

Homeland Security Research Program - 101
Gregory Sayles, Acting National Program Director
For SAB-BOSC, June 25, 2014



ADVANCING
OUR NATION'S
SECURITY
THROUGH
SCIENCE



Mission: to conduct research and develop scientific products that improve the capability of the Agency to carry out its homeland security responsibilities



EPA Homeland Security Responsibilities

Drivers

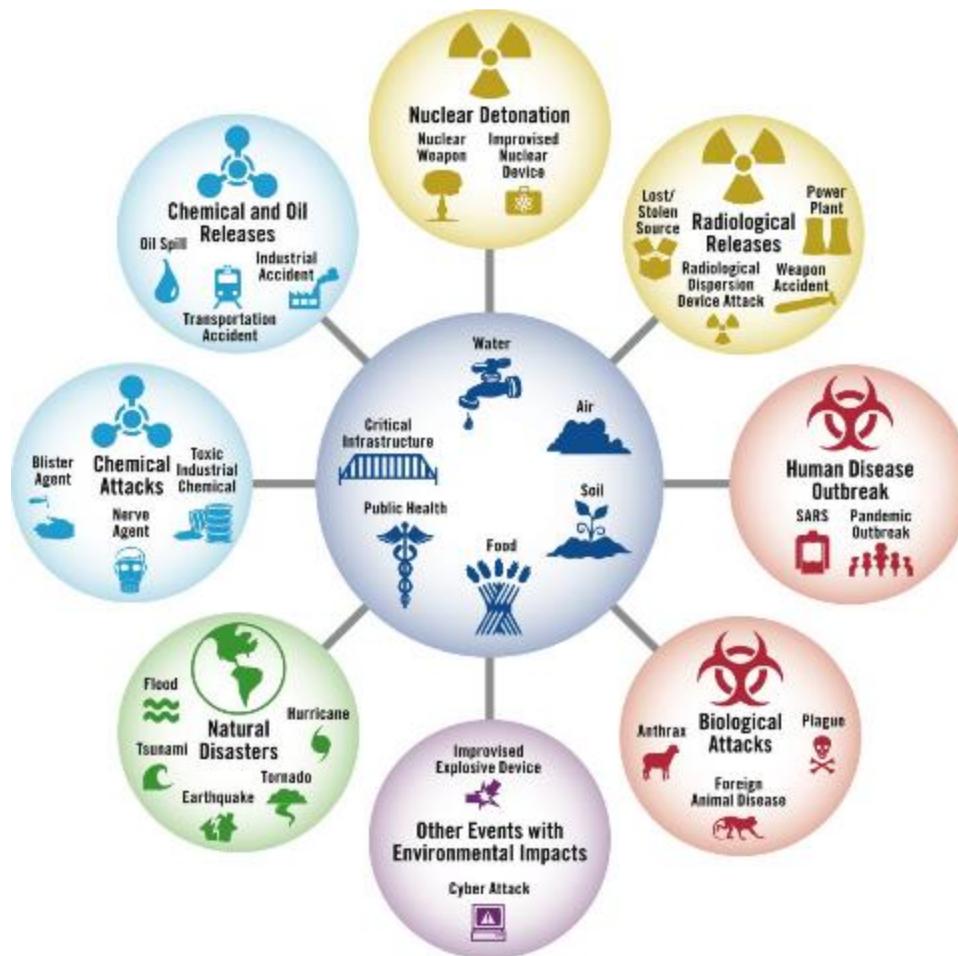
- Bioterrorism Act
- Presidential Directives
- Executive Orders
- National Response Framework
- Elements of:
 - Comprehensive Environmental Response, Compensation and Liability Act
 - Emergency Planning and Community Right-to-Know Act
 - Clean Water Act
 - Safe Drinking Water Act
 - Oil Pollution Act
 - Clean Air Act
 - Resource Conservation and Recovery Act



Responsibilities

- **Support water systems to prepare for and recover from attacks and other disasters**
 by leading efforts to provide States and water utilities guidance, tools and strategies. *EPA is the federal government Sector Specific Agency (SSA) lead for water infrastructure.*
- **Clean up buildings and outdoor areas**
 impacted by a terrorist attack or other disaster by leading efforts to establish clearance goals and clean up.
- **Develop a nationwide laboratory network**
 with the capability and capacity to analyze for chemical, biological and radiological (CBR) agents for routine monitoring and in response to a terrorist attacks.

EPA's "All Hazards" Universe



Refining EPA's Approach to Homeland Security, Office of Homeland Security (2011)

Contributing to Sustainability by Supporting Resilience

- Disasters, natural or man-made, are inevitable
- Sustainability of our communities requires resiliency to disasters
- Resiliency is improved with EPA guidance, tools and support
- Scientific gaps exist in our ability to prepare for and recover from environmental disasters
- Homeland Security Research Program's (HSRP) mission is to fill science gaps to improve EPA's response capabilities



EPA Fiscal Year 2014-2018 Strategic Plan

HSRP Alignment with Goals and Strategies

Strategic Goal	Objective
Goals 2 Protecting America's Waters	Objective 2.1 - Protect Human Health: "...protect and sustainability manage drinking water resources"
Goal 3 Cleaning Up Communities and Advancing Sustainable Development"	Objective 3.1 – Promote Sustainable and Livable Communities Land, "Support sustainable, resilient, and livable communities by working with local, state, tribal, and federal partners to promote...emergency preparedness and recovery planning"
	Objective 3.2 - Restore Land: "prepare for and respond to accidental or intentional releases of contaminants and clean up"
Goal 4 Ensuring the Safety of Chemicals and Preventing Pollution	Administrative location in the Strategic Plan
Cross-Agency Strategies	Working Toward a Sustainable Future "advance sustainability science, indicators, and tools"

