

EPA Office of Research and Development

HOMELAND SECURITY RESEARCH PROGRAM



OVERVIEW

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ACTING NATIONAL PROGRAM DIRECTOR

- Introductions
- Program Mission and Drivers for Research
- Research Activities and Impacts
- Communication of Research





ORD Research Programs



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

**ADVANCING
OUR NATION'S
SECURITY
THROUGH
SCIENCE**





EPA's 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

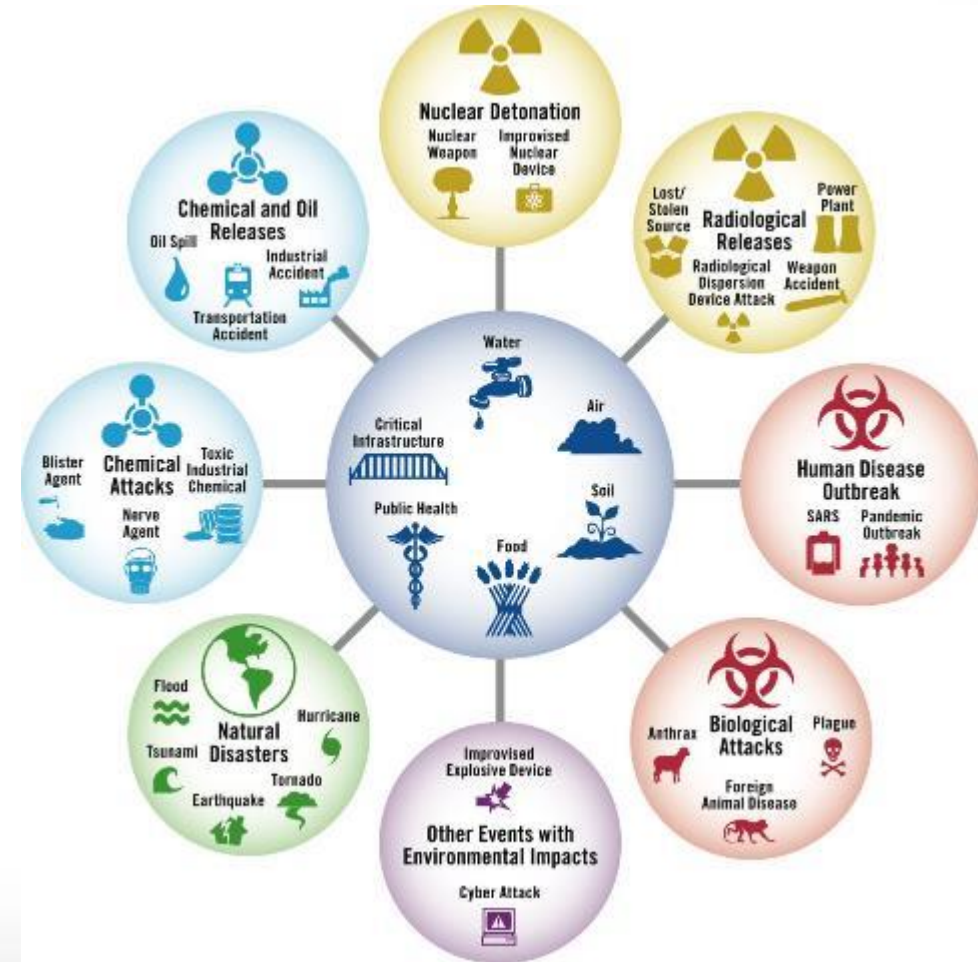


Responsibilities

- **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

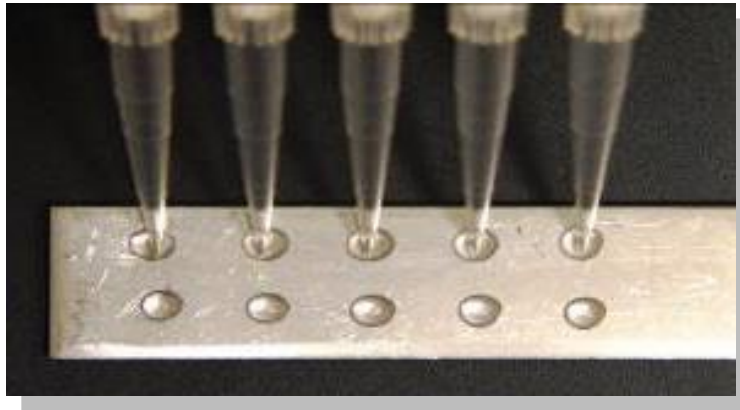




Overarching Homeland Security Research Priorities

- Advance EPA's capabilities to respond to wide-area contamination incidents
- Improve water utilities' abilities to prepare for and respond to incidents that threaten public health
- Increase the capability and capacity of the EPA's Environmental Response Laboratory Network
- Improve community resilience to disasters





- ❖ Applied research and technical support -
- ❖ Customer & stakeholder engagement -
- ❖ Systems-based approaches -
- ❖ Realistic schedules -
- ❖ High quality tools and technical data -

