B O S C
Board of Scientific Counselors

REPORT OF THE U.S. ENVIRONMENTAL PROTECTION AGENCY BOARD OF SCIENTIFIC COUNSELORS HOMELAND SECURITY (HS) SUBCOMMITTEE

RESPONSES TO CHARGE QUESTIONS

Homeland Security Subcommittee

Paula Olsiewski, Ph.D. (Chair) *Alfred P. Sloan Foundation*	Andrew DeGraca, PE *San Francisco Public Utilities*	Edwin Roehl, MS *Advanced Data Mining International*
Lance Brooks (Vice Chair) *Defense Threat Reduction Agency*	Shawn Gibbs, Ph.D., MBA, CIH *Indiana University*	Monica Schoch-Spana, Ph.D. *Johns Hopkins University Center for Health Security*
Charles Barton, Ph.D. *Valspar Corporation*	Edward Hackney *SUEZ (United Water)*	Robert Scudder, Ph.D., CIH, CSP, CET *Mayes County Emergency Management*
Murray Cohen, Ph.D., MPG, CIH *Frontline Healthcare Workers Safety Foundation Ltd.*	David Klein, Ph.D. *Texas Tech University*	Justin Teeguarden, Ph.D. *Pacific Northwest National Laboratory*
Kari Cutting *North Dakota Petroleum Council*	Debra Reinhart, Ph.D. *University of Central Florida*	Dana S. Tulis *U.S. Coast Guard*
	Michael Wichman, Ph.D. *FDA/ORA Arkansas Regional Laboratory*	

EPA Contact
Tom Tracy, Designated Federal Officer

June 17, 2019

CONTENTS

LIST OF ACRONYMS

AnCOR	Analysis for Coastal Operational Resiliency
BOSC	Board of Scientific Counselors
CBR	chemical, biological, radiological
CBRN	chemical, biological, radiological, and nuclear
CBRNE	chemical, biological, radiological, nuclear, and explosive
CDC	Centers for Disease Control and Prevention
CRADA	Cooperative Research and Development Agreement
CSS	Chemical Safety for Sustainability
EPA	U.S. Environmental Protection Agency
ESAM	Environmental Sampling and Analytical Methods
FACA	Federal Advisory Committee Act
HHRA	Human Health Risk Assessment
HS	Homeland Security
HSRP	Homeland Security Research Program
INL	Idaho National Laboratory
LEPC	local emergency planning committees
MTBE	unusually rapid environmental transport
ORD	Office of Research and Development
RTP	Research Triangle Park
SHC	Sustainable and Healthy Communities
SSWR	Safe and Sustainable Water Resources
StRAP	strategic research action plan
USCG	United States Coast Guard
WEST	Waste Estimation Support Tool
WOW	Water on Wheel
WRF	Water Research Foundation

INTRODUCTION

The mission of the U.S. Environmental Protection Agency (EPA) Office of Research and Development (ORD) is to provide the best available science and technology to inform and support public health environmental decision-making at the federal, state, tribal, and local levels, addressing critical environmental challenges and anticipating future needs through leading-edge research. ORD's Homeland Security Research Program (HSRP) aims to increase the United States' capabilities to prepare for and respond to releases of oil and hazardous substances into the environment, as mandated by Congress. The hazardous substances involved can include chemical, radiological, nuclear, and biological materials. HSRP is one of the Agency's six highly integrated national research programs. The other five are Air and Energy (A-E), Chemical Safety for Sustainability (CSS), Human Health Risk Assessment (HHRA), Safe and Sustainable Water Resources (SSWR), and Sustainable and Healthy Communities (SHC).

ORD has developed a strategic research action plan (StRAP) to guide each research program. The draft HSRP StRAP, 2019–2022, is a four-year research strategy to deliver research necessary to support EPA's overall mission to protect human health and the environment, fulfill the EPA's legislative mandates, and advance cross-agency priorities identified in the FY2018–FY2022 EPA Strategic Plan. It is the third such strategic planning exercise in this format (previous StRAPs covered 2012–2016 and 2016–2019). The current StRAP evolved through close collaboration with partners in EPA's program offices and regions, other federal agencies, states, and tribes.

Currently, ORD is seeking input from the Board of Scientific Counselors (BOSC) on the draft 2019–2022 StRAP documents and proposed research strategies. The emphasis is on advancing ORD research that can successfully address the needs identified by EPA programs and regions, states, and tribes. This review by the BOSC HSRP Subcommittee of the draft HSRP StRAP will be followed by regular BOSC reviews of research activities over the course of the StRAP implementation.

