Homeland Security (HS)

Synopsis of the 2023 – 2026 Strategic Research Action Plan

Vision: Through its scientific research, the HS Research Program's vision is that (1) federal, state, tribal, and local decision makers and stakeholders have timely access to information and tools they need to ensure equitable community resilience to catastrophes involving environmental contamination that threatens public health and welfare, and (2) decision makers have capabilities to assess and address community needs and vulnerabilities to ensure equitable incident management.

Approach: HS performs applied research that delivers relevant and timely methods, tools, data, technologies, and technical expertise in support of federal, regional, state, tribal, water systems, and local community resilience. HS will continue development of tools and information for drinking- and waste-water systems via cyberattack and chemical, biological, and radiological (CBR) contamination. The Program will adapt suitable methodologies that have proven their effectiveness and usability for success in real-world settings via high quality science with laboratory and field tests as well as modeling. Research will be performed to understand community needs, effective risk communication, and to maintain good stakeholder relationships. HS will continue research to address science gaps related to protecting water systems, oil spill response, and clean-up of wide area contamination with high priority Homeland Security CBR agents, including contamination incidents due to natural disasters, pathogens that cause communicable diseases, covert release of chemicals, and agricultural incident with animal and crop diseases. HS's technical and social research and development in preparation of homeland security incidents will address the current Administrator's priorities related to environmental justice and climate change.

Organization:

Topic 1: Contaminant Characterization and Risk Assessment. Contaminant characterization provides essential information to plan the effective response actions. The characterization process includes the extent and nature of the environmental contamination. Information on contaminant characterization coupled with an understanding of exposure potential can be used to inform the potential consequences of the contamination on public health. Furthermore, understanding the fate and transport of contaminants in the environment will ensure proper contaminant characterization. Following CBR incident, EPA may support or lead site characterization, remediation, and management of waste in the contaminated environment. Additional characterization of the site may be required during cleanup operations to assess progress and determine waste streams and to inform site re-occupancy and reuse decisions (sometimes referred to as clearance decisions).

- ***Research Area 2:*** **Contaminant Characterization and Risk Assessment –** The goal of this research is to develop, synthesize, and compile the protocols into user-friendly and readily-available tools for the EPA response community and homeland security partners and stakeholders. Reliable and field usable methodologies and strategies for sampling, sample processing, and analysis will be developed by adopting widely accessible and applicable approaches. Sampling strategies, sampling plans, and analytical capabilities will be used to address contaminant incidents, including impacts associated with changing climate, by incorporating an all-hazards approach stemming from man-made or natural disasters.

  This research area will produce information to predict the movement of contaminants in the environment and develop tools and methods to effectively characterize the contamination in the affected area. This research area also assesses exposure to contaminants through understanding the implications of the sampling results. The research area will be able to provide resources to assist decision-makers during response and remediation incidents. Furthermore, the information can be applied to address environmental justice concerns of affected communities during contaminant sampling and analysis decisions.

Topic 2: Environmental Cleanup and Infrastructure Remediation. After understanding the extent of the contamination and accessing its potential impact on public health, EPA may then be responsible for supporting the cleanup of oil or hazardous contaminants and mitigating their impact on human health and the environment. Remediating CBR contamination released over wide areas including indoor and outdoor areas, critical infrastructures, or impacted water systems, is a responsibility for which EPA needs to cumulate operational experiences. Such a release, including oil spills, can pose a continual challenge with long-standing consequences. HS activities in this topic aim to fill the most critical scientific gaps in the capabilities of EPA's response community so that, when needed, EPA can make the most informed mitigation and remediation decisions.

- ***Research Area 3: Wide-Area Decontamination –*** Wide-area contamination from natural disasters and intentional incidents requires comprehensive remediation capabilities to help all impacted communities recover rapidly, and safely. This research area delivers options with consideration for safety, resource demand, logistics, training, availability, and technology necessary to remediate all impacted communities equitably. Researchers will continue to develop self-help methods and resources for all stakeholders who will be primarily responsible to remediate their own property and facilities during a wide-area incident. Research will be expanded to pathogens that cause communicable diseases, agricultural incidents involving animal and crop disease, and wide-area contamination incidents due to natural disasters. Communicable pathogens can cause pandemics, such as COVID-19, which require an understanding of persistence and effective disinfection technologies for multiple media (e.g., surfaces, aerosols) to aid in the informed decision-making process.