HS Research Partner Engagement

PARTNER

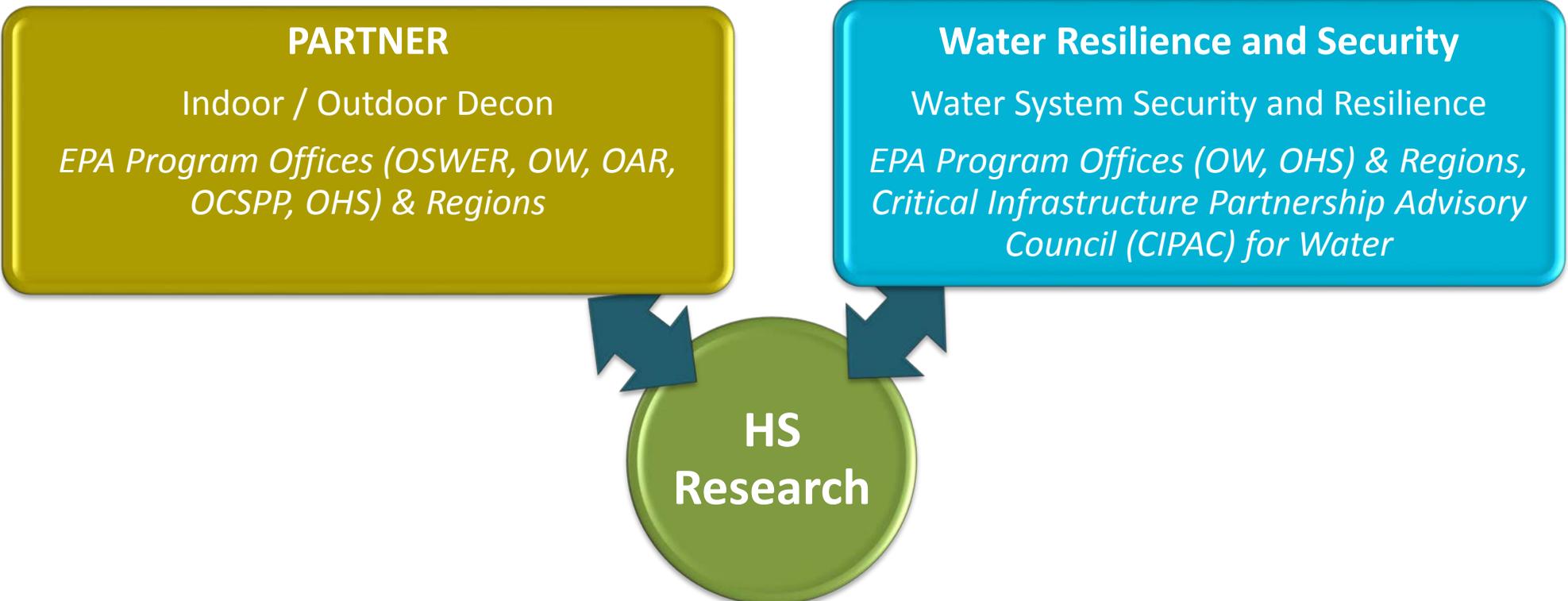
Indoor / Outdoor Decon

EPA Program Offices (OSWER, OW, OAR, OCSP, OHS) & Regions

Water Resilience and Security

Water System Security and Resilience

EPA Program Offices (OW, OHS) & Regions, Critical Infrastructure Partnership Advisory Council (CIPAC) for Water

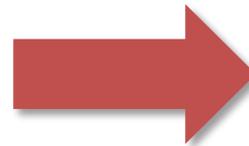
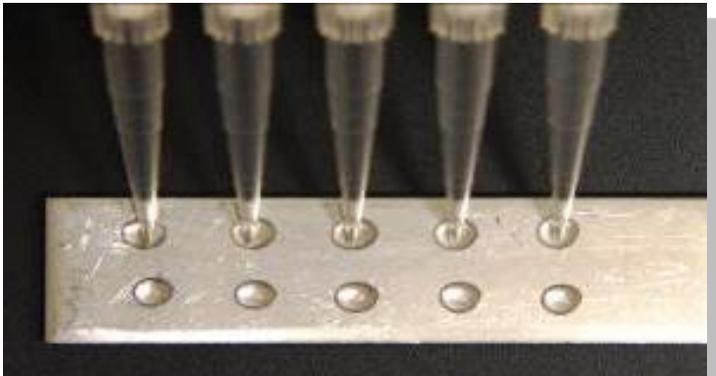


HS
Research

All partners engaged in:
Needs prioritization
Research implementation
Product formulation/delivery