oriented to solutions

focused on needs/gaps

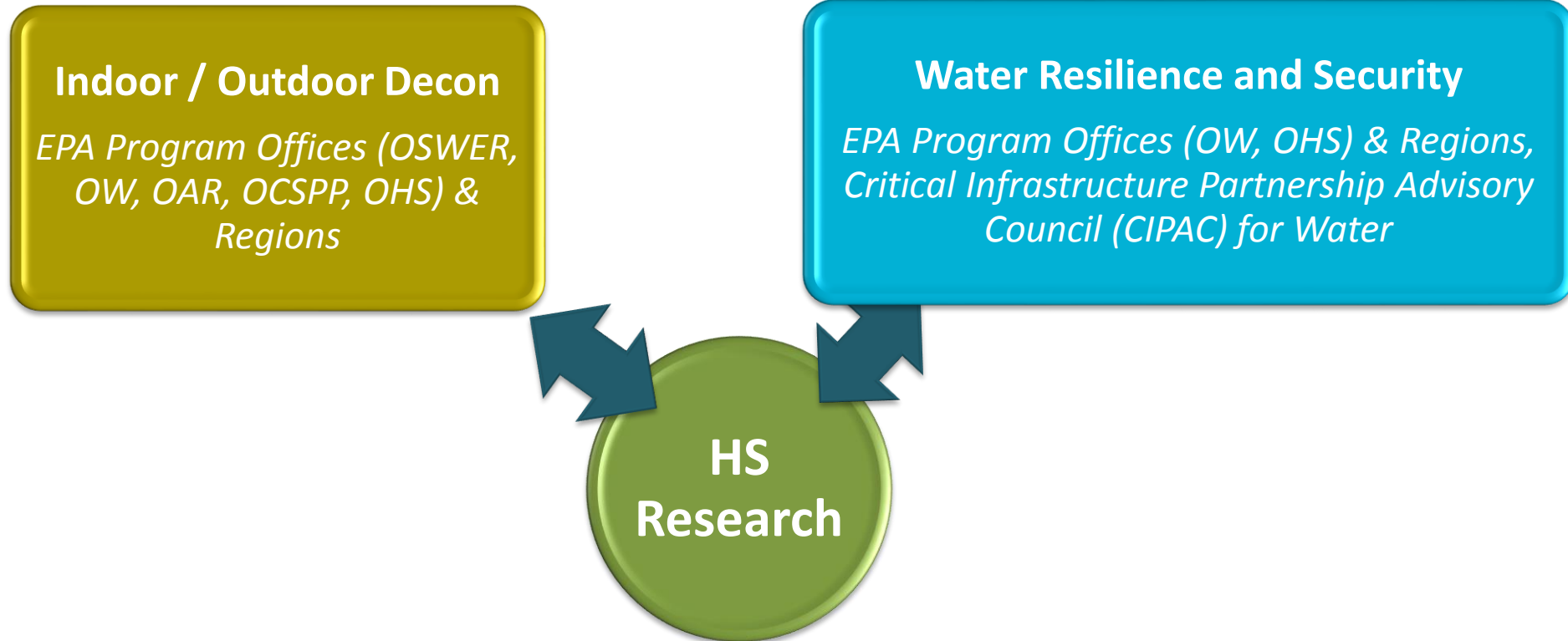
increased relevance and utility

timely delivery

more informed decision making

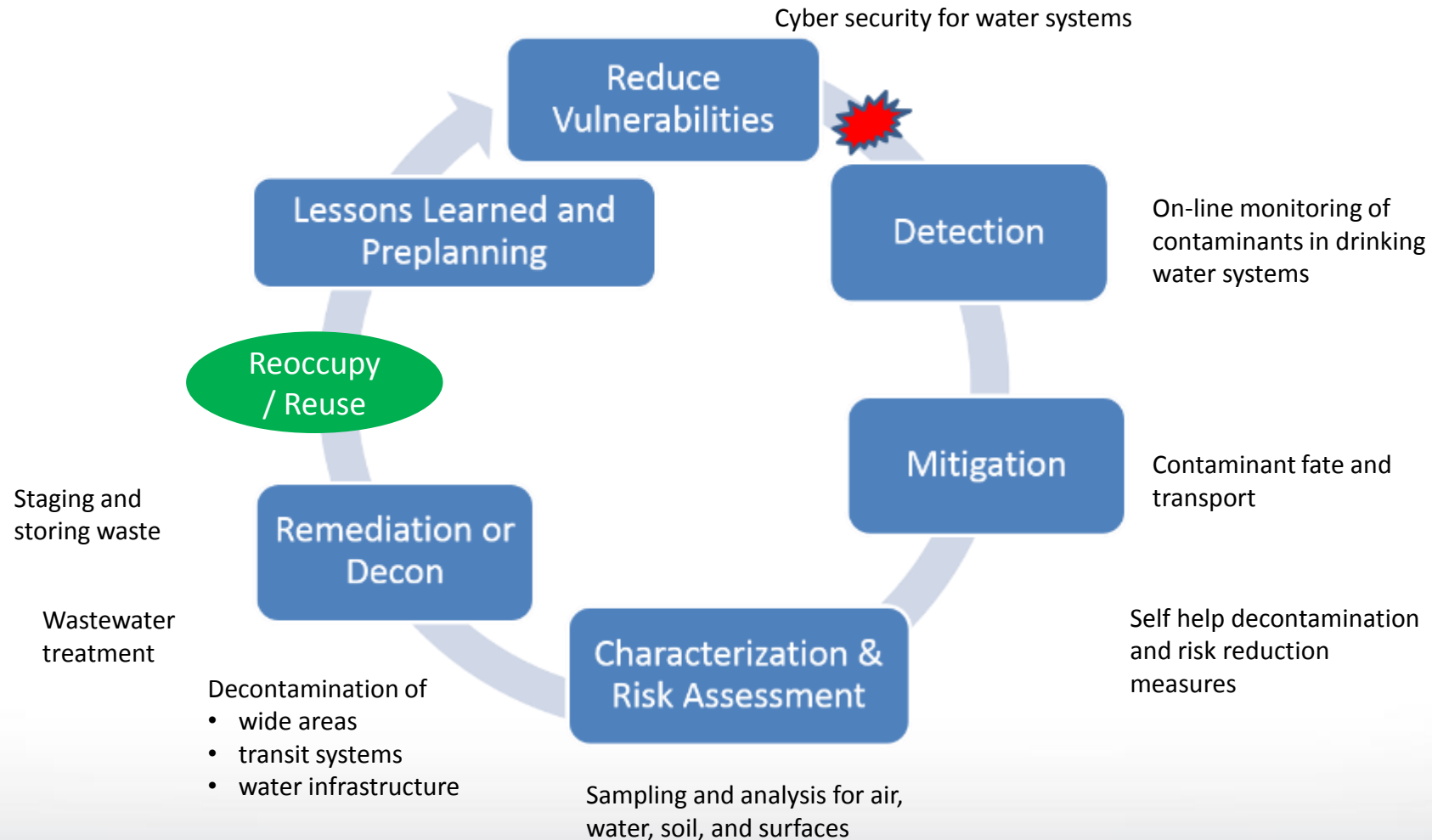


HS Research Partner Engagement



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

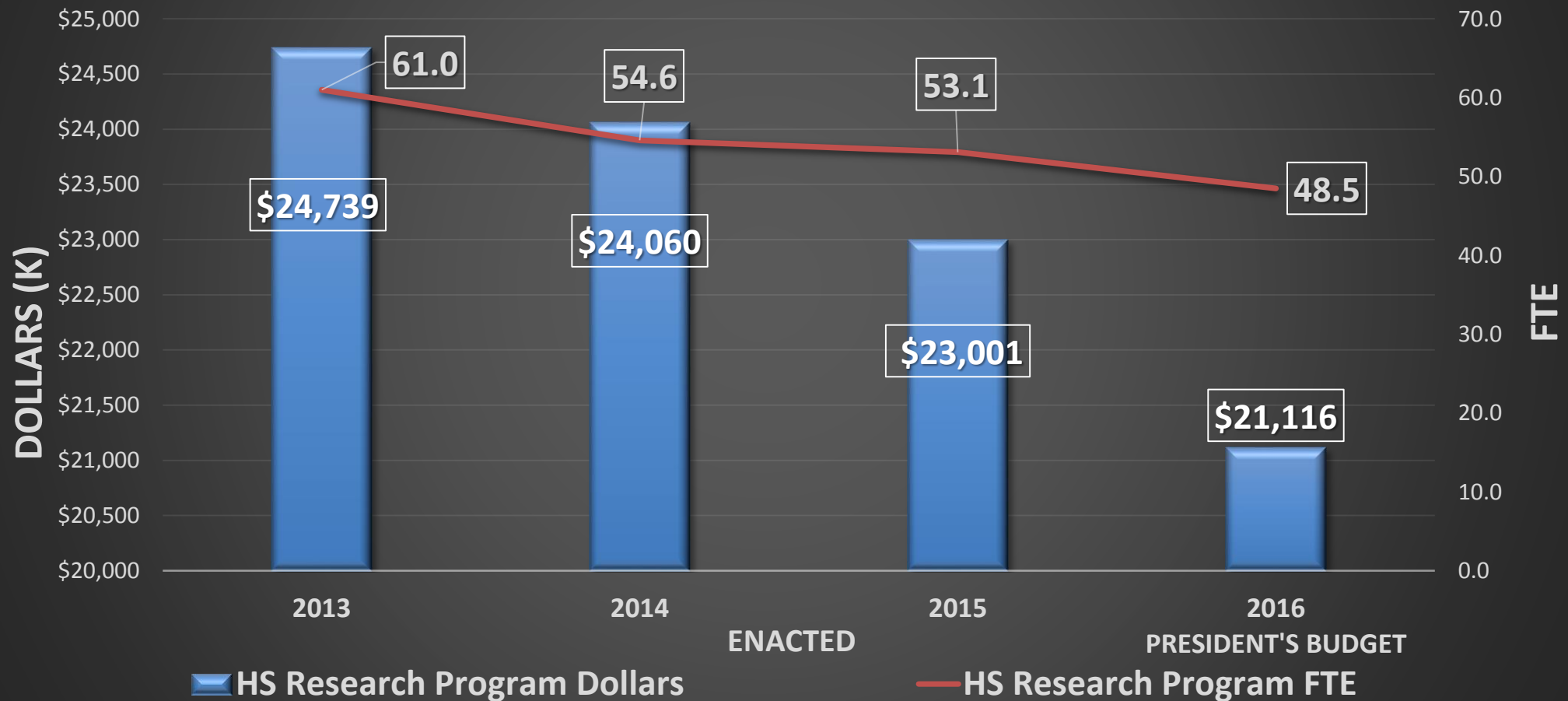
Addressing Partner Priorities using a Systems Approach