BACKGROUND

In November 2018, HSRP provided the BOSC HSRP Subcommittee with review materials relating to the draft HSRP StRAP and six charge questions to consider when reviewing the materials. Subsequently, the HSRP Subcommittee:

1. Reviewed the draft StRAP and related materials (see Attachment B for list of materials);
2. Met with the HSRP National Program Director and program staff on December 12–14, 2018, in Research Triangle Park (RTP), North Carolina, and listened to HSRP presentations (see Attachment A for meeting agenda);
3. Deliberated as a group on the charge questions;
4. Divided into six sub-groups to draft initial responses to each charge question;
5. Deliberated as a group on the draft initial responses and reached consensus on recommendations for all six charge questions during a teleconference on March 19, 2019; and
6. Prepared this report for review by the BOSC Executive Committee in June 2019.

STRAP RESEARCH OBJECTIVES

The HSRP StRAP, 2019–2022, is a four-year research strategy designed to meet the following objectives:

> **Research Objective 1:** Advance EPA's capabilities and those of our state, tribal, and local partners to respond to and recover from wide-area contamination incidents; and
>
> **Research Objective 2:** Improve the ability of water utilities to prevent, prepare for, respond to, and recover from water contamination incidents that threaten public health.

EPA's HSRP is organized into three topics supporting these objectives: (1) contaminant characterization and consequence assessment; (2) environmental cleanup and infrastructure remediation; and (3) systems approaches to preparedness and response. Short- and long-term goals accomplished through research areas within these topics outline a strategy for addressing the objectives.

CHARGE QUESTIONS AND CONTEXT

The HSRP Subcommittee was charged with six questions as follows:

> Q.1a: Does the research outlined for the 2019-2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?
>
> Q.1b: Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?
>
> Q.1c: Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019-2022 time frame.
>
> Q.1d: Recognizing ORD's focus on addressing identified partner research needs, in the presence of reduced scientific staff and resources, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?
>
> Q.1e: What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?
>
> Q.2: Homeland Security Research is designed to address known threats and vulnerabilities. At the same time, the Nation regularly faces unforeseen challenges in public health and the environment (e.g., Ebola and Zika viruses, opioid misuse). Please comment on the extent to which the Program's design enables use of its scientific contributions in also addressing unforeseen needs of the EPA programs and regions, states, and tribes. How can HSRP improve is applicability to unanticipated urgent threats?

SUBCOMMITTEE RESPONSES TO CHARGE QUESTIONS

The HSRP Subcommittee reviewed the HSRP research over three days in December 2018. The overarching issue addressed by the committee was, Is HSRP doing the right research? In other words, how well does the HSRP's current research portfolio address high-priority Agency needs in this area? Taking resource limitations into consideration, should HSRP increase or decrease the emphasis of certain areas of research?

Given limited resources and the urgency of its mission, HSRP must develop a research portfolio that is closely aligned with the high-priority needs of the Agency. The EPA end-users of the program's research work closely with the program to delineate these needs, help define the science questions that must be addressed, advise on the research as it is conducted, and help design and deliver effective products. These high-priority needs are cross-walked with the science questions that are designed to address identified needs. The HSRP Subcommittee's review resulted in a series of observations, suggestions, and recommendations, which are described in detail below for each charge question.

Charge Question 1a

> Q.1a. Does the research outlined for the 2019-2022 timeframe <u>support</u> the relevant Agency priorities as described in the EPA and ORD Strategic Plans?

To answer this question, it is important to review the relevant parts of both the EPA and the ORD strategic plans for 2018–2022.

EPA's strategic plan for 2018–2022 lists three goals: to deliver clean air and water to the American public to protect human health and the environment; to embrace cooperative federalism; and to follow the rule of law and process. Agency priority goals 2 and 3 for 2018–2019 are particularly aligned with ORD-Homeland Security research as shared with the HSRP Subcommittee:

> Agency Priority Goal 2: Empower communities to leverage EPA water infrastructure investments.
>
> Agency Priority Goal 3: Accelerate the pace of cleanups and return sites to beneficial use in their communities.

The HSRP StRAP supports EPA's regulatory and non-regulatory programs by providing the best science, technical support, and guidance possible. Delivering research products to better protect human health and the environment is HSRP's foremost goal. The science and research results that HSRP provides form the foundation for the environmental policies that are a precursor to achieving the best possible public and environmental health. Program, regional, state, federal, and tribal partners are HSRP's primary stakeholders and their needs will be used to determine HSRP core priorities. Therefore, the research outlined for the 2019–2022 time frame does indeed support Agency priorities as described in the EPA Strategic Plan and the HSRP StRAP.