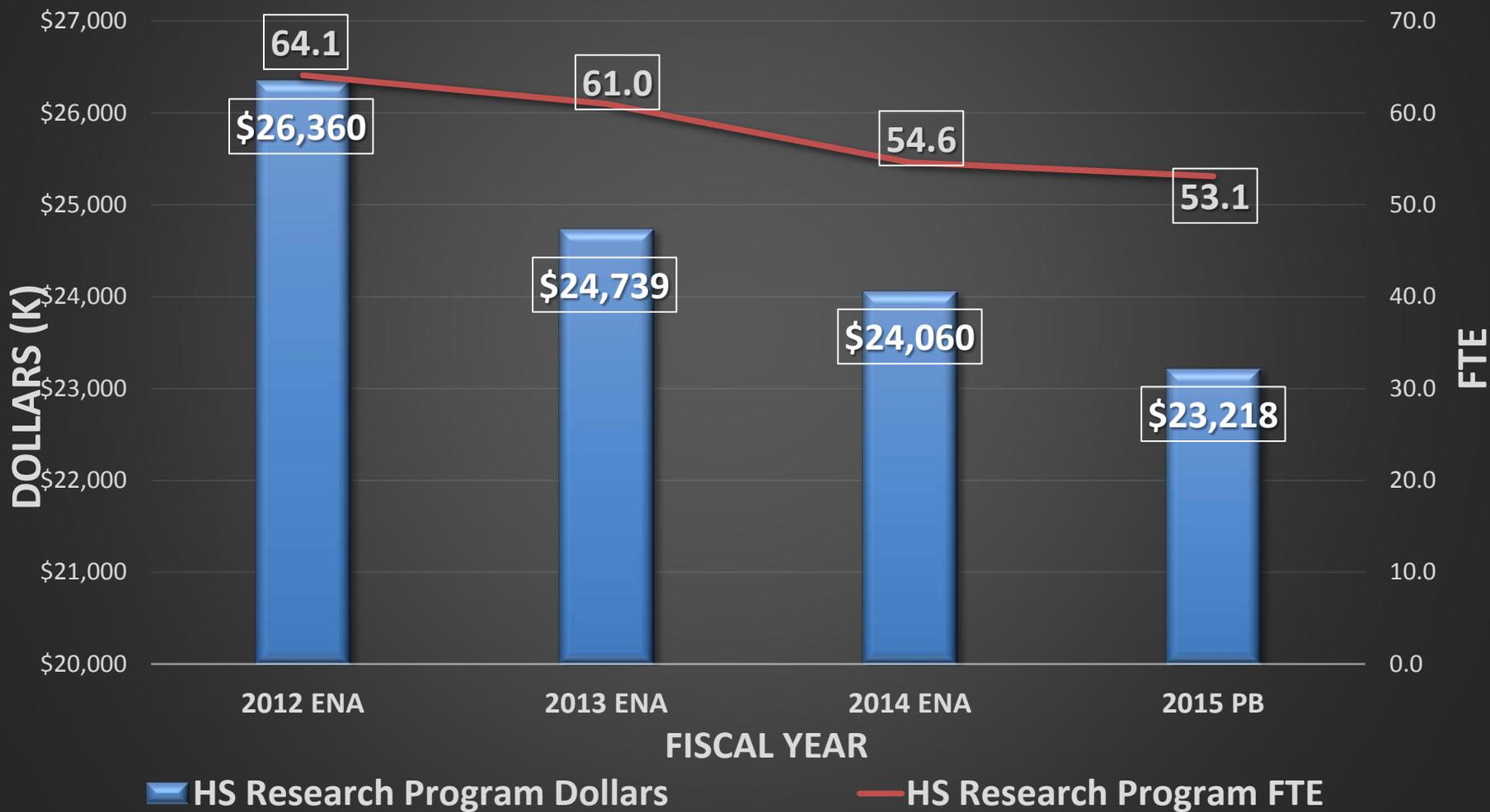
HSRP's Foundation

- Applied research and technical support - *oriented to solutions*
- Customer & stakeholder engagement - *focused on needs/gaps*
- Systems-based approaches - *increased relevance and utility*
- Realistic schedules - *timely delivery*
- High quality tools and technical data - *more informed decision making*





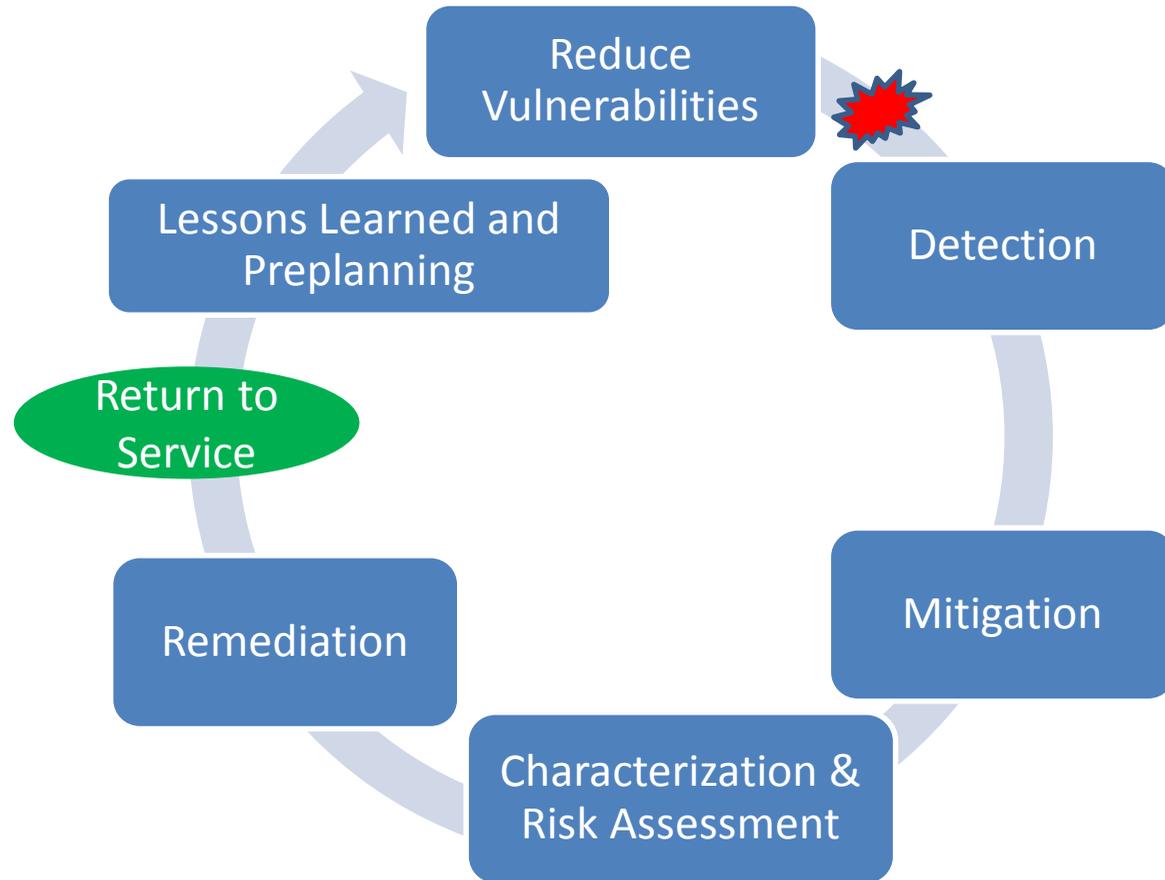
ORD – Homeland Security Research Program Resources FY12 – FY15 Dollars and FTE



Research Summary Outline

- **Water System Security and Resilience**
- **Indoor/Outdoor Cleanup**
 - Systems model
 - Evolution
 - Research conducted/underway
 - Impacts
- **Cross Cutting Research Areas:**
 - **Fate and transport**
 - **Exposure**
 - **Sampling and analysis**

Water System Security and Resilience Systems Approach



Water Security and Resilience

Evolution of Program

Detection

Mitigation

Cleanup

Resilience

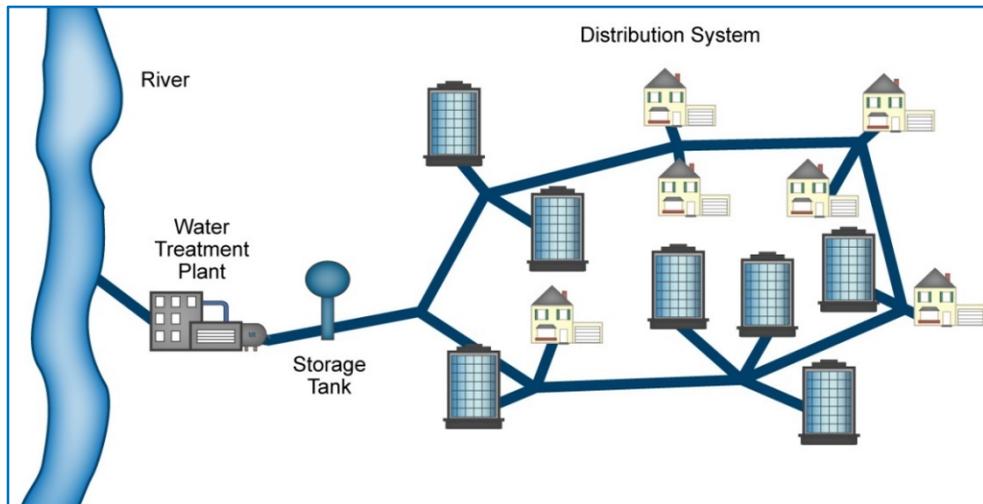


Contamination warning system data and tools

Flushing strategies

Infrastructure decon, water treatment

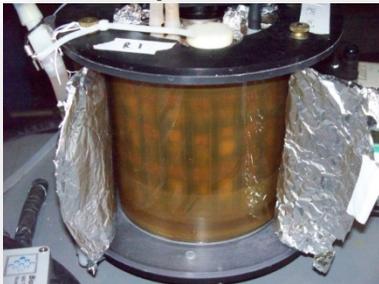
System designs, vulnerability tools, indicators



Schematic of drinking water distribution system.