  This research area will also focus on options for treating indoor air including air handling systems. A large-scale animal or plant agricultural incident would require EPA assistance in the national response to contain, mitigate, and remediate. Researchers, in collaboration with USDA, will focus on developing and evaluating processes and technology to remediate extremely large volumes of biomass. Research will also expand to wide-area incidents due to natural disasters related to climate change. These wide-area incidents not only could have additional impacts on traditional Homeland Security events (e.g., CBR) but could also cause CBR contamination incidents. Large-scale urban transport-predictive models for CBR will continue to be developed and field tested to ensure they are operationally relevant and include all communities equitably within the impacted area.

- ***Research Area 4: Water Systems Incident Response Support –*** Resilient water infrastructure systems can facilitate quick and effective decision-making during emergency situations including cyberattacks to ensure access to adequate water capacity and quality. This research area focuses on understanding the movement and persistence of contaminants over wide areas and in water and wastewater systems to inform decisions regarding sampling, decontamination, waste management, and operational countermeasures. The priority is to provide tools and methodologies to inform decontamination of water infrastructure, management of the contaminated water, and resumption of operations. In particular, research into full scale contaminant persistence and decontamination in home plumbing, wastewater, and stormwater system. Full-scale decontamination of priority agents in the distribution system, as determined in conjunction with EPA's Office of Water (OW), will continue.

  In partnership with OW and Department of Homeland Security, developing full scale cybersecurity research capability will be a priority. Treatment of contaminated water will continue with an emphasis on field testing water treatment technologies that could be used by the response community. Wastewater research will continue with a focus on decontamination of critical parts of the treatment plant and collection system. Emphasis will be placed on priority pathogens in wastewater and storm water systems, with modeling being conducted in addition to pilot and full-scale research. Detection of contamination in water system using online detectors will be deemphasized. Pilot-scale detection capability and management of sensor data in FEDRAMP approved clouds will continue. Research on treatment of CBR contaminated water and delivery of potable water after could be applied to situations

where environmental justice is a concern, such as the Flint, MI lead incident. Furthermore, climate changed induced natural disasters such as hurricanes and wildfires are occurring more frequently. Water treatment technologies developed and/or field tested in this RA could be used to supply potable or non-potable water for sanitation in disaster affected areas.

- ***Research Area 5: Oil Spill Response Support –*** EPA is responsible for responding to and assessing environmental releases of oil that occur over land, on inland waters, and in the ocean (in conjunction with the U.S. Coast Guard). Oil spills can affect human health and the environment through their impacts on water (including drinking water supplies), air quality, ecosystem health, or through direct exposure to toxic constituents. HS's innovative research approaches help to achieve more efficient and effective management of oil spills with respect to preparedness, emergency response, and fate and transport. This Research Area will continue to refine approaches for spill monitoring and detection technologies for small and large–scale incidents, develop treating agent effectiveness and toxicity protocols for NCP Product Schedule and to inform regulatory actions, evaluate tradeoffs for spill response mitigation (i.e., conventional booming and skimming, in situ burning, and the application of spill treating agents such as dispersants), and examine ecological issues concerning oil and agent toxicity and biodegradation on aquatic flora and fauna. The research deliverables help to formulate guidance and rulemaking with respect to preparation for and response to oil releases and minimize the unequitable impact to communities. In addition to the Agency program offices, this research informs technical support to the regions, states, and other regulatory authorities.
- ***Research Area 6: Waste Management –*** Waste management presents considerable challenges during any large-scale disaster; additional challenges will exist during a wide-area CBRN incident. This Research Area will continue efforts to integrate its all hazards tool to determine optimal waste management including staging, transporting, and disposal with other EPA tools supporting disaster waste and materials management with the goal of the tools communicating with one another, be integrated on the sample platform (as much as possible), and providing guidance to the end user as they transition from response to recovery. Research will continue to improve the existing tools to estimate waste volumes including evaluation of advanced technologies (e.g., unmanned aerial vehicles) for waste estimation following CBR incidents. To facilitate sustainable use of materials and avoid potential shortages, the program will also identify technologies and solutions for reusing/recycling waste (e.g., PPE). The social implications of disaster waste and materials management decisions will be analyzed and interventions to better address environmental justice concerns of communities will be identified. Finally, research will build social and economic considerations into the waste management tools and associated guidance, practices, and trainings.