Resource Trends

ORD – Homeland Security Research Program Resources FY13 – FY16 Dollars and FTE

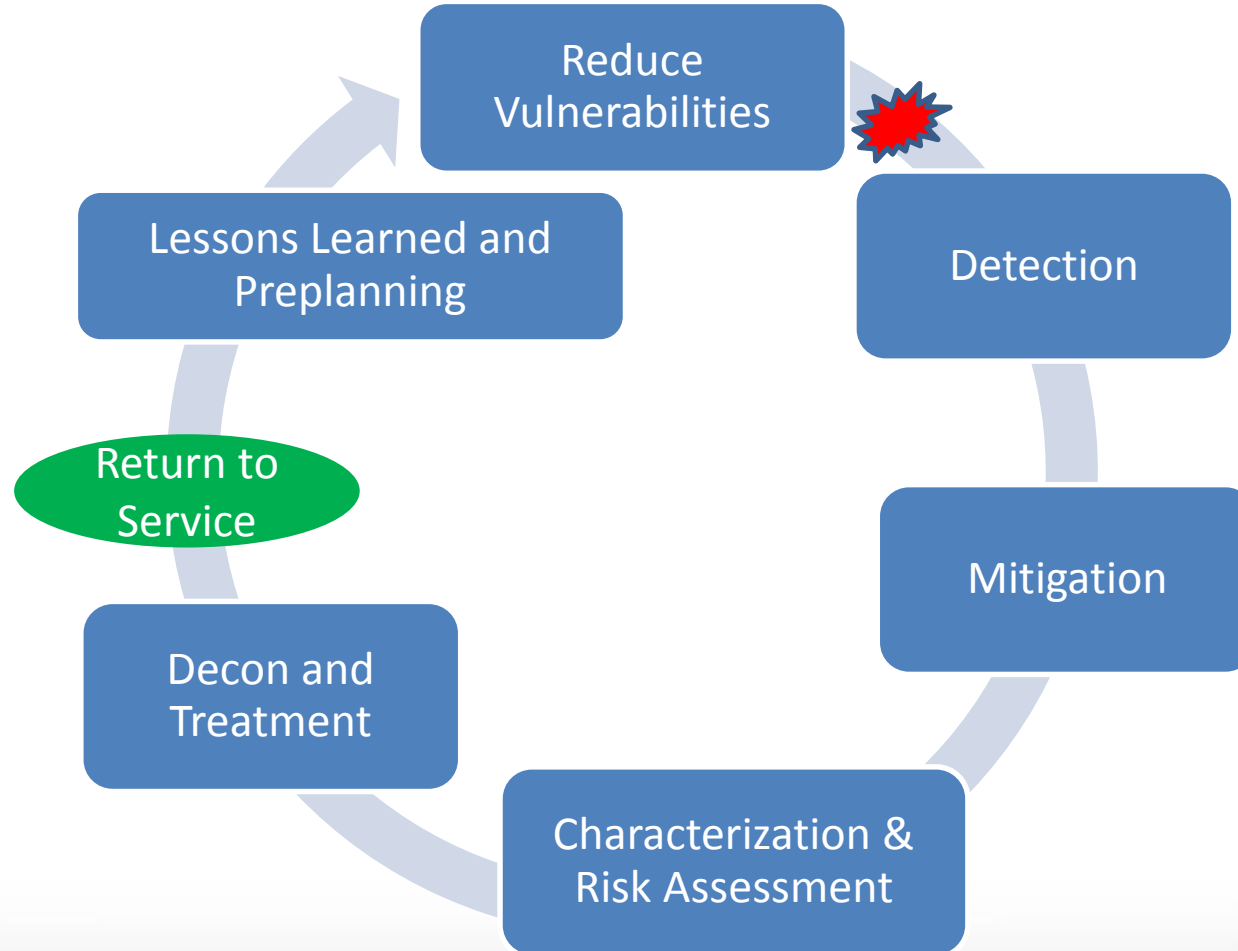




HS Research Activities and Impacts



Water System Security and Resilience Systems Approach



Water Security and Resilience

Evolution of Program

Detection

Mitigation

Cleanup

Resilience

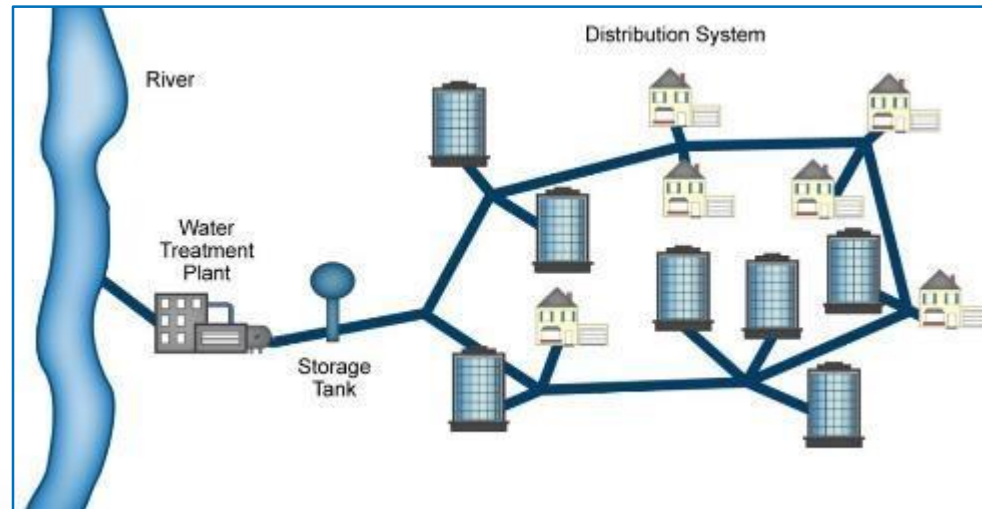


Contamination
warning system
data and tools

Flushing
strategies

Infrastructure
decon, water
treatment

System designs,
vulnerability tools,
indicators



Schematic of drinking water distribution system.

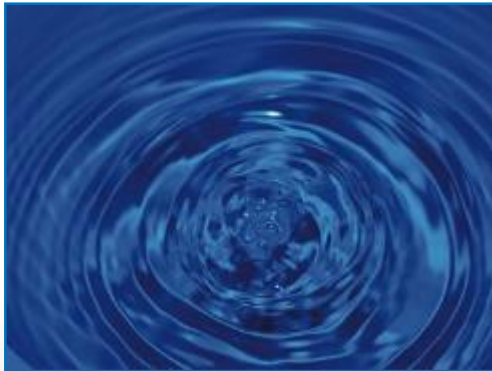


Water Security and Resilience - Science Questions

Can water systems models best be designed to enable utilities to be more **resilient to disruptions while enhancing daily operations?**

What methodologies and strategies are most effective for water infrastructure **decontamination and water treatment?**

What technologies, methods, and strategies for **detection and mitigation** of contamination in water systems best minimize public health consequences?



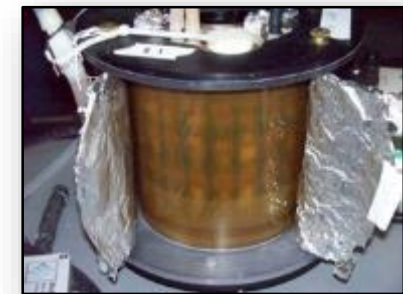
- Sensor testing for contamination warning:
 - Water quality parameters (chemical and biological contamination)
 - Radiation
- Infrastructure decon
- Water treatment
 - Distribution system
 - Wash water
- Bench – pilot- full scale



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



Sievers 900 Portable (UV Persulfate TOC)



Biofilm reactor for bench decon studies



Example: Contaminant Persistence and Decontamination of Drinking Water Infrastructure

- Persistence studied - determine the need for decontamination
- ^{137}Cs , ^{85}Sr , ^{60}Co and spore form of *Bacillus* spp - all persistent
- Flushing alone not successful for decontaminating infrastructure
- Coupons made from commonly used water pipe materials inserted into a pipe loop to test decontamination methods
- Field scale testing is required





Water Security Test Bed

U.S. Water Sector identified full-scale testing of water security tools, sensors, methods, with real contamination, a major gap

Response: build and operate a full-scale water system that:

- **Simulates intentional and inadvertent distribution system contamination (chem, bio, rad) and disruptions (cyber-attacks)**
- **Supports diverse applied research**
- **Located at Idaho National Lab**



Summary of general applications

- Estimating consequences to support vulnerability assessment
- Contaminant warning to support detection and mitigation
- Emergency response to support mitigation, characterization, and decontamination strategies
- Holistic assessment of resilience indicators