Experimental Research

- Sensor testing for contamination warning:
 - Water quality parameters (chemical and biological contamination)
 - Radiation
- Infrastructure decon
- Water treatment
 - Distribution system
 - Wash water
- Bench – pilot- full scale



Biofilm reactor for bench decon studies



Test and Evaluation Facility where the on-line monitors and pilot decon approaches are assessed



Sievers 900 Portable (UV Persulfate TOC)

Suite of Water Security and Resilience Tools

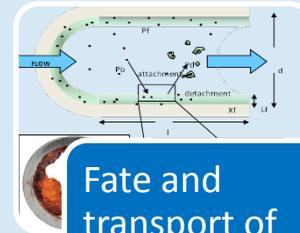
Preparing

Assessing vulnerabilities and consequences



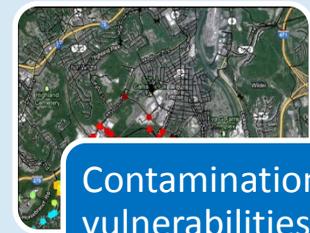
Blast vulnerabilities

- BVAT



Fate and transport of contaminants

- EPANET-MSX

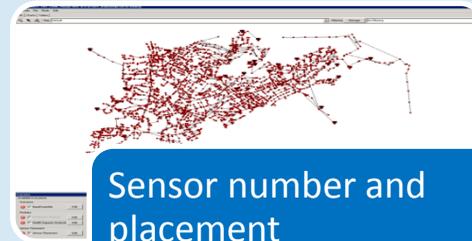


Contamination vulnerabilities, consequences

- C/VA

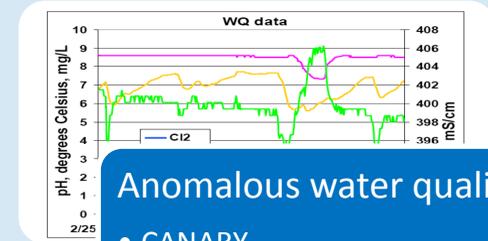
Detecting

Locating sensors and analyzing water quality data



Sensor number and placement

- TEVA-SPOT

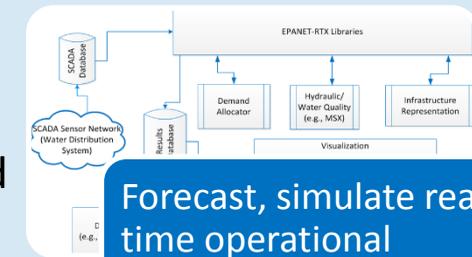


Anomalous water quality

- CANARY

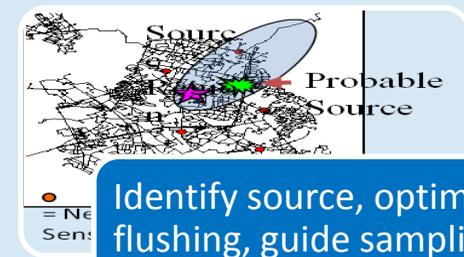
Responding

Evaluating response and remediation actions



Forecast, simulate real-time operational conditions

- EPANET-RTX



Identify source, optimize flushing, guide sampling

- WST

Assessing Tools and Approaches at Full Scale Water Security Test Bed

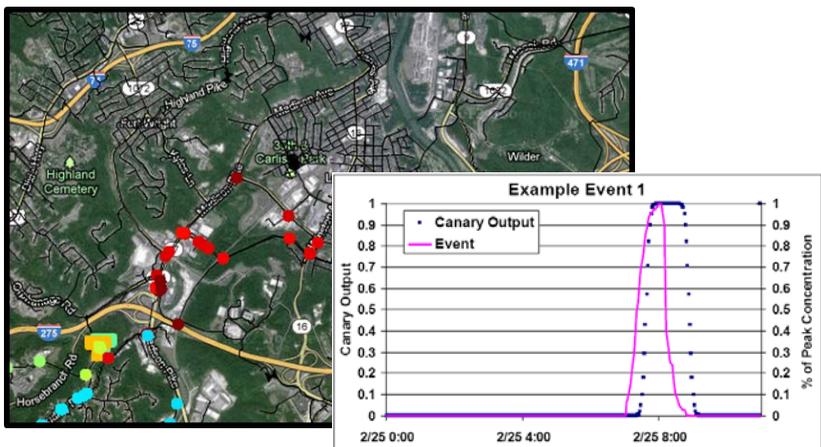
- Above ground drinking water pipe system with a 40,000 gallon lagoon, high rate groundwater pump, and storage tanks
- Supports research on distribution system decontamination, sensors, cyber security, and wash/flush water treatment
- Located near adjacent office building with plumbing
- CBR agents or simulants
- Located at Idaho National Lab



