampling Protocol for use in Outdoor Areas

- Evaluate aggressive air sampling (AAS) methods for outdoor surfaces
- Develop protocols and determine appropriate uses for Activity Based Sampling (ABS) and AAS following large incident
- Rapidly and effectively inform mitigation and consequence management decisions

1) Sampling and Analysis

Evaluate Long-Term Air Sampling Methods

- Determine how air sampling networks can aid in post-remediation, long-term monitoring.
- Determine optimum network characteristics:
  - Sampler types
  - Sampler grid spacing
  - Sampler flow rates and analysis schedule
  - Cost considerations
- Inform post-incident operations, to quickly and easily detect and mitigate residual exposure risks.



1) Sampling and Analysis

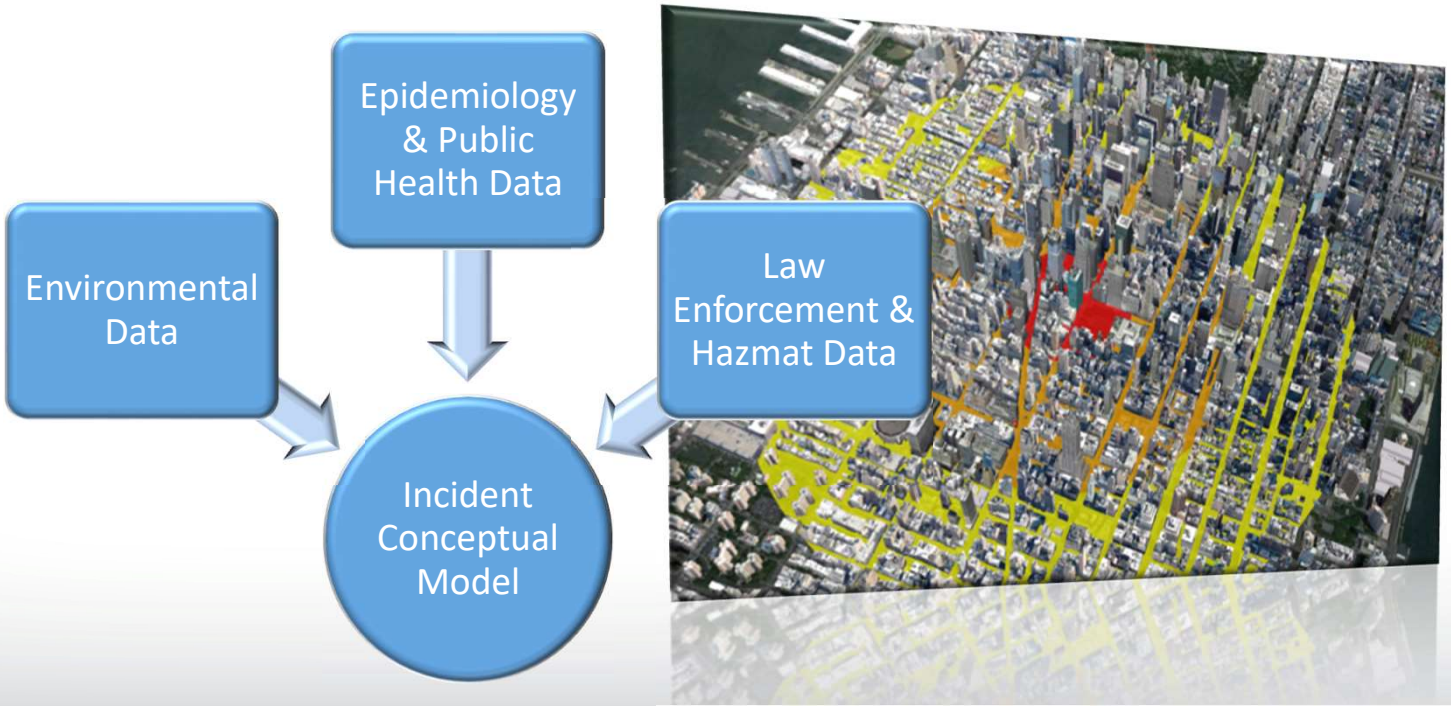
Develop Sampling Protocols and Strategies for Solid Waste Samples

- Review existing sampling strategies and protocols.
- Recommend potential modifications to make current methods applicable to solid wastes.
- Conduct laboratory tests to optimize waste sampling methods
- Demonstrate modified methods in a large-scale field test.