The body of research planned and presented to the Subcommittee advances the EPA and ORD strategic goals of advancing critical science to provide the American public clean air, clean water, and clean land by furthering the identification, remediation, and waste management phases of any cleanup effort whether biological, chemical, radiological, or nuclear.

EPA's collaborative federalism goal opens the door for further information sharing between ORD's HSRP, the federal government, states, and tribes. The research outlined for 2019–2022 has all the necessary components for ease of sharing with state, tribal, and local leaders. Additionally, EPA's roles in incident command per the National Biological Defense Strategy are clearly defined and serve as a basis for training experienced teams for effective response and remediation to protect the public in the event of chemical, biological, radiological, nuclear, and explosive (CBRNE) events. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- HSRP has provided the critical science and research that has informed and supported the implementation of EPA's goals and strategy.
- HSRP conducts research that spans a continuum of time frames from longer-term forward-looking research to nearer-term research that both informs current Agency programs and responds to emergency situations. This continuum enables EPA to prepare for emerging environmental events.
- The Water on Wheel - Emergency Mobile Drinking Water Treatment System (the WOW water cart) addresses improved response time for impacted communities toward providing clean water for their population both during and after a crisis.
- HSRP's Oil Program is expanding lessons learned from DWH, coordinating with NOAA's initiatives, USCG, and other partners to use remote sensing, satellite images, and synoptic sampling to feed algorithms to determine oil thickness at oil spills, as opposed to prior human visual methods.
- The development of analytical tools—such as Waste Estimation Support Tool (WEST) for waste estimation, Remediation Data Repository (RADAR) for identifying critical remediation solutions, Environmental Sampling and Analytical Methods (ESAM) for identifying available sampling and analysis techniques, and the River Spill Tool for modeling contamination location—serve to place valuable information in the hands of incident commanders, decision-makers, and first responders directly achieving EPA Agency priority goal 2: accelerate the pace of cleanups and return sites to beneficial use.
- Global incidences and their response have provided HSRP with knowledge that can be extrapolated and interpolated into other similar or related events in the United States.
- HSRP has built partnerships with foreign governments to assist in foreign events, but more importantly to glean lessons learned to advance the U.S. knowledge base for similar incident management.
- Cooperative Research and Development Agreement (CRADA) partnerships open the door to collaborative and cost saving efforts for HSRP and will create valuable public/private partnerships to include the regulated community.
- HSRP has a highly motivated group of highly educated and intelligent scientists who significantly advance the body of scientific information given the resources available to them.

Suggestions

- The development of valuable tools to place in the hands of decision-makers in times of crises can only reach their full value through broad dissemination throughout the incident response community. HSRP should enhance this information sharing electronically, such as by posting on its public website.
- In the area of oil spill cleanup, the regulated community is currently conducting most of the spill cleanups across the country. The oil and gas industry has expertise in chemical characterization of domestically produced shale oils, fate and transport, and advanced remediation techniques including bioremediation. Is there a mechanism to bring this knowledge to HSRP? With the limited manpower

and resources available to HSRP, this would be advantageous to support EPA's mission and priorities in this area.

- The EPA's collection of reference oils was lost during a previous storm. HSRP should obtain a collection of reference oils to continue relevant research.
- Develop further and test the scalability of analytical tools, including WEST for waste estimation, RADAR for identifying critical remediation solutions, and ESAM for identifying available sampling and analysis techniques.

Recommendations

The Subcommittee offers this recommendation to further advance the research outlined for the 2019–2022 time frame as it supports the relevant Agency priorities as described in the EPA and ORD Strategic Plans.

Recommendation 1a.1: Expand communication of HSRP's valuable research and spill response tools to state emergency response commissions (SERCs), local emergency planning committees (LEPC), and tribal emergency responders. Although direct communication exchange may be too costly in terms of manpower, it might be achieved through videos, webinars, and white papers that can be broadly shared across the country. SERCs often have EPA personnel in attendance who may be able to brief them on the newest HSRP information, answer questions, and continue the dialogue to put these tools to greatest benefit. Another path to communication with states and tribes, and with the regulated community, is through EPA's Smart Sectors Program. This type of information sharing, along with training for the boots on the ground, will advance EPA's strategic goal of accelerating the pace of cleanup.

Charge Question 1b

> Q.1b. Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?