Impacts

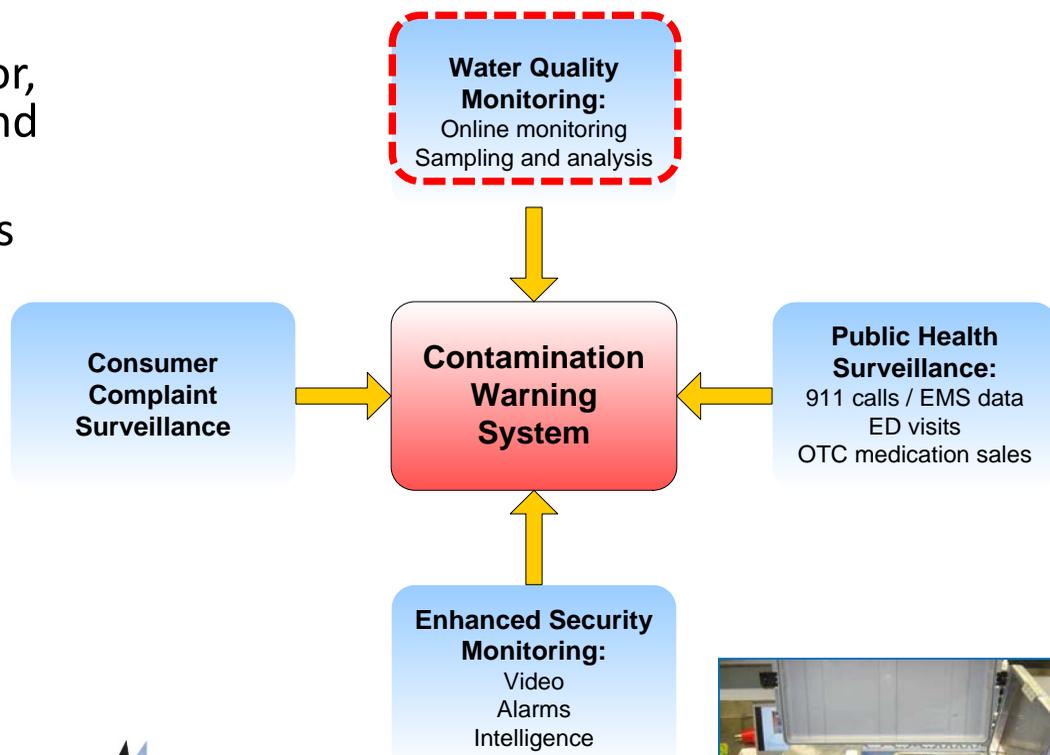
Office of Water's Contamination Warning System

- HSRP evaluated water quality sensors, developed a water sample concentrator, software tools for sensor placement and real-time sensor data monitoring
- Suite of water security computing tools piloted in 5 cities
- Components now used in many other cities



Sensor placement and event detection tools are part of the suite of water security computing tools

Contamination Warning System Architecture



Portable water sample concentrator

Impacts (cont.)

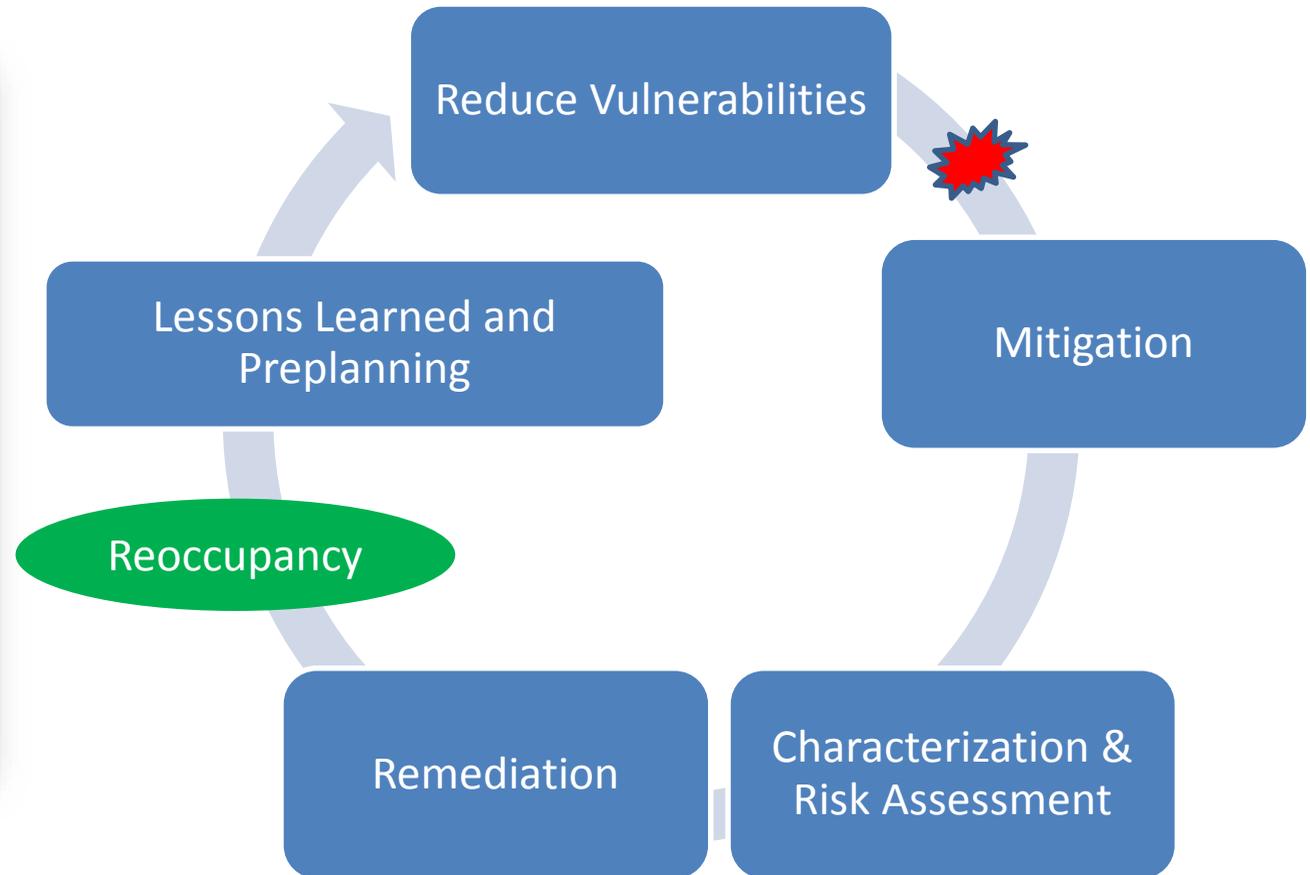
Research results included in the widely used Water Contamination Information Tool (WCIT):

- contaminant characteristics (e.g., persistence on infrastructure)
- decontamination methodologies
- monitors
- sampling and analysis methods



WCIT is a secure on-line database with comprehensive information about CBR agents of concern to the water sector.

Indoor/Outdoor Cleanup Systems Approach



Indoor / Outdoor Cleanup

Evolution of Program

Buildings

Wide areas

Emerging issues

Efficacy, engineering, traditional CBR agents

Efficacy, systems approaches, decision support tools

Ag security, emerging chemicals, all hazards



Transportable gasifier for carcass management.

Decontamination Efficacy Research

- What clean up technologies are most effective for contaminants on surfaces?
- How is efficacy changed by real world variations in environmental, process and agent characteristics?