1) Sampling and Analysis

Sampling Strategies for an Outdoor Wide-area Response

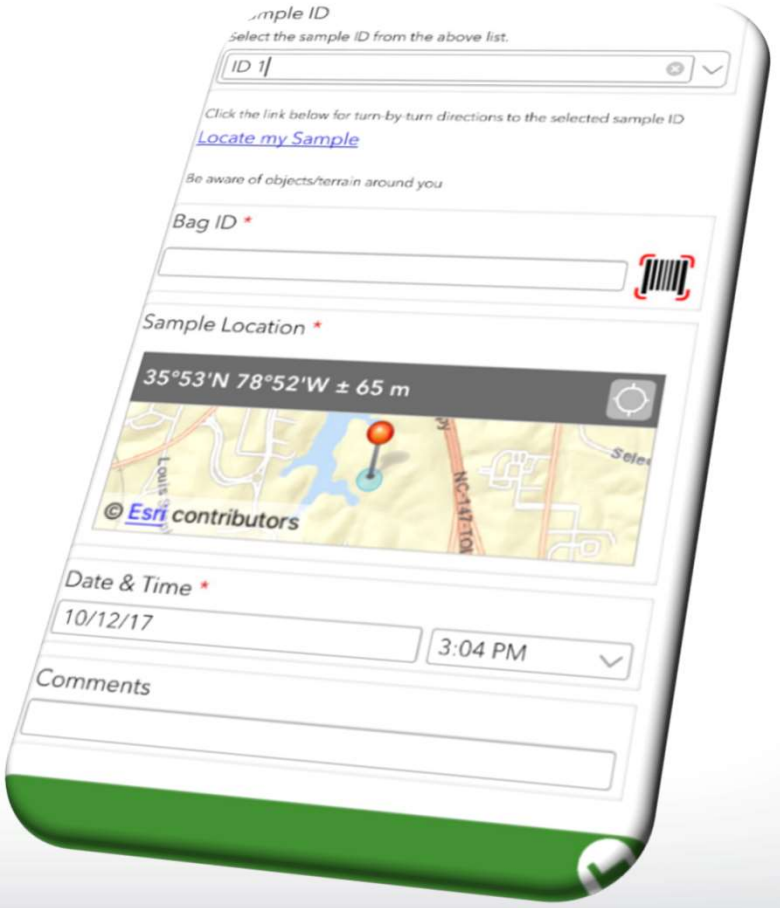
- Develop a framework to guide site characterization & clearance.
- Develop a strategy that can be applicable to any size, any setting



1) Sampling and Analysis

Data Management

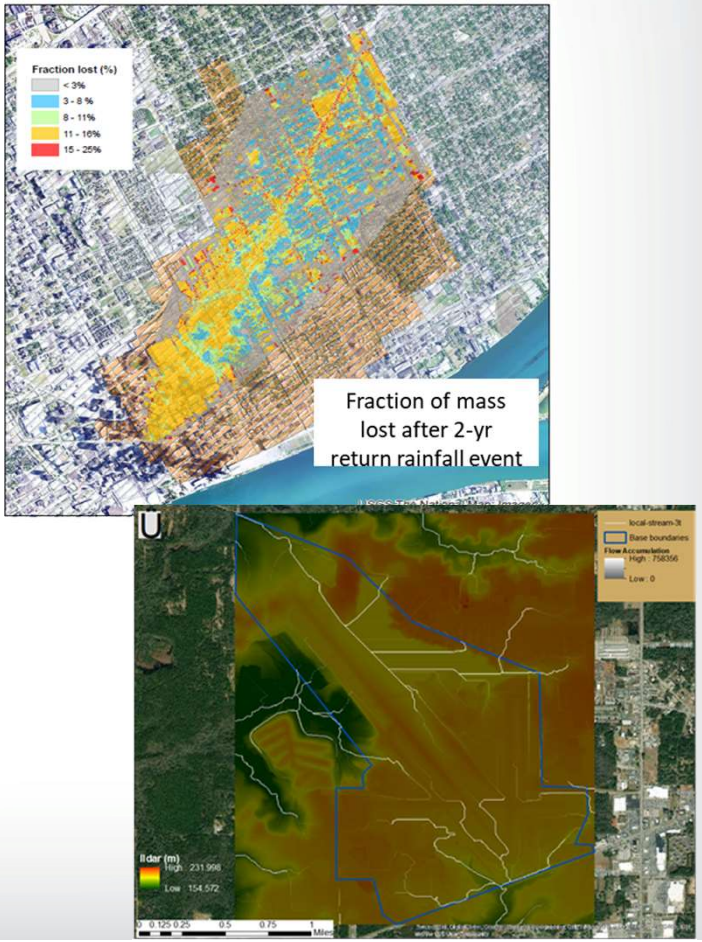
- Evaluate currently-available technologies for conducting site surveys and managing response data.
- Improve technologies and guidance to enhance capabilities.