Core to EPA, ORD, and the HSRP vision and mission is serving the needs of its partners, including EPA offices, states, tribes, communities, the public, industry, international organizations, and other interested parties. Partners are served in multiple ways, such as through the Critical Infrastructure Partnership Advisory Council, which provides input and guidance to planning, testing, and implementing results for EPA's Water Security Test Bed. Through partnerships, the mission support for response is more successful, and stakeholders identify and use appropriate strategies developed within ORD. Lives are saved through access to the information and tools needed to respond to disasters. The proposed research program responds directly to the partner-identified needs. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- HSRP addresses and engages its partners' needs and has developed a well-planned strategic priority list. An example of this plan includes the Analysis for Coastal Operational Resiliency (AnCOR) program, which addresses multiple agencies' concerns related to the characterization of agents, decontamination of watercraft, fate and transport, and waste management.

- HSRP regularly extends opportunities to engage end-users, such as through sessions with On-Scene-Coordinators, during which they provide an assessment of needs and product effectiveness. In May 2018, the program hosted the International Conference on Decontamination Research and Development, engaging both domestic and international stakeholders, with the goal of sharing findings and gaining insight into the needs of end-users.
- The ORD has executed agreements with stakeholder organizations such as the National Environmental Health Association, the Association of State and Territorial Health Officials, and the Critical Infrastructure Protection Advisory Committee to gain insight into research needs of stakeholders represented by these organizations.
- A need identified through interaction with partners includes HSRP's ESAM tool. This online resource is an excellent example of a publicly available tool used to support response to threats and releases.

Suggestions

- HSRP should consider expanding engagement with state, county, and local responders to include citizens and stakeholder organizations (e.g., real estate, homeowners' associations, banks, and insurance industry groups) for input. Citizens can provide a valuable source of data to increase the early notification of potential releases or threats (e.g., "if you see something, say something").
- While the HSRP has developed a seemingly successful tool in ESAM for sample collection and analysis, it should contemplate providing a tool for citizen decontamination and response actions appropriate to a known hazard to reduce exposure. HSRP should also develop a strategy to incorporate engagement with local and county level emergency responders to expand the use of tools and resources, examine use of computer-based training platforms, and use train-the-trainer programs to build capacity.
- HSRP should consider controls to research waste and decontamination at the Idaho National Laboratory (INL) field testing water system lagoon because it is an outdoor lagoon and susceptible to windblown debris and runoff.
- The program should expand collaboration attempts to engage cyber experts when conducting research into critical software operating and supervisory control and data acquisition systems. HSRP should also consider the interface potential with the plume modeling tools under development with existing platforms such as Cameo, Marplot, and Aloha and other packages that these entities already use.

Recommendations

The Subcommittee offers these two recommendations to address partner-identified needs.

Recommendation 1b.1: HSRP should expand the water research portfolio (i.e., decontamination) to include materials other than ductile iron and concrete-lined piping (e.g., PVC, CPVC, Transite, and tree trunks), and develop a strategy to study emergent materials.

Recommendation 1b.2: HSRP should adapt mobile platforms for tools to apps for future users (next generations). HSRP should incorporate a means by which product updates, new versions of guidance, and changes to existing topic areas could be emailed to users of electronic tools (for which users could opt in).

Charge Question 1c

> Q.1c. Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019-2022 time frame.

HSRP StRAP topics, research areas, and outputs are clearly aligned with the strategic vision of the program. HSRP works in coordination with its partners and stakeholders to effectively conduct research that provides decision-makers information needed for their communities and environments to rapidly recover after a known disaster. The environmental problems that HSRP is addressing are diverse and subject to emerging issues that may change priorities and detract from some focused activities.

StRAP research topics include 1) Contaminant characterization and consequence assessment, 2) environmental cleanup and infrastructure remediation, and 3) systems approaches to preparedness and response.

Research areas associated with contaminant characterization and consequence assessment include contaminant fate and transport; exposure and contaminant detection; and environmental sampling and analysis. Environmental cleanup and infrastructure remediation research areas include wide-area decontamination, water treatment and infrastructure decontamination, oil spill response support, and waste management. Further development of tools to support systems-based decisions is aligned with the systems approaches to preparedness and response. Research activities are solutions-driven and applied broadly across ORD's six national research programs, and include pilot translational science projects and case studies of previous and current research to develop and implement best practices for addressing wide-area contamination and prevent, prepare, and respond to water contamination impacting public health.