Research

Study efficacy against chemical, biological, radiological, and nuclear fallout contamination on surfaces encountered during a wide area contamination incident



Decontamination Research from Bench to Full-Scale

Bench Studies



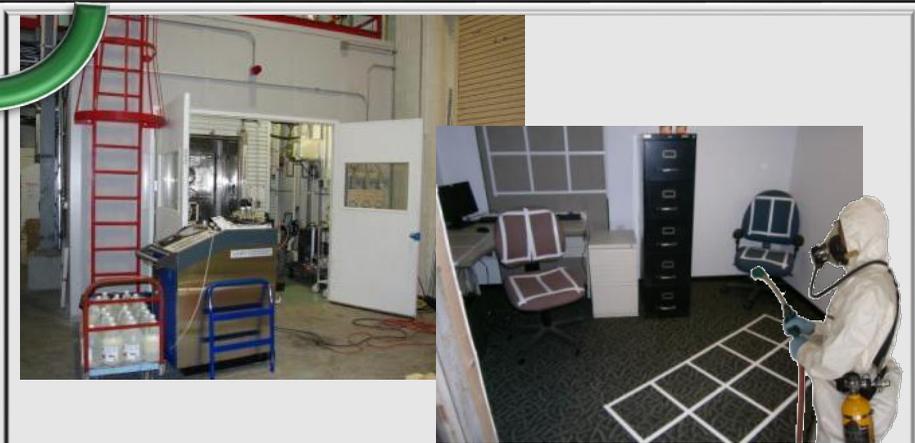
Spray Chamber



Full Scale



Room Scale



Decontamination Engineering

How can decontamination processes be successful at full scale?

- Optimization – delivery and recovery of fumigant
- Monitoring – fumigant, decon progress
- Materials compatibility
- Waste generated



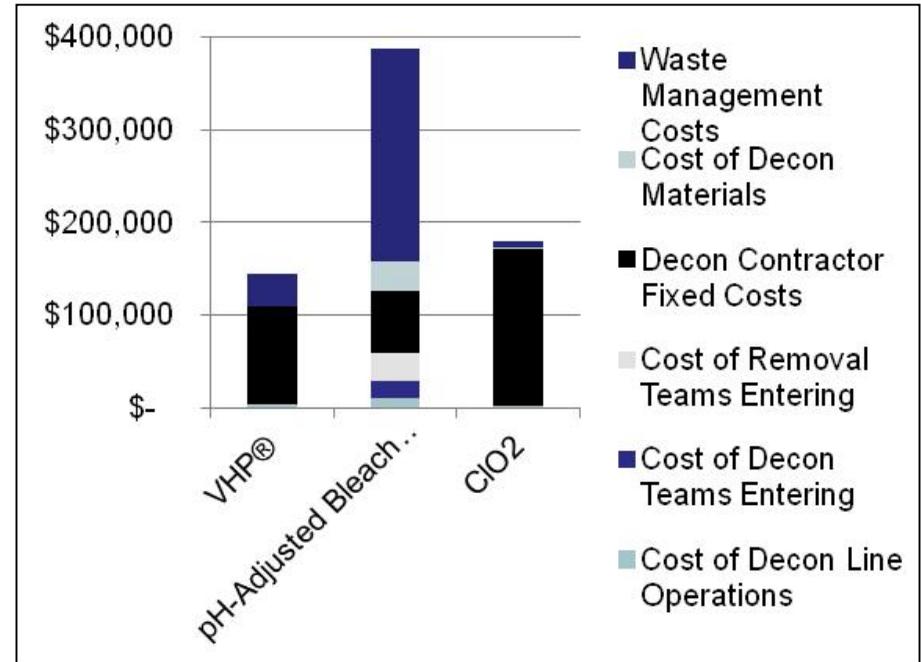
Systems Approach to Response and Remediation

What are the decision interdependencies?

How can decision makers become aware of these interdependencies during response and preparedness activities?

Developing decision-support tools:

- For choosing decon options - shows that interconnection between decision points during facility remediation
- For waste management - assesses the impact of wide area decontamination strategies on waste



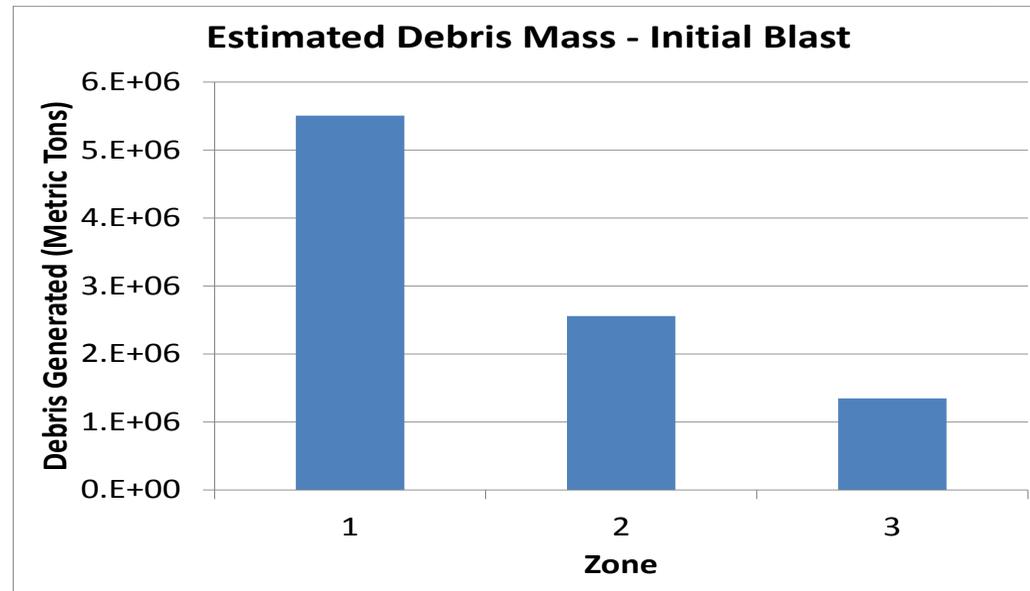
Example output of facility remediation tool.

Impacts

- Natural anthrax contamination cleaned up based on our decon research
- Waste tools used in national disaster exercises
- OCSPS anthrax exclusion policy heavily cites our work
- OSWER guidance and other response guides heavily cite our work



House contaminated with anthrax is tented in preparation for fumigation



Waste Estimation Support Tool predicts waste volumes generated from an Radiological Dispersion Device blast

Impacts - A Story of Research Influencing a Response

In 2013, mail containing the biotoxin, ricin, was discovered at White House and Congressional postage handling facilities.