2) Fate and Transport

Fate and Transport

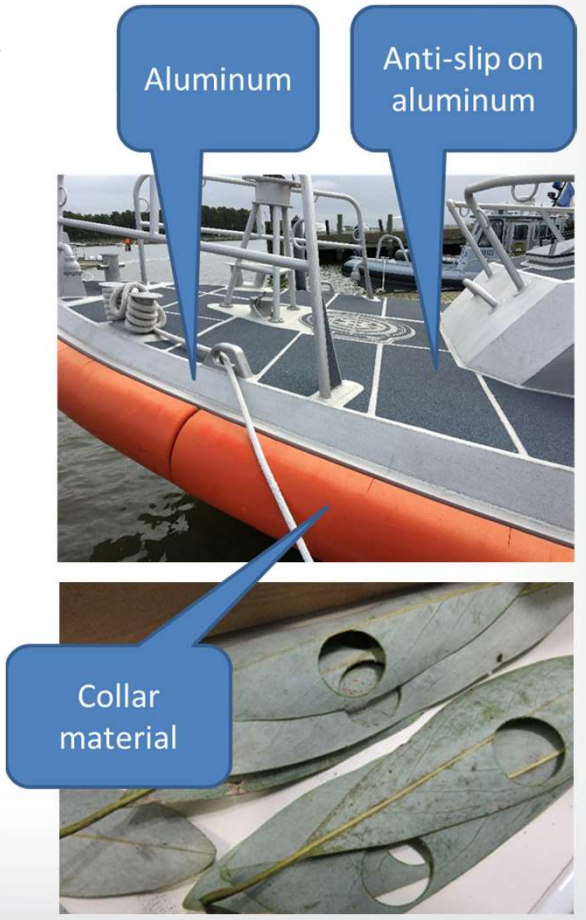
- Develop predictive capabilities for spore transport in the environment.
- Enhance response operations by facilitating more efficient use of response resources and better coordination of response activities.
- Leverage existing contaminant model, EPA SWMM.
- Conduct field-scale evaluations of transport predictions.



3) Decontamination

Assess and Enhance Decontamination Options USCG Installations

- Determine the efficacy of common liquid sporicides for inactivating a spores on outdoor (vegetation) and USCG base built (vessels, infrastructure) surfaces.
- Evaluate raw seawater for wash-off, gross decon.
- Optimize decon approaches as needed.
- Evaluate decon in field-scale outdoor testing.



3) Decontamination

Survey the Market and Evaluate Commercially-Available Equipment

- Conduct market survey for commercially-available equipment that could be used for all response/ remediation activities.
  - Sampling, decon, waste management, etc.
- Conduct equipment demonstration in mock city.
- Evaluate in field-scale study, for decon effectiveness.

4) Waste Management

Develop CONOPS for On-Site Waste Treatment

- Develop semi-permeable waste bag material (fumigants can get in; spores can't get out).
- Treat waste in bags without reopening bags.
- Minimize handling of waste once bagged and potential worker exposure.
- CONEX box/roll-off could be sent to landfill.
- Testing to verify effectiveness of concept.
  - Infiltration of fumigant and humidity through material.
  - Establish operational parameters (time/temp/RH) requirements.
  - Fumigating in CONEX box or roll-off container.

5) Demo - Vessel Decon

- Decontamination of 25' RBS I
  - Evaluate three treatment options
    - Methyl Bromide Fumigation
    - Low concentration hydrogen peroxide fumigation (LCHP)
    - Fogging with peroxyacetic acid (PAA)
- Simulated Bio-Incident (*Bacillus anthracis*)
- Three surrogates for Ba evaluated (Ba Sterne, Bg, Btk)

5) Demo - Vessel Decon Results

- Identified and evaluated effective decontamination methods for USCG vessels
- Assessed decontamination methods for compatibility with electronics and other sensitive components
- Refined CONOPS for vessel containment and tenting required for decontamination
- Trained USCG Strike Teams on sample collection and decontamination methods

5) Demo - Vessel Decon Videos

5) Demo - Wide Area

AnCOR Wide Area Demonstration

- Wide area decontamination demonstration of USCG base/station including vegetation and urban areas
- Operationally test and evaluate options for decontamination, sampling, and waste management for areas impacted by a biological agent release

Urban Area with:

- Vegetation (grass and trees)
- Concrete
- Asphalt
- Building(s)
- Dock (wood or concrete)
- Vehicle(s) exiting hot zone
- USCG Vessel

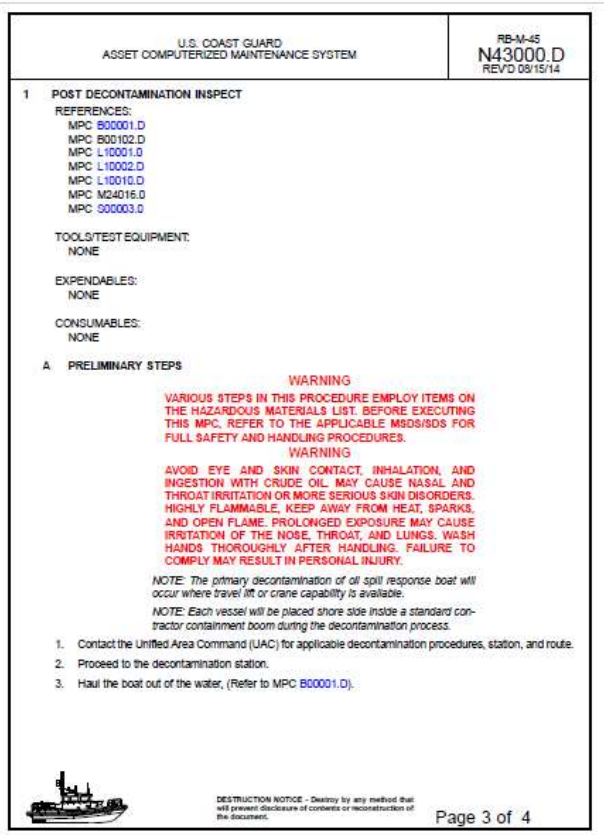
5) Demo - Wide Area

- Spring 2022
- Fort AP Hill, VA
  - ~10 Ac Urban Area Complex
  - Grass, Trees, Concrete, Asphalt, and Building Exteriors
  - Hot Zone Vehicles and USCG Vessel Decontamination
- Modern building materials
- Operationally test equipment at field scale using bench and pilot-scale information
- Training opportunity for EPA and USCG