Proposed outputs for the HSRP are quite ambitious with 36 identified outputs prioritized by fiscal year through FY2022. HSRP has identified five outputs associated with fate, transport and exposure, including disseminating provisional advisory levels for high-priority chemical contaminants and determining cleanup goals for chemical warfare agents and their degradants in FY20. An additional five outputs are included in the HSRP plan associated with detection/environmental sampling and analysis, six outputs are associated with wide-area contamination, six outputs are related to water treatment and infrastructure decontamination, five outputs are associated with oil spill response support, four outputs are related to

waste management, and four additional outputs are for development of tools to support system-based decisions. Development of a database for data on remediation for all-hazards response and recovery research, operations, and tools is scheduled for FY2019. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- HSRP is composed of an outstanding, committed, multidisciplinary research team.
- Research is solution or outcome-driven.
- Effective applied research projects are designed to address needs of stakeholders.
- Subject matter experts (SMEs) are engaged as needed to address problems as they arise.
- Research priorities/activities are developed through engagement with stakeholders.
- Best practices are incorporated in communicating risk to stakeholders and the public.
- ESAM online tool is an example of an effective tool developed by the HSRP to guide sampling and analysis associated with an event.
- Application of the CRADA model is beneficial in addressing identified research gaps.
- Research findings are summarized in fact sheets and "one pagers" for emergency responders and on-scene coordinators.
- Key research findings are published in reports and peer-reviewed journals.

Suggestions

- Partner with other EPA labs (e.g., NERL, J. Sobus, M. Stryner), NIEHS (David Balshaw), and agencies like the FBI to keep abreast of emerging methods for identification of chemical or other unknowns and to determine when those capabilities can be accessed through partnership or when the resource needs to be developed within the HSRP.
- Use whole genome sequencing technology where appropriate, e.g., biological agents.
- Maintain relationships with partners such as the Centers for Disease Control and Prevention (CDC) to develop strategies to respond to emerging and reemerging diseases.
- Monitor and develop strategies to respond to public health threats resulting from extreme weather events, hurricanes, tornadoes, flooding, wild fires, etc.
- Develop template and online process to collect and report data effectively and rapidly to stakeholders.
- Work with other federal agencies with laboratory response networks (e.g., CDC LRN) to ensure that data are reported promptly and in a format to rapidly produce and provide risk communication information to stakeholders.
- Temper timeline and outputs, which may be overly ambitious given ongoing response needs of stakeholders.
- Assess current capabilities and capacity to respond to a radiochemical event. Analytes are known and analytical methods are relatively well developed, but laboratory expertise and capacity are diminishing, particularly at the the state level.

Recommendations

The Subcommittee offers these two recommendations to further address research areas and proposed outputs.

Recommendation 1c.1: Further develop screening methods to rapidly identify and characterize "chemical unknown(s)" from contamination events.

Recommendation 1c.2: Further establish means to isolate, decontaminate, and purge sections of drinking water distribution systems to limit and mitigate deliberate or accidental chemical, biological, radiological, and nuclear (CBRN) contamination events.

Charge Question 1d

> Q.1d. ORD resources and scientist numbers and hiring have declined over recent years. With the objective of maintaining a dynamic research organization at the forefront of environmental science, and recognizing the importance of addressing the identified partner research needs, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

As the scientific research arm of the EPA, ORD's HSRP can advance the field through its own research, and serve as a force multiplier, leveraging the research of others through expertise, partnership, collaboration, incubation, facility and technique sharing, funding, and many other entrepreneurial techniques. Much like the negative human and environmental health consequences of increased atmospheric carbon dioxide that were not as well understood 30 years ago as they are today, there are likely other adverse environmental developments unknown at this point. Therefore, HSRP must be positioned to assist in the discovery of such issues and to advance solutions. While fiscal stewardship within any governmental organization is critical, cutting edge science and advancing knowledge requires strategic investment. ORD must invest resources and scientific personnel into advancing the science within its established research areas and advance scientific questions that push the field and knowledge base forward so that it better protects the environment and the health of all. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- HSRP's existing research plans are strengths from both a scientific personnel and scientific infrastructure perspective; of particular note is the unique capabilities of the Water Security Test Bed at INL. The Test Bed is a singular facility within the United States that gives HSRP the ability to respond to emergent needs influencing the countries water infrastructure.
- Each area within HSRP has been very entrepreneurial in leveraging its relatively small budget and personnel numbers through collaboration and partnerships with other governmental partners. An operating principle of the organization is to build partnerships with entities that have complementary expertise. This allows the reduction of governmental duplication and gives all parties the flexibility to address emerging issues and/or expertise needs.
- HSRP's bio-decontamination focus on the spore-forming *Bacillus anthracis* and surrogate organisms is an excellent approach. Determining how to decontaminate this environmentally hardy organism

can inform methods to handle less environmentally hardy organisms, including emerging pathogens yet to be identified.