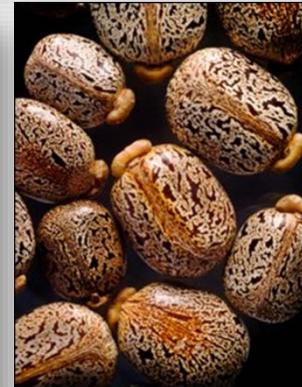
Provided real-time research product synthesis and technical support for ricin:

- sampling and analysis methods
- decontamination technologies
- exposure advisory values

Aided decisions made by Capital Police, OSWER, and Regions 3 and 4 on clean up of the:

- mail handling facilities including the expensive sorting equipment
- alleged perpetrator's home in Mississippi

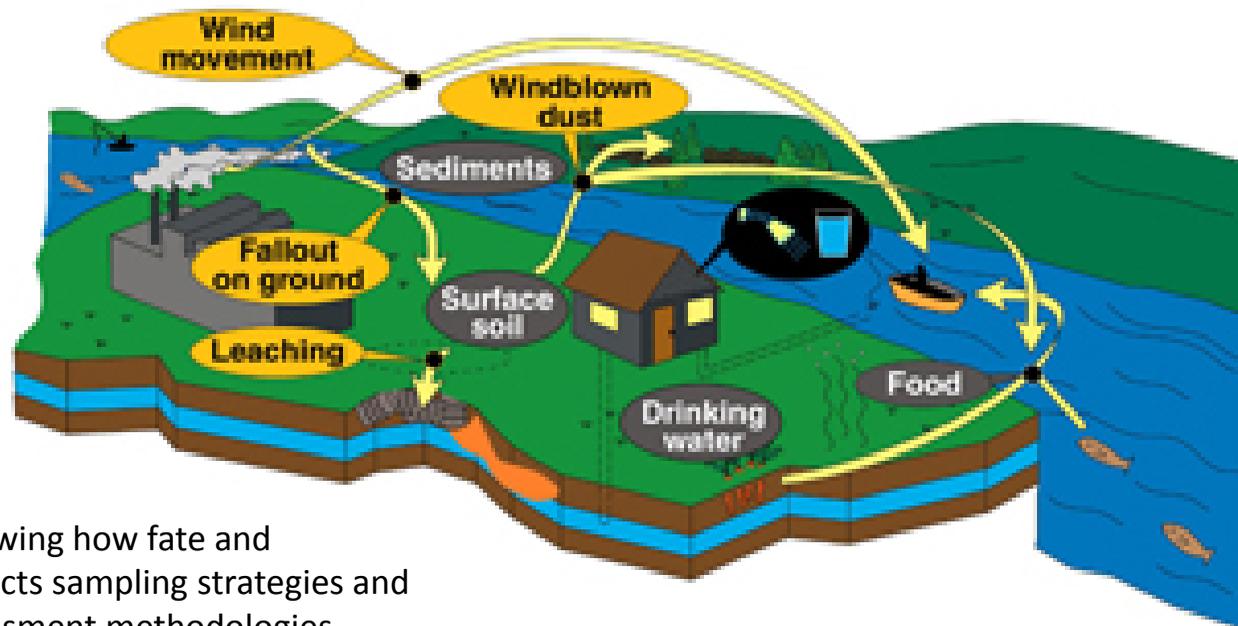
Afterwards, HSRP contributed to training given by Region 3 and OEM to responders on ricin sampling and analysis.



Bottom: ricin training, and castor beans, the source of the ricin toxin

Cross Cutting Research Areas

- Fate and transport
- Exposure
- Sampling and analysis methods for characterization



Schematic showing how fate and transport impacts sampling strategies and exposure assessment methodologies

Agent Fate and Transport

For chemical, biological, and radiological (C,B,R) contamination, what is the agent's fate?

- C/B – persistence over wide area and on water infrastructure?
- C/B/R – contaminant spread?
- C/R – reactivity over wide area and in water systems?

Impacts detection, characterization, mitigation, exposure assessment, and remediation

Research:

- Examining fate and transport of contaminants in drinking water
- Examining spore transport in urban outdoor environment

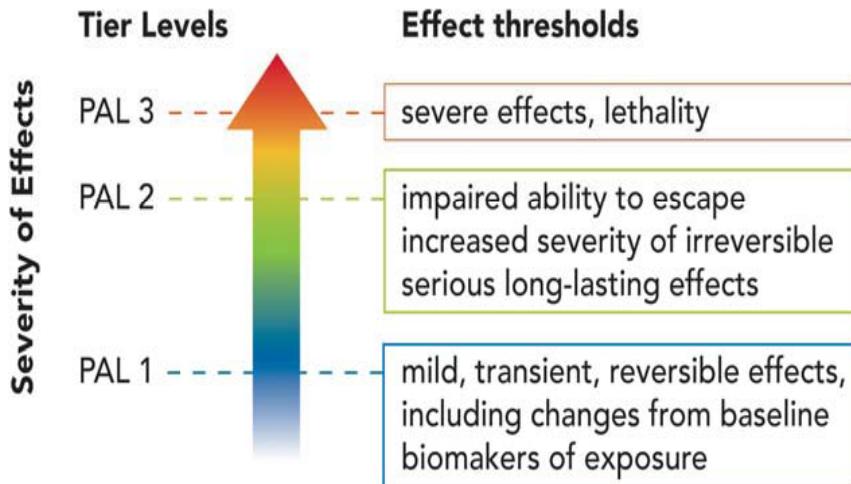


Exposure Assessment

How can characterization of exposure pathways and health risks from contamination be improved to better inform risk assessment and risk management decisions?