Homeland Security
Science and Technology

Guidance Documents and Tools

- Develop guidance for:
  - Sampling
  - Decontamination
  - Waste Management
  - Data Management
- Dashboard of Tools
  - Decon Decision Support Tool
  - Trade Offs to Sampling (TOTS)
  - Waste Estimation Tool
  - Data Management
- Tabletop Exercise (TTX) for each of the 3 USCG NSF Teams



U.S. COAST GUARD
ASSET COMPUTERIZED MAINTENANCE SYSTEM

RB-M-45
N43000.D
REV'D 08/15/14

1 POST DECONTAMINATION INSPECT

REFERENCES:
MPC B00001.D
MPC B00102.D
MPC L10001.0
MPC L10002.D
MPC L10010.D
MPC M24016.0
MPC S00003.0

TOOLS/TEST EQUIPMENT:
NONE

EXPENDABLES:
NONE

CONSUMABLES:
NONE

A PRELIMINARY STEPS

WARNING

VARIOUS STEPS IN THIS PROCEDURE EMPLOY ITEMS ON THE HAZARDOUS MATERIALS LIST. BEFORE EXECUTING THIS MPC, REFER TO THE APPLICABLE MSDS/SDS FOR FULL SAFETY AND HANDLING PROCEDURES.

WARNING

AVOID EYE AND SKIN CONTACT, INHALATION, AND INGESTION WITH CRUDE OIL. MAY CAUSE NASAL AND THROAT IRRITATION OR MORE SERIOUS SKIN DISORDERS. HIGHLY FLAMMABLE. KEEP AWAY FROM HEAT, SPARKS, AND OPEN FLAME. PROLONGED EXPOSURE MAY CAUSE IRRITATION OF THE NOSE, THROAT, AND LUNGS. WASH HANDS THOROUGHLY AFTER HANDLING. FAILURE TO COMPLY MAY RESULT IN PERSONAL INJURY.

NOTE: The primary decontamination of oil spill response boat will occur where travel lift or crane capability is available.

NOTE: Each vessel will be placed shore side inside a standard contractor containment boom during the decontamination process.

1. Contact the Unified Area Command (UAC) for applicable decontamination procedures, station, and route.
2. Proceed to the decontamination station.
3. Haul the boat out of the water, (Refer to MPC B00001.D).

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Page 3 of 4

Homeland Security
Science and Technology

Operational Testing and Evaluation of Chemical Remediation Activities (OTECRA)