Range in maturity



Contaminant Warning – CANARY Event Detection Software

Monitors standard water quality data at multiple sensor locations continuously

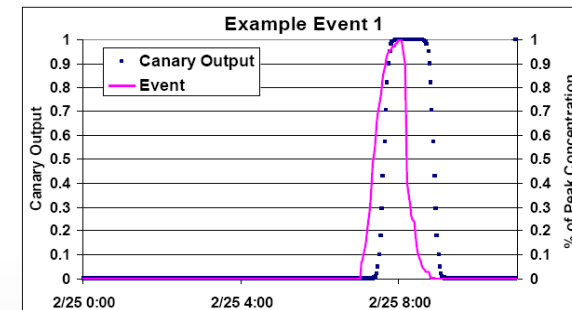
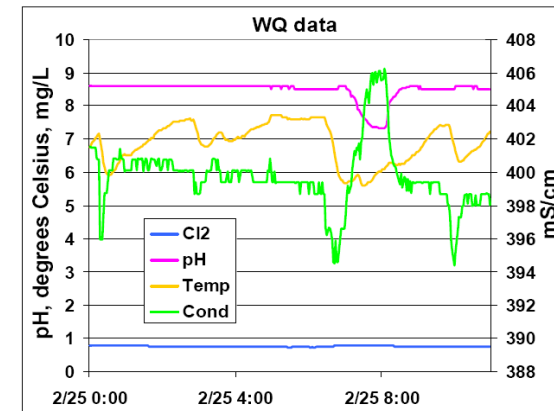
Recognizes recurring water quality patterns

Ignores data during periods of sensor malfunction or hardware alarms

Analyzes data using multiple statistical algorithms

Alerts during periods of anomalous water quality

Produces graphics for analysis



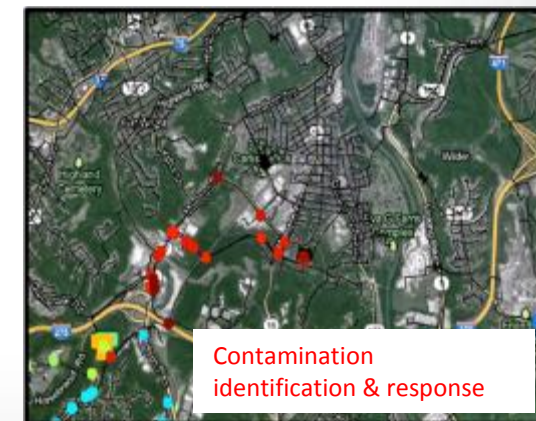
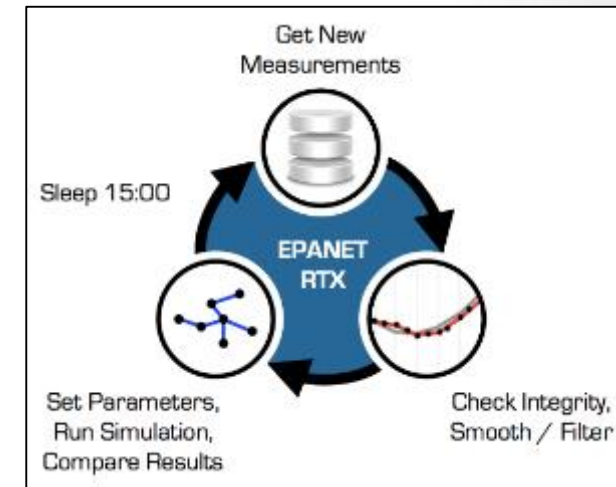
Recognized by R&D Magazine as one of the 100 most significant new technologies of 2010!

Analytical software tools to integrate network model with SCADA operational data

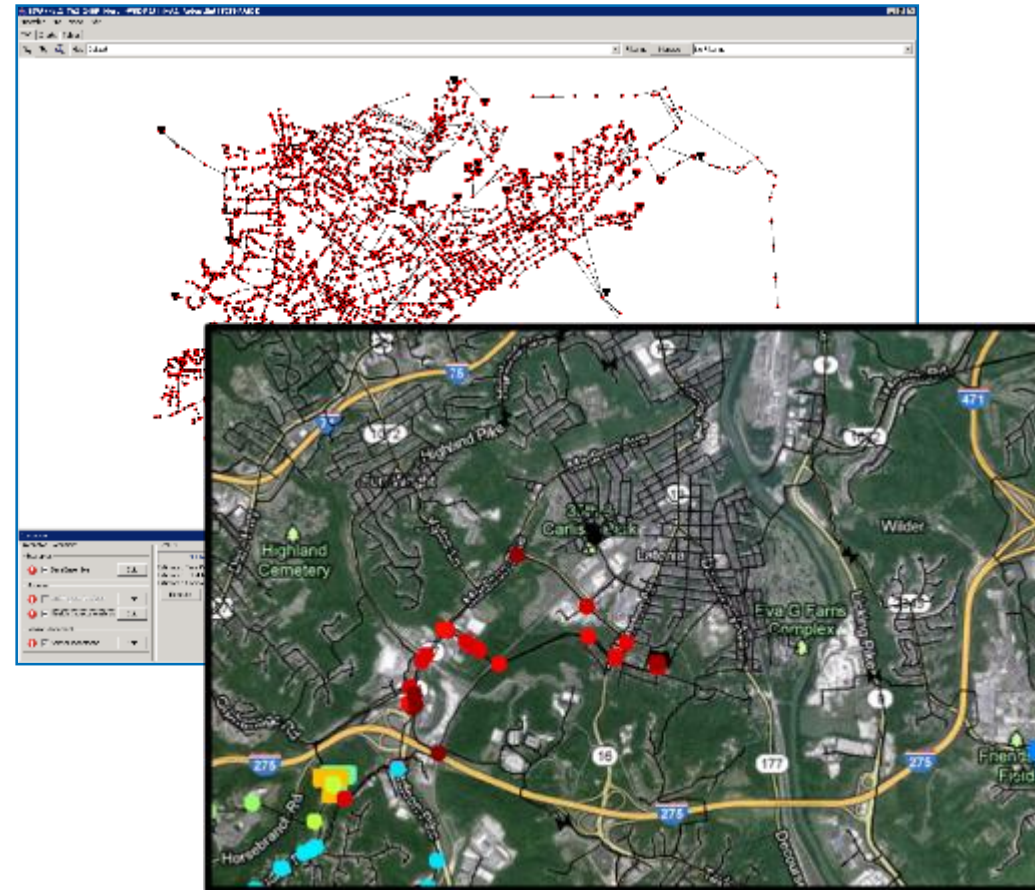
- Real-time analytics for automated and routine capability to:
 - Forecast
 - Hind cast
 - Simulate response actions
- Continuous graphical data comparison and analysis between model and SCADA outputs

Why are real time analytics important?

- Planning and Data Analysis
- Routine Operations
- Emergency Preparedness and Response
 - Example: Respond to contamination events more effectively (WV river spill)



- **Emergency response**
Emergency management decision support tool
- **Resilience assessment**
Systems modeling to support tools and standards for resilient design and operation