Developed Provisional Advisory Levels for Chemical and Toxins (159 total)

Characteristics of PAL Severity Levels



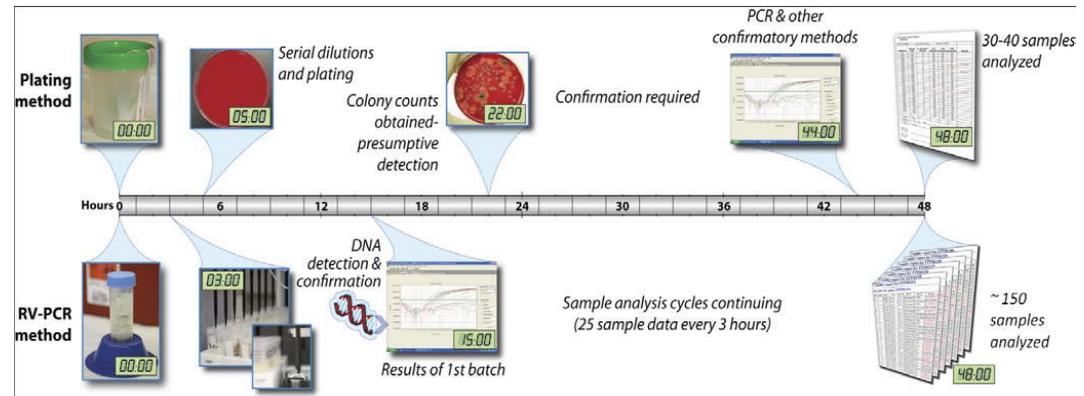
Research:

- Incorporating exposure into water security and resilience tools
- Determining exposure assessment methodologies for biological contaminants (e.g., virus causing foot and mouth disease, *anthracis* spores)
- Developing provisional advisory exposure levels

Innovative Method Development

Improving capability and capacity

- Developing efficient sampling methods and rapid sample processing techniques
- Developing rapid, sensitive, and selective analysis protocols
- For CBR contaminants in environmental matrices and on surfaces



Plating Method: 30-40 samples
RV-PCR Method: 150 samples

Example of innovative analytical protocol developed for *Bacillus anthracis* spores in environmental samples.

Impacts

Selected Analytical Methods compendium used during tabletop exercises and responses by

- EPA's Environmental Response Lab Network (ERLN)
- EPA's Water Laboratory Alliance (WLA)



Chemical Methods

142 analytes
5 matrices

Pathogen Methods

31 analytes
4 matrices

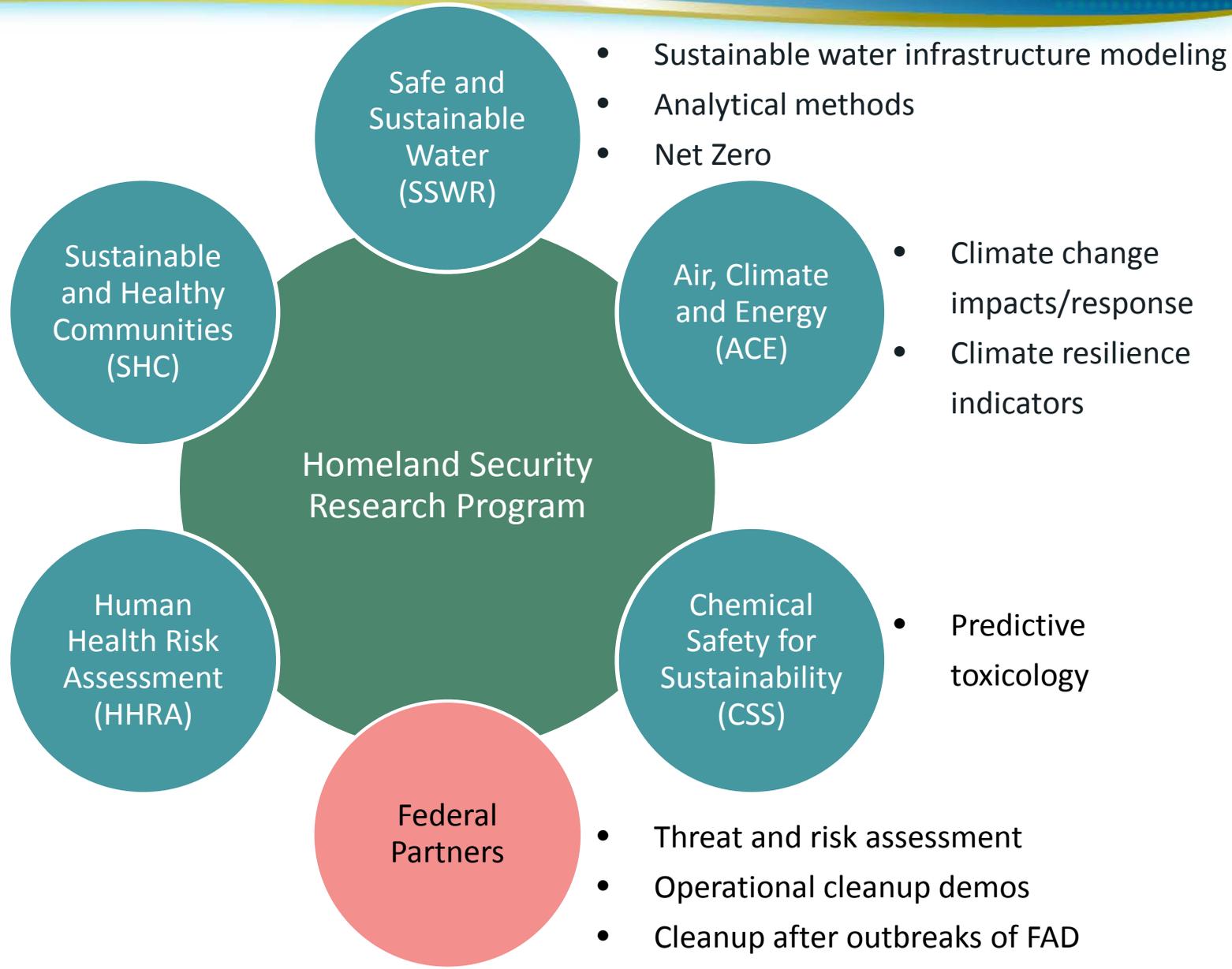
Radiochemical Methods

25 analytes
6 matrices

Biotoxin Methods

18 analytes
5 matrices





- Sustainability indicators
- Sustainable materials management
- Contaminated sites

Sustainable and Healthy Communities (SHC)

Safe and Sustainable Water (SSWR)

- Sustainable water infrastructure modeling
- Analytical methods
- Net Zero

Air, Climate and Energy (ACE)

- Climate change impacts/response
- Climate resilience indicators

Human Health Risk Assessment (HHRA)

- Cumulative risk
- ExpoBox

Federal Partners

Chemical Safety for Sustainability (CSS)

- Predictive toxicology

- Threat and risk assessment
- Operational cleanup demos
- Cleanup after outbreaks of FAD

Future Program Directions

- Wide area clean up – technologies and strategies
- Full scale demonstration of water tools and decontamination
- Exposure assessment
- Addressing “all hazards” science gaps
- Developing resilience metrics
- Cybersecurity
- Food Safety Modernization Act
- Emerging issues