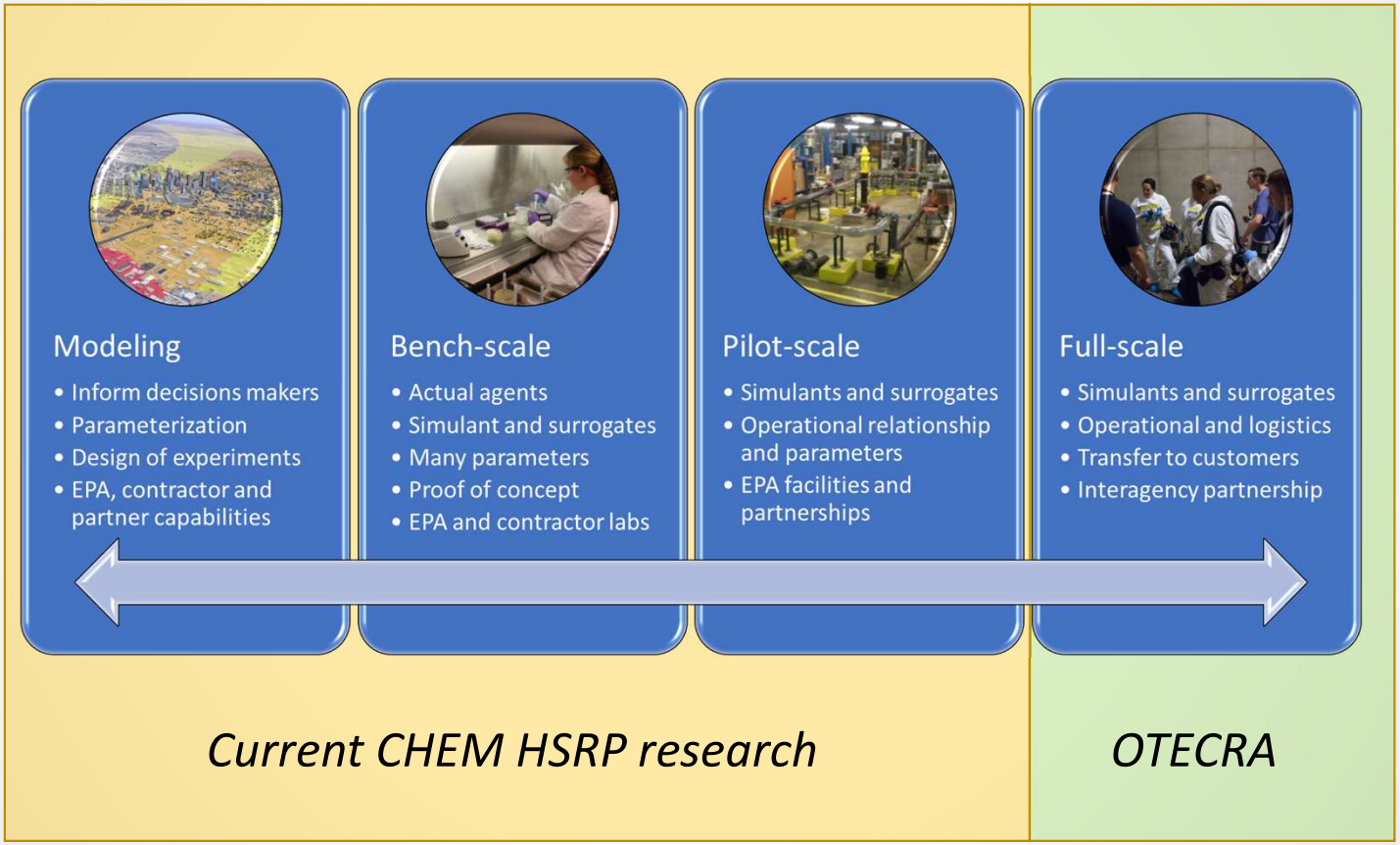
A Full-scale Technology Demonstration

and a Joint Effort with OLEM/OEM/CMAD

Lukas Oudejans (ORD/CESER/HSMMD)

Larry Kaelin (OLEM/OEM/CMAD

OTECRA


Modeling
• Inform decisions makers
• Parameterization
• Design of experiments
• EPA, contractor and partner capabilities
Bench-scale
• Actual agents
• Simulant and surrogates
• Many parameters
• Proof of concept
• EPA and contractor labs
Pilot-scale
• Simulants and surrogates
• Operational relationship and parameters
• EPA facilities and partnerships
Full-scale
• Simulants and surrogates
• Operational and logistics
• Transfer to customers
• Interagency partnership
Current CHEM HSRP research
OTECRA

OTECRA

Goal:

- To test and evaluate in a real-world scenario the remediation and response to an incident with a highly toxic and persistent chemical

OTECRA

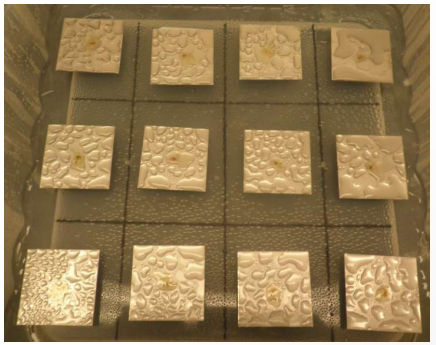
Main Objectives:

- Develop sampling strategies
- Assess wipe and/or other novel sampling approaches
- Conduct/Evaluate field-level application of decontaminants
- Determine efficacy (pre/post decontamination sampling)
- Assess personnel decon line approaches
- Perform cost analysis
- Consider waste management throughout
- Note any adverse impacts to facility

OTECRA

Technical Approach:

- Apply current EPA developed methods, tools and other knowledge on sampling, decon and waste management to assess their status at the field scale



Bench/Pilot → **Full-scale**

OTECRA

Timeline

- FY20/21: OTECRA Planning
- FY21: Chemical Scenario Selection
- FY21/FY22 Surrogate Selection and Validation
- Q4 FY22 or Q1 FY23 OTECRA Execution
- FY23/24OTECRA Reporting & Lessons Learned

OTECRA

Planned Location:

- Muscatatuck, IN
  - Interior of a single-story modern construction building

EPA OTECRA

Intended Impacts:

- Field usable sampling methods and strategies
- Operational assessment of decontamination approaches
- Established decontamination line procedures
- Overall improved decision making
- Lessons learned of this field-scale demo will benefit remediation of other (chemical) spills

OTECRA

Partners/Stakeholders:

- Joint effort of EPA's OEM/CMAD and ORD/CESER/HSMMD
- Region 5
- CWA Preparedness Work Group Member Participation (Regional On-Scene Coordinators and Special Teams)

OTECRA

Point of Contacts:

- **Lukas Oudejans, ORD/CESER/HSMMD** oudejans.lukas@epa.gov

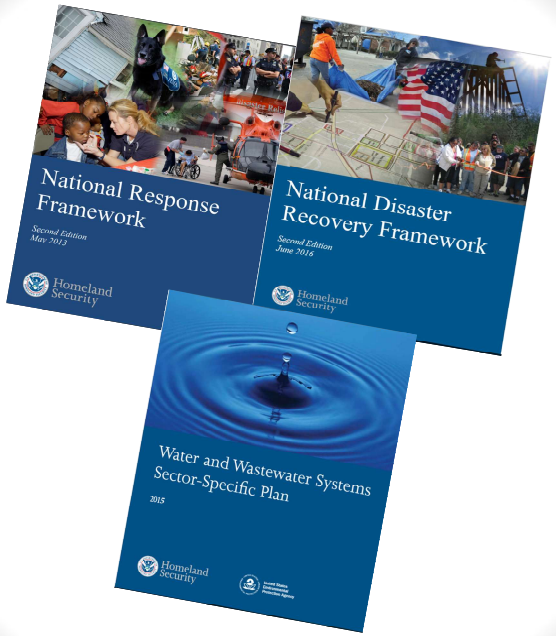
- **Shannon Serre, OLEM/OEM/CMAD** serre.shannon@epa.gov
- **Larry Kaelin, OLEM/OEM/CMAD** kaelin.lawrence@epa.gov