- HSRP's work associated with large area decontamination takes a broad approach; particularly of note has been its focus on usability and adaptation of off-the-shelf products for novel decontamination applications (e.g., wet vacuums). By remaining open to off-the-shelf options and problem-based solutions relating to emerging needs, HSRP achieves organizational flexibility and greater operational capacity.
- In both staffing and strategy, HSRP has recognized that human elements influence the successful development and implementation of scientific and technological solutions to the problems of wide-area and water contamination incidents—from engaging diverse partners to scope issues to communicating risk and its management in meaningful terms (e.g., 3D City for visualizing fate/transport) so that the public has a full grasp of, and faith in, the technical solutions.
- Cybersecurity is a compelling emerging concern. HSRP has done due diligence in exploring whether its partners and customers need scientific research support within this area. For example, it convened a workshop with SMEs to identify cybersecurity risks, gaps, and needs. At this point, HSRP has rightfully determined that other organizations are better suited and more aligned with expertise and resources to address this emerging issue.
- The integration of oil spill issues into the HSRP portfolio provides for greater synergy and advances across the board. This organizational shift allows for greater flexibility in addressing emerging concerns, and in particular those in partnership with the United States Coast Guard (USCG).

Suggestions

- Preserve current workforce capacity and reconfigure existing program initiatives to address emergent priority needs. For instance,
  - Create deliberate plans for the succession and the continuation of projects and expertise as individuals depart or retire, given HSRPs heavy reliance on a small number of individuals;
  - Leverage the resident social scientist's connections with the larger community of social and behavioral scientists across the six ORD programs and within EPA, and feature a full community resilience panel at future decontamination conferences.
  - Seize the rare research opportunities enabled by a full-scale, resource-intense field test (e.g., AnCOR) to integrate a socio-behavioral component at the outset e.g., Coast Guard personnel perceptions of clean up and re-entry.
- Weigh potential resource investments in research topics related to critical environmental developments (e.g., changing climate, oil drilling in the arctic region, complex exposures). For instance,
  - Expand HSRP focus and modeling to more mixtures, degradation products, and different exposure variables because emerging threats are increasingly more complex (e.g., post-9/11 air quality affected by multiple degradation products tied to burning building).
  - Consider climate-related interactions. As predicted sea level rise continues, the coastal areas will have greater significance as near-shore pollutants move from the riparian or coastal soil environments into water bodies.
  - More thoroughly integrate waste management and oil spill response support within the HSRP research portfolio. For example, in distinct environments (i.e., gulf coast versus the arctic), different operational challenges may arise for waste management, or oil dispersants and other compounds could have different ecological impacts
- Leverage partnerships to stretch scarce resources and create synergy to meet emergent needs. For instance,

- Work with Air Force Research Lab on materials compatibility with decontamination processes. NIEHS WTP has a robust program of training works in the field to address issues associated with CBRN events.
- Collaborate with the Department of Agriculture, Occupational Safety and Health Administration and commodities groups on decontamination and issues associated with mass depopulation of animal agriculture and the waste management of a large volume of contaminated animal biomass.
- Collaborate with the Department of Transportation on the science of transporting Category A Waste. More scientific research associated with emerging and reemerging pathogen issues on a large scale could benefit current recommendations for the packaging for transport of Category A Waste.

Recommendations

The Subcommittee offers this recommendation to address critical emerging environmental needs in a cost effective manner.

Recommendation 1d.1: Develop a cross-cutting matrix of subject matter expertise that can be applied toward any novel issue. What urgent issues have yet to surface are uncertain; what is certain, however, is the wide-ranging expertise that HSRP now commands and could apply to a newly emergent threat or exigent situation.

Charge Question 1e

> Q.1e. What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

The Subcommittee sees significant opportunities for HSRP to increase the impact of its limited financial and human resources by leveraging market-oriented innovation and problem-solving resources. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- HSRP's innovativeness, capabilities, and productivity benefit from collaborating with other organizations.
- Employing interns can reduce labor costs while increasing access to latest technologies (e.g., via students already trained in the latest software tool development methods).
- Development of the WOW Cart demonstrated that a CRADA, which protects the cooperator's intellectual property investment, can produce an innovative product with commercial potential at minimal cost (to the EPA).
- The EPA offers challenges and prizes "to find solutions by tapping into the ingenuity and creativity of crowds" (https://www.epa.gov/innovation/challenges-prizes).
- The EPA collaborates with organizations, such as the Water Research Foundation (WRF), to guide funding to qualified researchers to work on specific problems. WRF recently sponsored a well-subscribed challenge (http://www.werf.org/LIFT/IWSChallenge2018) that offered no prize other than publicity and "fame and glory" to the winners.