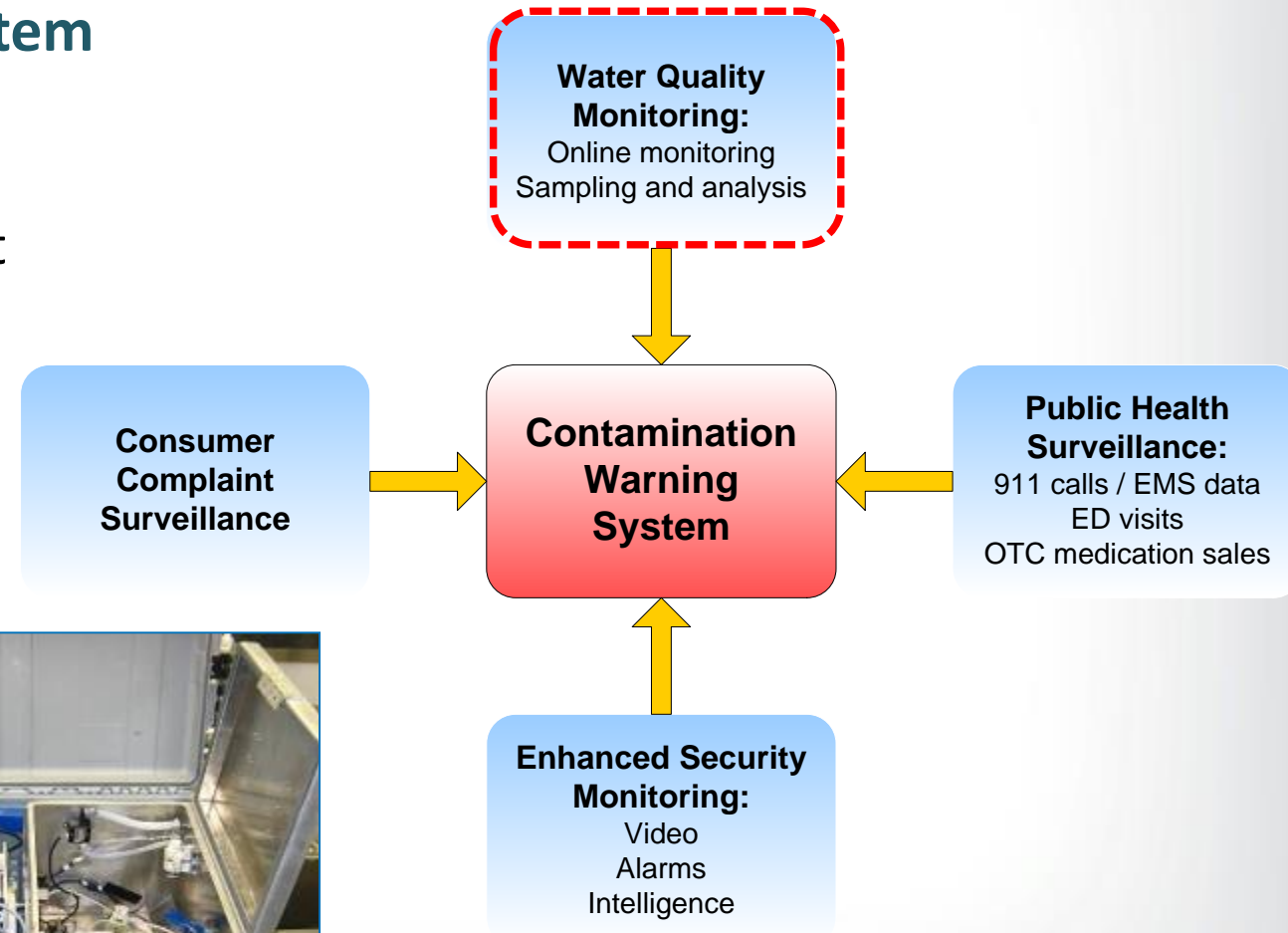


For tools and additional info:
<http://www2.epa.gov/homeland-security-research>

Office of Water's Contamination Warning System

- HSRP evaluated water quality sensors
- Developed a water sample concentrator used at high profile events (e.g. national conventions)
- Developed software tools for sensor placement and real-time sensor monitoring
- Suite of water security computing tools piloted in 5 cities
- Components now used in many other cities in the US and abroad

Portable water sample concentrator



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

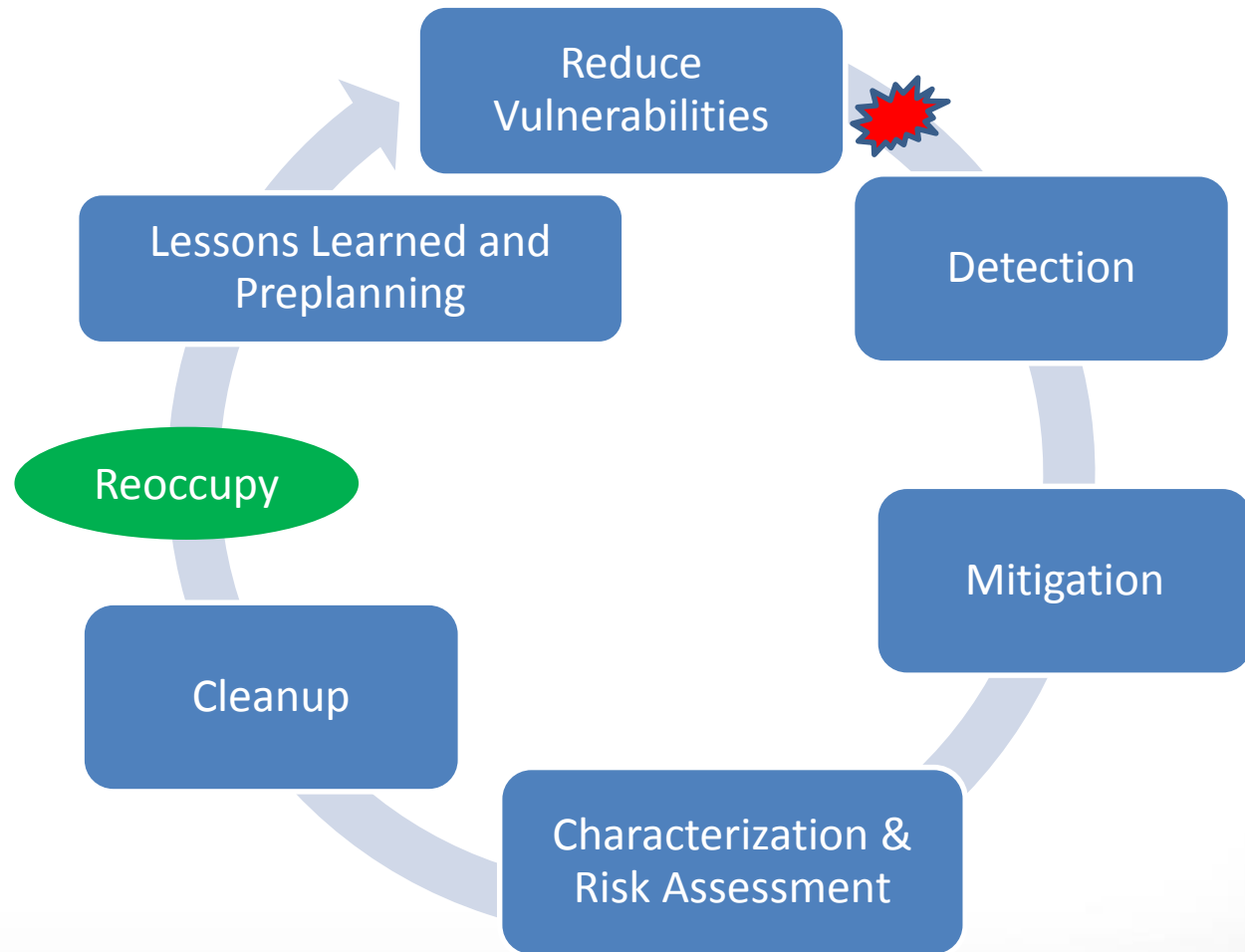
- contaminant characteristics (e.g., persistence on infrastructure)
- decontamination methodologies
- monitors
- sampling and analysis methods

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



Water Systems Research contributed to Office of Water guidance documents:

- [Containment and Disposal of Large Amounts of Contaminated Water: A Support Guide for Water Utilities \(PDF\)](#)
- [Response Protocol Toolbox: Planning for and Responding to Drinking Water Contamination Threats and Incidents \(PDF\)](#)





Indoor / Outdoor Cleanup

Evolution of Program

Buildings

Efficacy, engineering,
traditional CBR agents



Wide areas

Efficacy, systems
approaches, decision
support tools

Emerging issues

Ag security, emerging
chemicals, all hazards



Transportable gasifier for carcass
management.