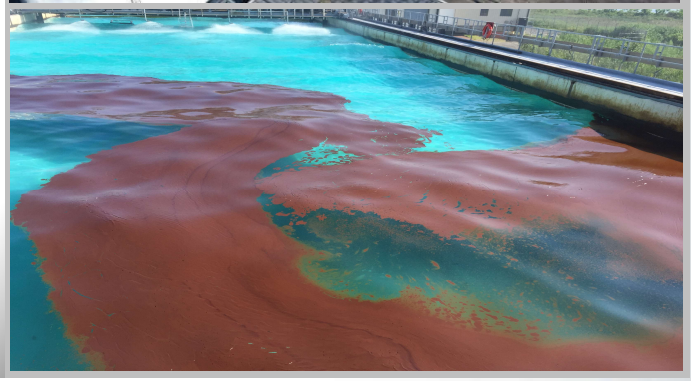
Emerging Challenges

EPA Office of Research and Development

Homeland Security Research

Managing Research during Emerging Challenges





Shawn Ryan and Sang Don Lee
Homeland Security Research Program

Research Needs for Emerging Challenges

- Many questions are raised during the response to the incidents with new agents (e.g., Sars-CoV-2) and/or wide area contamination (e.g., Fukushima)
- Decision makers will need data and information to make timely and effective decisions
- Lack of information
  - Existing data may be limited for its tested scale and conditions
- Too much of information
  - Many products, techniques, and proposed applications for decontamination and environmental cleanup of contamination including ongoing research on other products.

HSRP's Research and Development for Emerging Challenges

- Research and development in real time can inform ongoing response measures and help understand phenomena
- Timely, unbiased, and easily-accessible information is essential
- HSRP has the capabilities to conduct rapid-response, real-time R&D during incidents
- HSRP has conducted real-time research during response to characterize emerging threat agents and generate response tools and methods
- The real-time research results have improved response and recovery capacity, capability, and future preparedness

Ricin – Tupelo, MS

- April 2013 – ricin containing letters sent to President Obama, Sen. Wicker (MS) and Judge Holland (Tupelo, MS)

- EPA Region 4 called ORD-HSRP for support
  - Decontamination options (e.g., bleach solution vs. pH-adjusted bleach solution)
  - Sample analysis technical support

- Sample analysis issues
  - The time-resolved fluorescence (TRF) immunoassay - primary screening methods to determine the presence of ricin,
  - Post decontamination samples reported unsatisfactory results due to high-fluorescence backgrounds

Ricin – Research Support

- EPA Region 4 sent sampling materials to EPA-RTP labs
- ORD-HSRP sampled cleaned, bleached/dried, and bleached/rinsed materials and sent samples back to Region 4 for analysis at the Jackson, MS Laboratory Response Network (LRN) lab
- Samples reported as not suitable for analysis due to high background (same as field samples)
- EPA-HSRP, in collaboration with LLNL, further investigated to resolve the issue
  - Developed sample processing approach for surface samples
  - No TRF assay interference was observed with high concentrations of bleach residue, wetting buffer, and materials from sampling devices (sponge-sticks and macrofoam swabs).