Suggestions

- Investigate options for crowdsourcing R&D with organizations like WRF that have interests in common with HSRP. Investigate companies that facilitate crowdsourcing innovative solutions to problems. For example, Innocentive (https://www.innocentive.com/) facilitates internal challenges to an organization's staff and external challenges to Innocentive's network of over 380,000 problem solvers (https://en.wikipedia.org/wiki/InnoCentive). Internal challenges further leverage the talents of already attuned employees. Problem solver networks like Innocentive's would provide the National Homeland Security Research Center with new sources of expertise, fresh ideas, inventiveness, and short- and long-term partnering opportunities, possibly via CRADAs. "Red-team/blue-team" challenges could meet pathfinding and horizon-scanning goals.
- Reorganize HSRP's software development and maintenance activities to leverage ready and willing experts through non-traditional contracting, such as prizes, challenges, and CRADAs, which could yield significant improvements in speed, quality, and cost. Software development and the maintenance of legacy applications can be more time consuming and expensive when performed within layered organizations like the EPA for whom such activities are not a core competency.
- Reach out to other agencies for leveraging opportunities, e.g., the oil spill research program works closely with the USCG and National Oceanic and Atmospheric Administration.

Recommendations

The Subcommittee offers these two recommendations for boosting innovation and employing market-based approaches that the program could use to advance solutions to existing and emerging environmental problems.

Recommendation 1e.1: Create an integrated plan for establishing an internal Innovation Council, reaching out to other agencies for interagency leveraging opportunities, and employing external crowdsourcing.

Recommendation 1e.2: Perform some trial challenges. For example, a "hardware challenge" could advance one or more of the NHSRC's early stage concepts or inventions. For example, candidates could include completing the development of equipment and methods for (1) the wet-vac sampling and (2) the water volume reduction via microfiltration with soil analysis methods. Similarly, a "software challenge" could advance one or more of the HSRP's software-related projects. For example, an internal challenge with a prize that is modest by the organization's standards could incentivize EPA employees to accelerate projects on their own time. Internal or external challenges might be especially helpful in modernizing legacy non-integrated applications that use different platforms.

Charge Question 2

> Q.2. Homeland Security Research is designed to address known threats and vulnerabilities. At the same time, the Nation regularly faces unforeseen challenges in public health and the environment (e.g., Ebola and Zika viruses, opioid misuse). Please comment on the extent to which the Program's design enables use of its scientific contributions in also addressing unforeseen needs of the EPA programs and regions, states, and tribes. How can HSRP improve its applicability to unanticipated urgent threats?

The StRAP proposes to continue HSRP's longstanding mission focus on specific products and outcomes developed in close coordination with its customers. A potential consequence of a highly focused research program like this is the development of capabilities and products that perform exceptionally well for a set of specific needs (an essential outcome), but may or not be more broadly useful for addressing a different set of "unforeseen" needs. Charge Question 2 asks whether the research and research plan are suitable for or can be adapted to respond to events or threats that fall outside the known threat space. To address this question, the Subcommittee considered the HSRP in the context of some characteristics of a highly adaptable research plan.

Characteristics of such an agile and adaptable program might include: (i) capabilities and expertise in fundamental physical, chemical, environmental, and biological processes applicable to a very broad set of threats; (ii) decision tools that allow identification of the unique/non-unique aspects of the unforeseen threat; (iii) adaptable technical tools; (iv) sampling, decontamination, waste management, and modeling tools for all environmental media (air, water, soil, built environment), and for broad chemical, radiological, and biological agent classes; and (v) strong partnerships with other organizations with expertise that can be leveraged (e.g., CDC).

The Subcommittee also considered the nature of unforeseen threats of consequence that would test the limitations and adaptability of a research program. These included but are not limited to: (i) unusual properties: biological or chemical agents with longer environmental half-lives, unusually rapid environmental transport (MTBE), or physicochemical properties that make it resistant to standard cleanup (soap, solvents, water, disinfectant, etc.); and (ii) new environments and interactions: terrestrial-aquatic interface and artic environment.