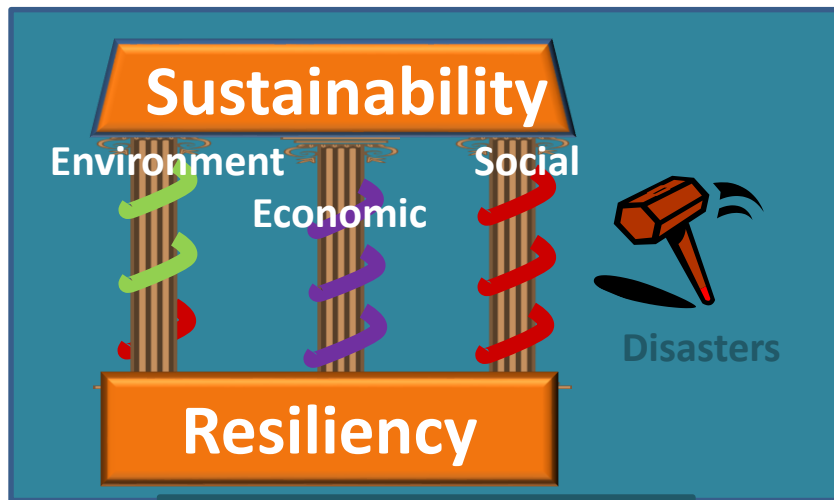
What social & environmental variables affect a **community's environmental resilience**? What are indicators & metrics of resilient communities?

What technologies, methods, and strategies are best suited for **cleanup of indoor and outdoor areas** (including management of waste)?

What technologies, methods, and strategies are effective for **mitigating the impacts** of the contamination and for **reducing the potential exposures**?



Environmental Resilience: *“Minimizing environmental risks associated with disasters, quickly returning critical environmental & ecological services to functionality after a disaster while applying this learning process to reduce vulnerabilities & risks to future incidents.”*



HSRP Resilience efforts:

- Core research on tools, methods for effective preparedness and response
- Environmental resilience assessment tools

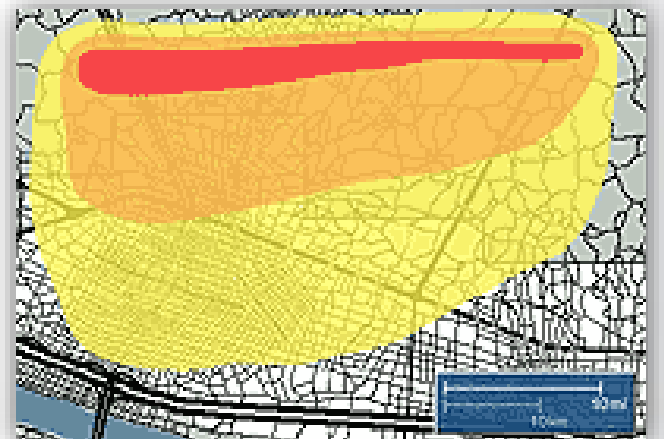
2012 US disasters cost:
> 300 lives; \$120 billion-

Addresses science questions related remediating wide areas and characterizing contamination and assessing exposure:

- How long will a contaminant persist as an exposure threat?
- How may the spread of the contaminant impact the hazard mitigation and remediation activities?

Research Areas:

- Persistence of biological and chemical agents as a function of time, materials, and environmental conditions
- Transport of biological agents (i.e., dispersion, infiltration, reaerosolization)
- Transport of radiological agents (i.e., penetration into materials)
- Transport of chemical agents (i.e., dispersion)





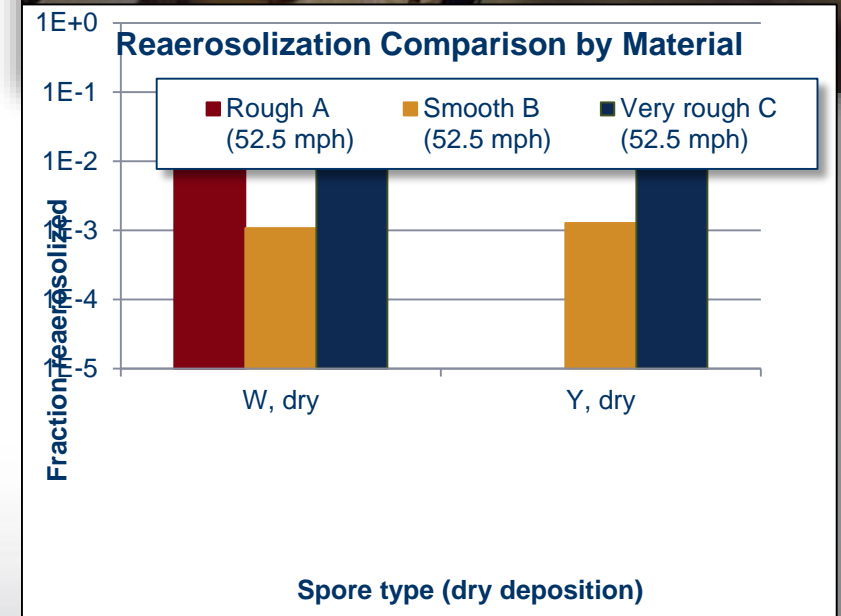
Example: Scientific Program on Reaerosolization and Exposure (SPORE)

Interagency Workgroup focused on reaerosolization

- On what surfaces should samples be taken?
- How should air monitors be utilized to assess potential exposures?
- What areas must be decontaminated first to avoid further spread of contamination?

Finding and Impact:

- Reaerosolization varied by material type
- Informs what surfaces should be sampled and where remediation activities may spread contamination





Decontamination

What technologies, methods, and strategies are best suited for cleanup of indoor and outdoor areas?

- What clean up technologies are most effective and how are their efficacies changed by real world variations in environmental, process and agent characteristics?

Research Areas:

- Decontamination efficacy
 - CBR agents
 - Porous and non-porous materials, including dirty surfaces
 - Surface and volumetric decontaminants
 - Application methods and parameters
- Material compatibility
 - Sensitive equipment/electronics
 - Historical or high-value materials/items