SARS-CoV-2: Disinfection Research

Regulatory

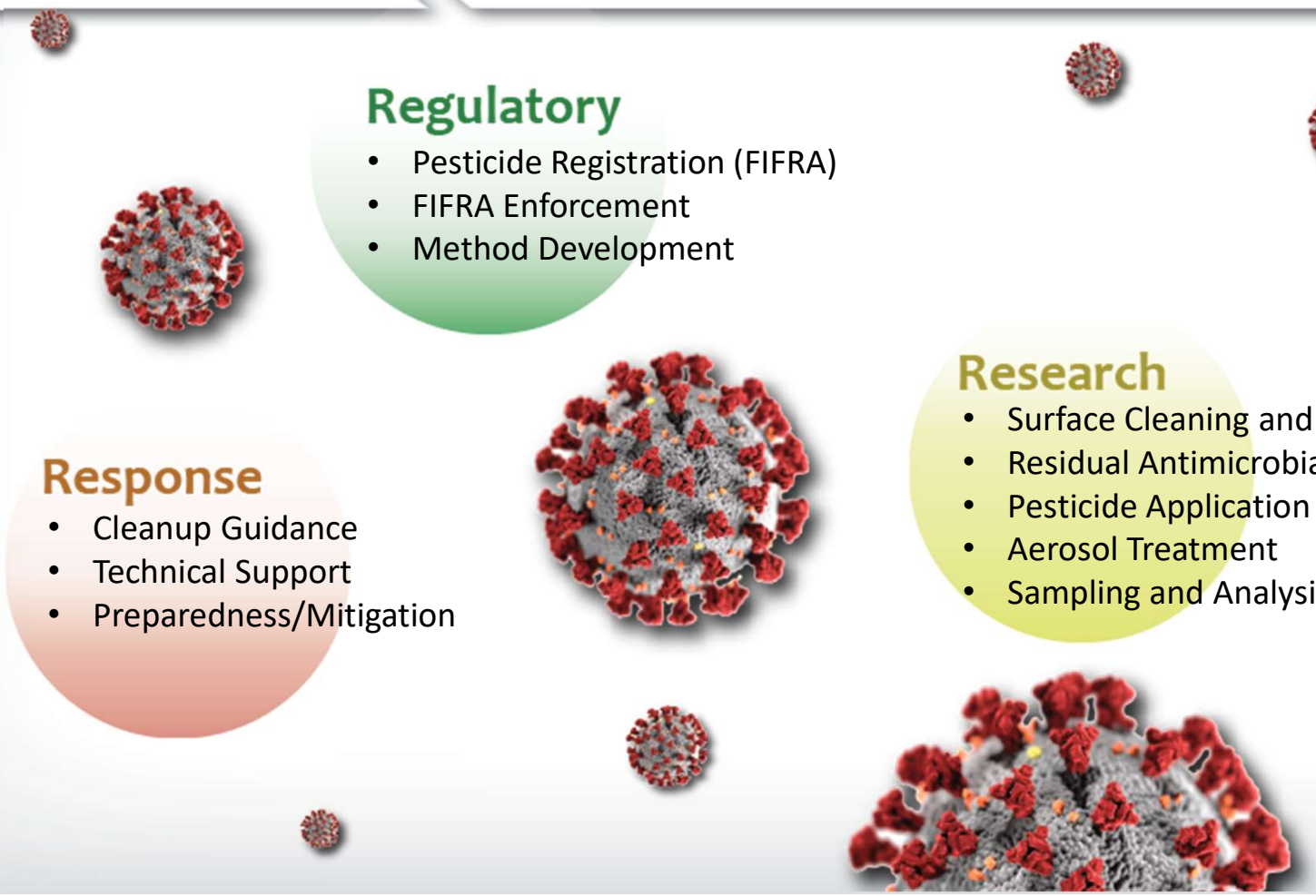
- Pesticide Registration (FIFRA)
- FIFRA Enforcement
- Method Development

Research

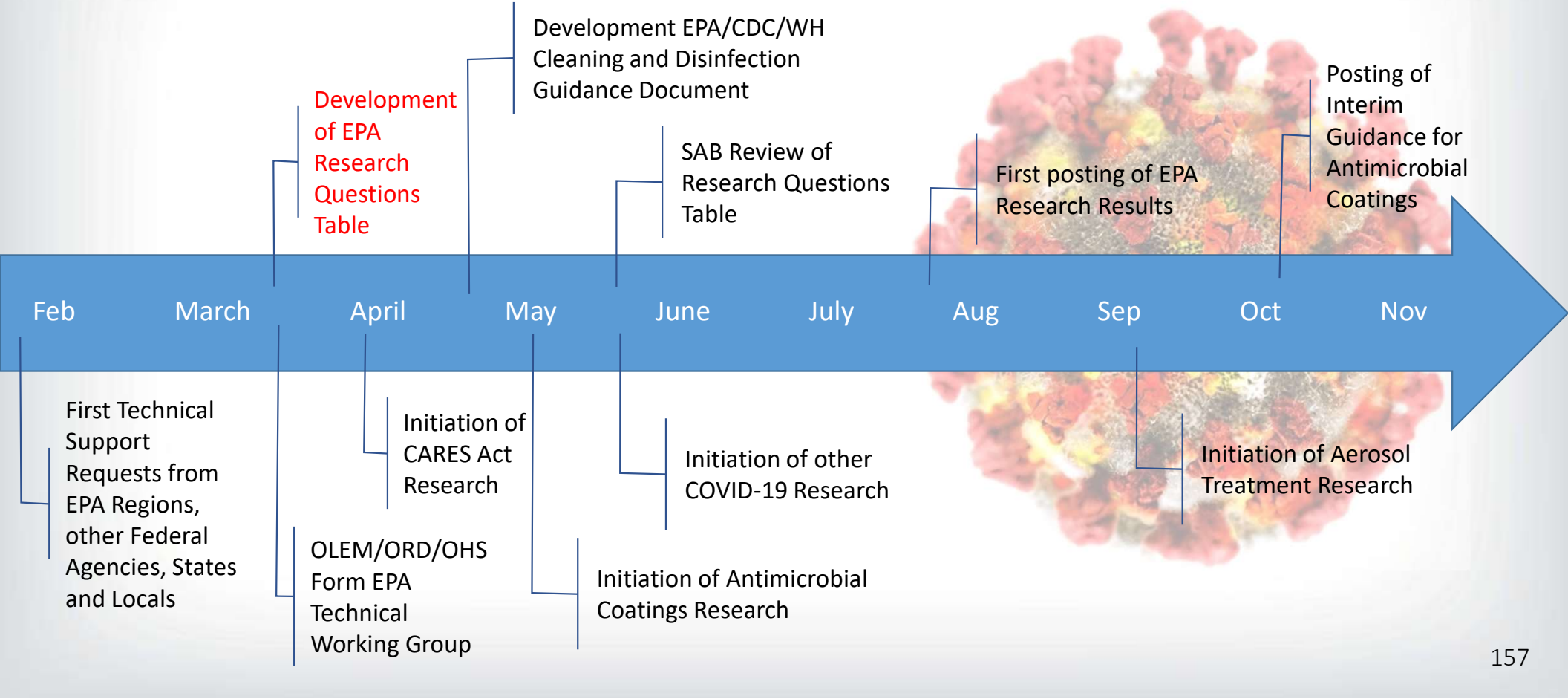
- Surface Cleaning and Disinfection
- Residual Antimicrobial Coatings
- Pesticide Application and Devices
- Aerosol Treatment
- Sampling and Analysis