Topic 3: Community Engagement and Systems-Based Tools Supporting Resilience Equity. Transitioning the research into reliable and field usable capabilities involves ensuring that decision makers and responders have knowledge of and access to the latest information. Decision makers and stakeholders need access to tools and information built from a systems approach where response and recovery activities are brought together through their interdependencies and relative impacts. This topic addresses the systems-based analysis results and tools by pulling together the connected elements in response and recovery activities including emergency mitigation, characterization, environmental cleanup, operations management, waste management, and community engagement. Effective technical support and decision-support tools will be developed to ensure that information is readily and easily accessible to decision makers and stakeholders throughout response and recovery efforts.

- ***Research Area 7: Systems-Based Decision Making –*** This area will continue improving a centralized and routinely-maintained database for monitoring and surveying the latest findings and methods for emergency mitigation, characterization, environmental cleanup, operations management, and waste management. HS plans to develop a tool that can simulate the remediation of various response activities

to assess the impact of selecting certain methods on the overall remediation, bottlenecks in the remediation activities, resource availability and demand for remediation, future decision-support-tool feasibility before development, and future methods/technologies before investment. Research under this area will address the data management gaps by developing easy-to-use tools to effectively collect and manage the data during all phases of a contamination incident.

- ***Research Area 8: Communities, Resilience, and Remediation –*** This research area investigates the intertwined social and environmental variables that affect community resilience and vulnerability to CBR incidents and other disasters. It focuses on the community scale, while also examining cross-scalar interactions at the watershed, regional, state, or neighborhood level. Research in this area is based in interdisciplinary social science, primarily drawing from environmental anthropological theories and methods. It uses mixed methods research, that is, qualitative and quantitative techniques for data collection, management, and analysis. Specific research methods include interviews, focus groups, surveys, participant observation, and content analysis of documents. These methods allow researchers to elucidate how culture, social dynamics, and other related factors affect decisions and outcomes. This research area uses human-centered design to develop decision-support tools and resources for EPA's state and local partners to use in disaster preparedness, response, and recovery. It generates resources, tools, and trainings for risk communication, outreach, building relationships, and community engagement. These products can be used in remediation and resilience work carried out by EPA and its state and local partners. They contribute to empowering under-resourced communities, populations of concern, and communities with environmental justice concerns.

Notable Research Focus

Topic 1: Contaminant Characterization	
RA2	*Sampling and analysis, fate, transport, and exposure assessment of CBR contaminants in the environment*
Topic 2: Environmental Cleanup and Infrastructure Remediation	
RA3	*Mitigation measures of communicable disease agents in built infrastructure* *Self-help remediation approaches* *Surface and media decontamination and disinfection for CBR including Fentanyls and Fourth Generation Agents*
RA4	*Water System cybersecurity research* *Water system security and resilience on wastewater, stormwater, and home plumbing*
RA5	*Oil spill monitoring, detection, and remediation technologies*
RA6	*Waste management tools integration to all hazards tools with enhancement to estimate waste volumes and social implications of disaster waste and materials management*
Topic 3: Community Engagement and Systems-based Tools supporting Resilience Equity	
RA7	*Data management for wide area response*
RA8	*Environmental Justice, community resilience, social vulnerability, risk communication, risk perception, and human behavior*