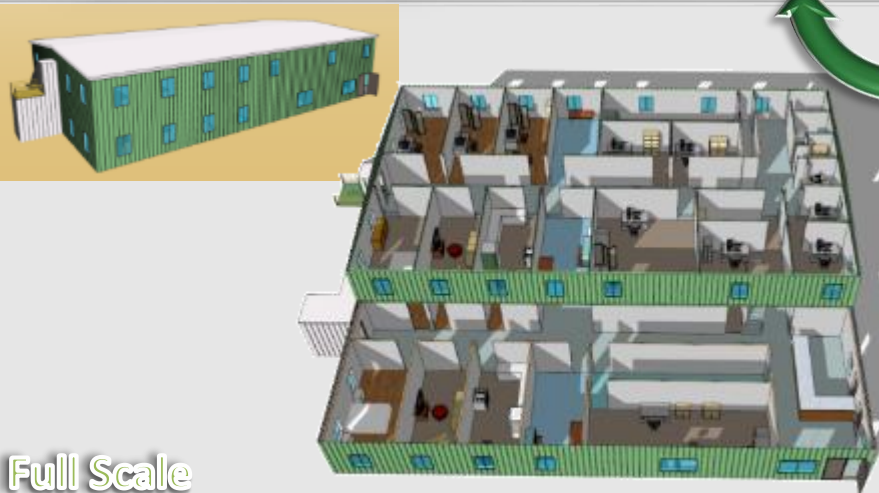


Decontamination Research from Bench to Full-Scale

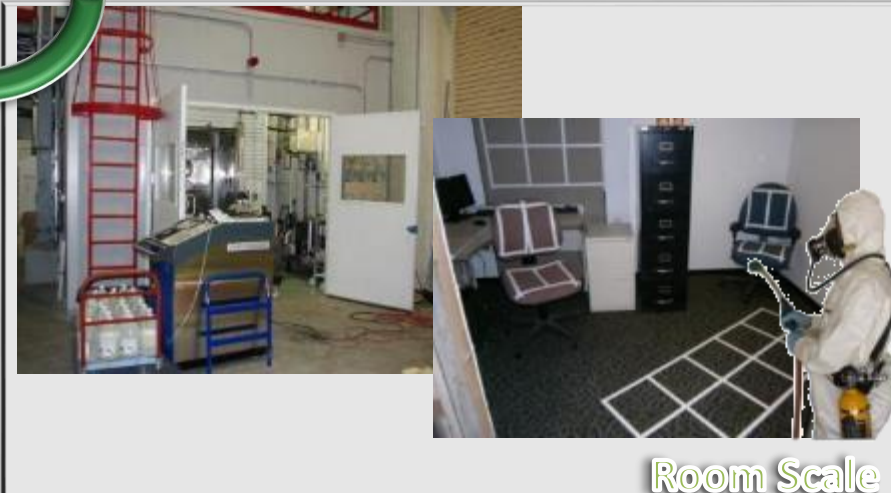
Bench Studies



Spray Chamber



Full Scale



Room Scale



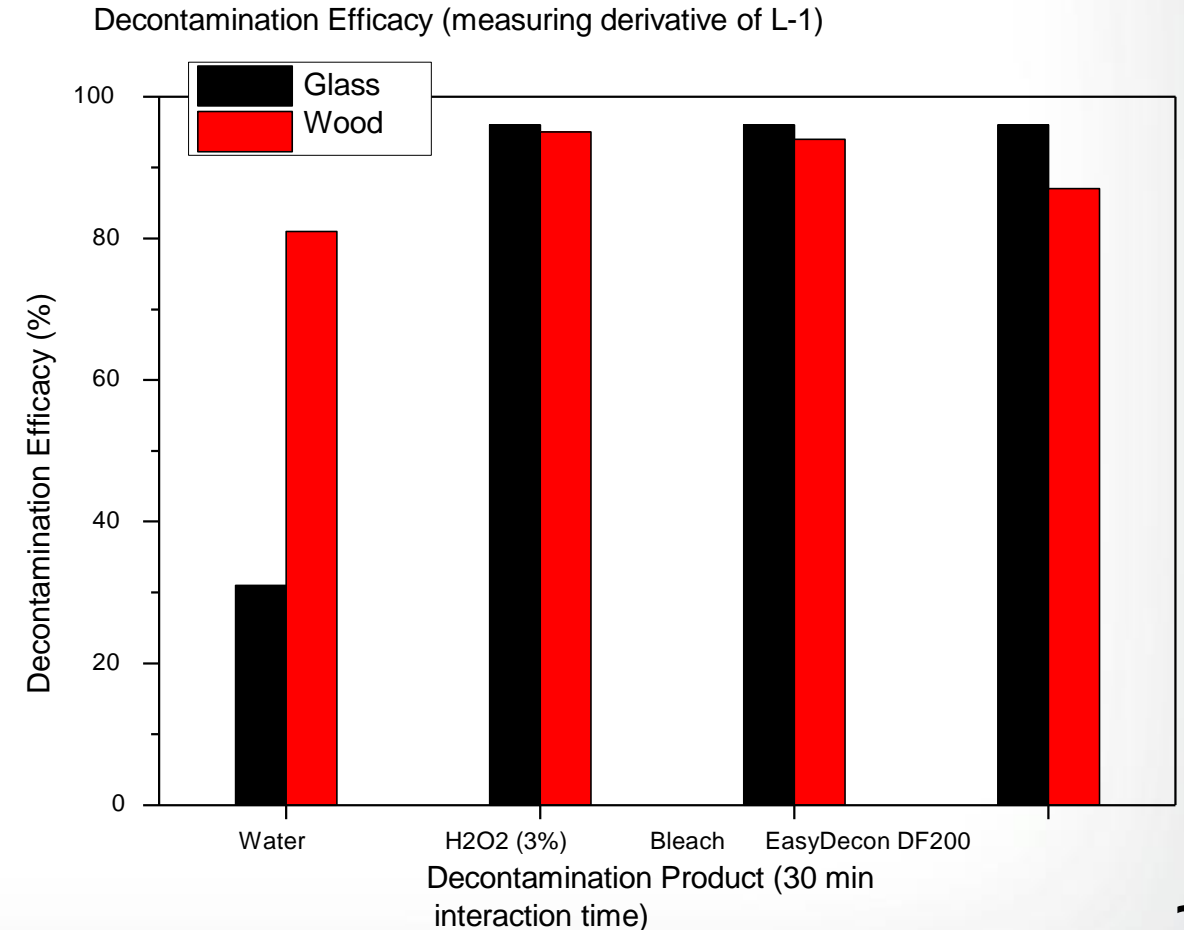
Example: Decontaminant Efficacy

CWA Decontamination Studies

- Bench scale determinations of decontamination efficacy for Lewisite on porous and non-porous materials (as a function of application time)

Impact

- Results facilitate remediation efforts by OSCs and Regions in case of Lewisite release
- Information will also be included in updated version of National Response Team's Lewisite quick reference guides (QRG)



What are effective, yet compatible, decontamination options for sensitive equipment or high value items?

Approach:

- Computer systems and other items as “surrogates”
- Initial collaboration with DHS S&T, established protocols with Alcatel-Lucent for handling sensitive electronics as test vehicles
- Efforts: ClO_2 , VHP[®], H_2O_2 , MeBr, EtO
- Current study on gamma irradiation
- Evaluation of time post exposure to the decontamination process

Impact:

- Options for decontamination of electronics/ high value items
- Simple, transportable system with minimal operational training required



What technologies, methods, and strategies are best suited for cleanup of indoor and outdoor areas **(including waste management)**?

- What are technically sound methods and tools for waste management (handling, treating, disposing)?

Research Areas:

- Waste handling, including efficacy of on-site treatment methods and impact of packaging
- Effectiveness of thermal treatment options
- Persistence in landfills
- Tools supporting waste management decisions



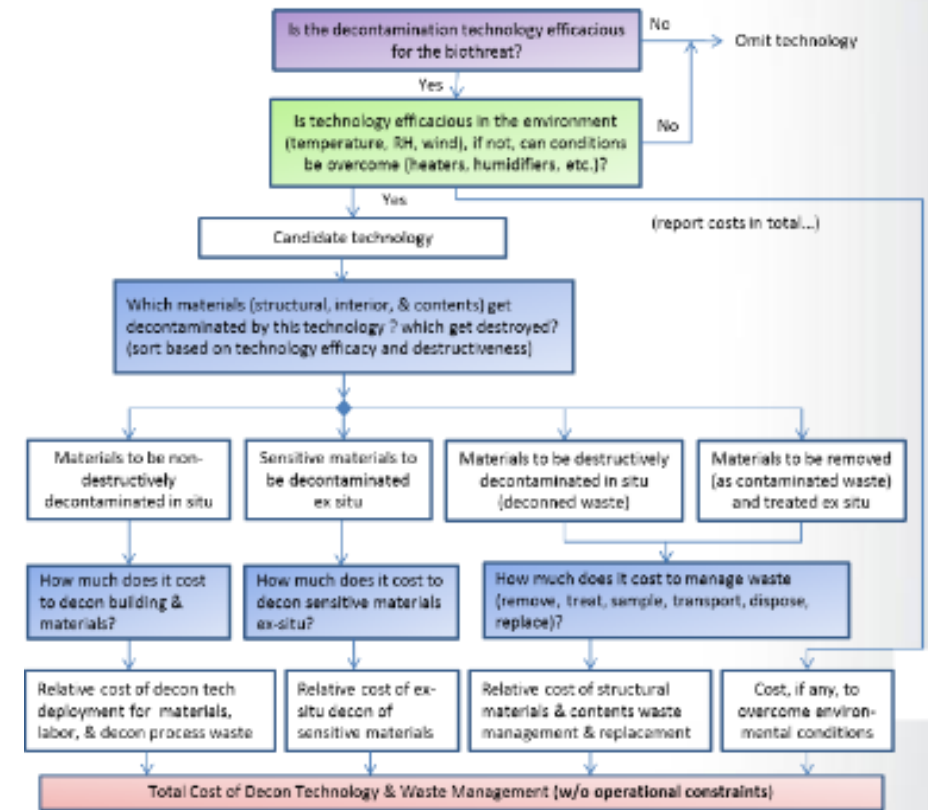


Remediation Decision Support Tools

Systems based tools to assist in decision making which support all the science questions related to remediating wide areas

Examples:

- DeconST: Decontamination support tool summarizing trade-offs of decontamination options (currently for biological agents)
- WEST: Waste estimation tool for radiological incidents, including trade-off analysis for decontamination/waste management options
- I-WASTE: web-based tool support waste management decisions by providing general waste estimation capability and readily available information on packaging, transport, treatment, and disposal requirements and options





Systems Approach to Site Cleanup

Bio-response Operational Testing and Evaluation (BOTE) Project Overview

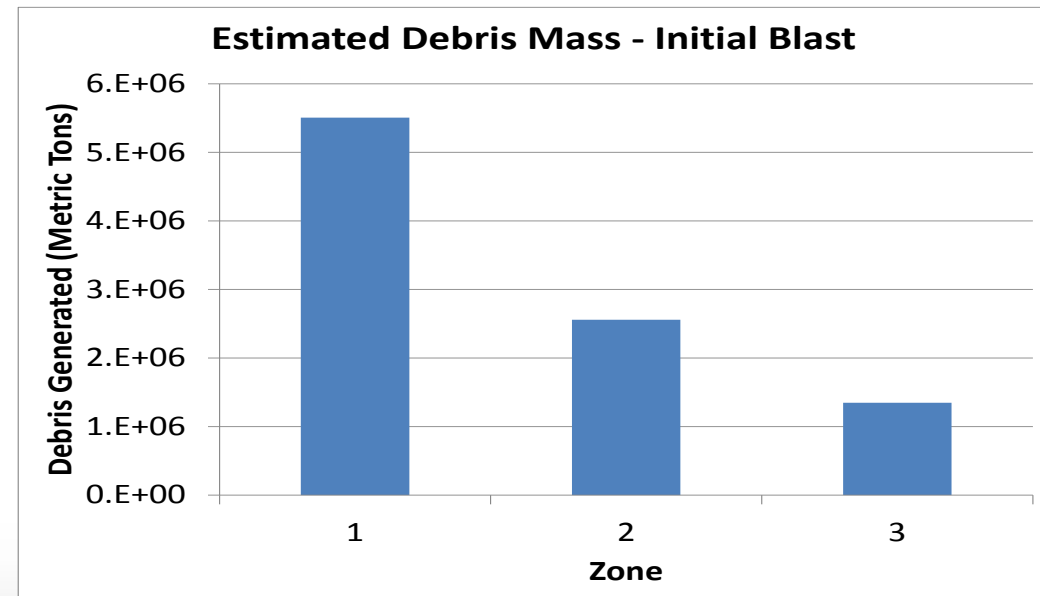
- Applied research in all areas of the program (from characterizing the extent of contamination to waste management) at the field scale
- Interagency study to bring advances to the field
 - EPA (NHSRC, OSWER, Regions ,OCSPP, NCER)
 - DHS, CDC, DoD, DoE/National Labs, FBI
- Partnership: EPA Researchers and Responders



- Natural anthrax contamination cleaned up based on our decon research
- Waste tools used in national disaster exercises
- OCSPP 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



Characterizing Contamination and Assessing Exposure

Can **exposure pathways and models** be improved to better inform risk assessment and risk management decisions for water-related exposures and wide area contamination incidents?

What are the standardized **sample collection and analysis methods** and strategies for characterization of contamination?



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

Example: Provisional Advisory Levels (PALs)



Health-based advisory levels for chemical exposure in both air and water to inform risk management decisions across response timeline (24 hours, 30 days, 90 days, and up to 2 years).

PAL 1: irritating, mild effects

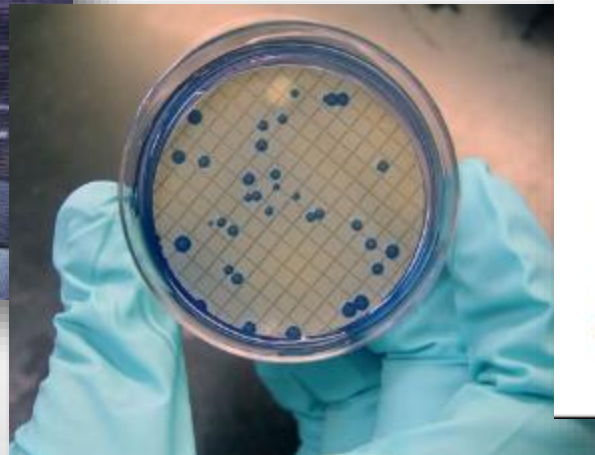
PAL 2: disabling, irreversible effects

PAL 3: lethal effects

Previous emergency exposure guidelines did NOT:

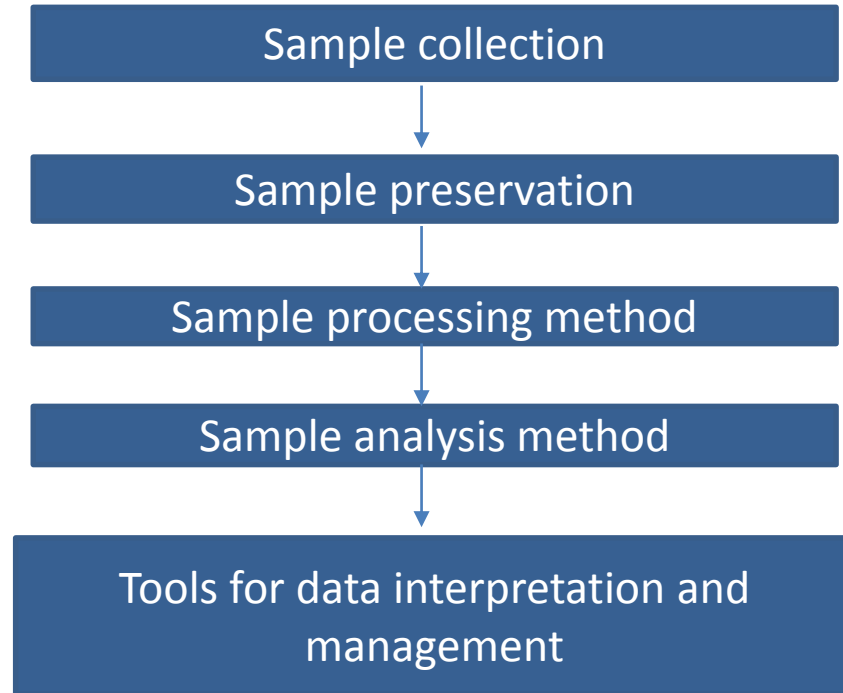
- Consider several potential chemical threat agents
- Address breakdown products in environmental media
- Address multiple exposure pathways and durations
- Assess exposure levels between acute and chronic exposures

- Develop the *Selected Analytical Methods* document for use by EPA's Environmental Response Lab Network (ERLN)
- Develop and assess sampling and analysis methods





Research to Inform Field Sampling → Laboratory Analysis → Data Interpretation





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



Water Systems

- ❖ Innovative design and operation of water systems and technologies for resiliency
- ❖ Fate and transport of contaminants and by-products in water systems
- ❖ Infrastructure decontamination methods
- ❖ Scale-up and systems approach to decontamination



Characterizing Contamination and Assessing Exposure

- ❖ Sampling methods and strategies
- ❖ Analytical methods
- ❖ Exposure assessment



Remediating Wide Areas

- ❖ Minimizing impacts of contamination
- ❖ Decontamination method efficacy
- ❖ Scale-up and systems approach to decon
- ❖ Decontamination wash water treatment and disposal



Outreach – Delivering research to end-users and listening to needs

Monthly/
As needed

- Check-in with lead region coordinator and science liaison
- Research product development team meetings
- Check-in with Program Directors and Deputy Program Directors

Multiple
times per
year

- Webinars on research or recent products
- Stakeholder notification of new products

Biannually
to
annually

- Program update Webinar/Meeting with Partners
- Assistant Administrator-level Briefing
- Meetings with partners to identify and prioritize needs
- Participate at annual meeting of regional liaisons



Interagency Cooperation

Strategic Direction and Identifying Leveraging Opportunities
OSTP and National Security Council

(CBRN) Research and Development Roadmaps



Leveraging and Identifying Opportunities for Supplementing
ORD HS Research
Other Interagency Workgroups



Conduct Joint Research
DHS, DOD, CDC, and others



Thank you for your service to EPA

We welcome you and look forward to your guidance



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