Response

- Cleanup Guidance
- Technical Support
- Preparedness/Mitigation



EPA SARS-CoV-2 Timeline



EPA CoV-2 Questions Being Addressed

Research topics were selected because they can result in a critical and rapid impact on the current CoV-2 response:

- How can real-world surfaces be disinfected most effectively?
- Are there ways to disinfect high-touch, public spaces that remain effective for long periods of time?
- What are effective ways to apply disinfectants?
- How effective are alternative disinfection devices, such as UVC?
- How effective are aerosol treatment technologies and what are appropriate methods to determine effectiveness?
- How can PPE be readily and effectively disinfected and reused?

What we have learned & next steps

- Cleaning and Disinfection
  - Spray vs. spray/wipe application
  - Cleaning compared to disinfection
  - Material dependency
- Antimicrobial coatings
  - Demonstrate promise from initial effectiveness and stability
  - Challenge with durability as supplemental coating products
- UV-C
  - Effective in laboratory studies, depending upon material types
  - Challenge in field application
- Aerosol treatment
  - Testing aerosol devices
  - Developing assessment methodology and discussing surrogate comparison
- PPE
  - Effective widely-available disinfection methods identified for many types of PPE materials
  - Scaling up testing and conducting functionality assessments

EPA Research on COVID-19 Website

More information is available at EPA's CoV-2 Research website:

https://www.epa.gov/healthresearch/research-covid-19-environment

Information and results will also be shared through:

- EPA Program Offices and Regions
- Stakeholders, including state and local agencies and public health organizations
- Future webinars

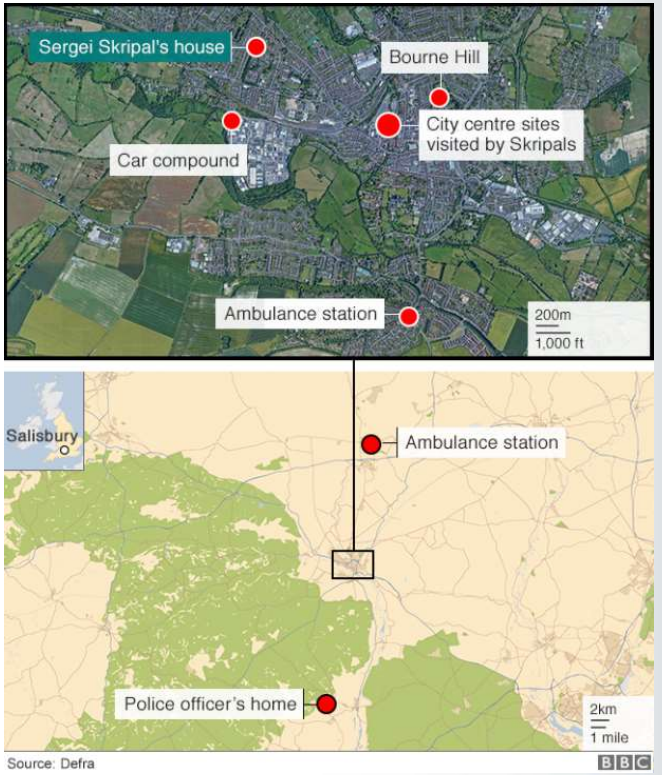
Additional questions can be submitted to CESER@epa.gov

Novichok Incident in UK

- Fourth Generation Agent used in U.K. with an attempt to assassinate former KGB agent and his daughter

- HSRP activities during UK's response
  - Observation during UK's remediation
  - Collection of information from UK government

- What are the HSRP actions after the observation?
  - Immediate communication with EPA and interagency partners
  - Response gaps and research needs identification
  - Roadmap development to fill gaps and needs
  - Implementation of research plan



More Information

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https://www.epa.gov/homeland-security-research

Videos of HSRP

- Water Security Testbed
- Underground Transportation Restoration Project
- Toolbox of technologies – rad demo
- Bio-Response Operational Testing and Evaluation (BOTE) Project
- Incident Waste Management Support Tool (I-Waste)
- Environmental Sampling & Analytical Methods (ESAM) Instructional Video