The Subcommittee has identified elements of the HSRP that aligned with and promoted adaptability to unforeseen threats (strengths) and opportunities to build on existing strengths to significantly increase flexibility and adaptability (suggestions). The most impactful suggestions were proposed as recommendations. Listed below are specific strengths, suggestions, and recommendations.

Strengths

- The ability to adapt and apply its research to meet unforeseen challenges in a timely manner is specified as a priority in the StRAP.
- Embracing computation and modeling maximizes the utility and applicability of data to new threats through simulation and extrapolation.
- HSRP's systems approach to decision-making produces expertise and tools with greater flexibility and applicability to imagined or real scenarios outside of the traditional threat space. RADAR and WEST are good examples of flexible tools emerging from a systems approach.
- HSRP reduces the scope of unforeseen threats, and increases time to respond through ties to agencies with responsibility for CBRN Horizon Scanning.
- Close coordination with customers' guides produces flexible solutions designed for the flexibility to serve multiple scenarios. The self-contained, portable water purifier is an excellent example.
- HSRP uses tools and knowledge developed for one purpose to address stakeholder questions for an unexpected threat (e.g., with Ebola).
- HSRP robotic platforms for sampling are an example of flexible platforms applicable to multiple scenarios.

Suggestions

- Detail or integrate HSRP staff with interagency intelligence teams/fusion centers to speed and extend identification of emerging threats. Involvement in the emerging biodefense plan should be pursued. Unclassified distillations of classified reports are a likely deliverable to EPA and should still contain useful information regarding the nature of emerging threats (chemical space, property of concern, etc.).
- Initiate a workshop or similar event with other agencies to create three to six scenarios that might represent important aspects of the scope of "unforeseen threats." Base scenario on functional characteristics rather than on specific agents. Formally evaluate the HSRP's adaptability/relevance in the context of the how it would perform in these scenarios. Revise the HSRP.
- Create a matrix of methods for sampling, decontamination, and analysis for persistent chemical, biological, radiological (CBR) agents. Identify gaps in these methodologies for important classes of compounds.
- Determine how existing HSRP products could be used or modified to address potential emerging threats. Expand efforts to produce new knowledge/data that enable interpolation and extrapolation of tools/approaches by selecting test agents/systems that over time expand the chemical/systems space or knowledge/tools in which data exist. Some focus on worst-case systems (e.g., BA spores, long half-life chemicals), in which resources are too limited, will continue to be the best way to meet the need of extrapolating conservatively.
- Expand interactions with stakeholders (citizen groups, infrastructure groups, state emergency response teams, associations) and include new stakeholders to identify new scenarios and find support for pilot and field demonstrations.

Recommendations

The Subcommittee offers these two recommendations to capitalize on how HSRP can improve its applicability to unanticipated urgent threats.

Recommendation 2.1: Refine or define what would constitute an unforeseen event that would fall outside current capabilities to address (outside of chemical space, biological space, environmental space). This document and/or matrix would serve as a guide for prioritizing what data gaps need to be addressed and how research priorities might change over the course of 3–5–10 years as unforeseen threats become actual threats.

Recommendation 2.2: Engage and leverage CBRN horizon-scanning agencies to increase knowledge about potentially emerging threats, particularly in the rapidly changing biothreat and chemical threat space. Frame in the context of Recommendation 2.1.

SUMMARY LIST OF RECOMMENDATIONS

Charge Question 1a: Does the research outlined for the 2019-2022 timeframe support the relevant Agency priorities as described in the EPA and ORD Strategic Plans?

- **Recommendation 1a.1:** Expand communication of HSRP's valuable research and spill response tools to state emergency response commissions (SERCs), local emergency planning committees (LEPC), and tribal emergency responders. Although direct communication exchange may be too costly in terms of manpower, it might be achieved through videos and white papers that can be broadly shared across the country. SERCs often have EPA personnel in attendance who may be able to brief them on the newest HSRP information, answer questions, and continue the dialogue to put these tools to greatest benefit. Another path to communication with states and tribes, and with regulated the community, is through EPA's Smart Sectors Program. This type of information sharing along with training for the boots on the ground will advance EPA's strategic goal of accelerating the pace of cleanup.

Charge Question 1b: Each ORD research program undertook a rigorous engagement process to provide additional detail on specific EPA program and region, state, and tribal needs, the results of which are summarized in the StRAP objectives and explanations of research topics and areas. How well does the proposed research program respond to these partner-identified needs?

- **Recommendation 1b.1**: HSRP should expand the water research portfolio (i.e., decontamination) to include materials other than ductile iron and concrete-lined piping (e.g., PVC, CPVC, Transite, and tree trunks), and develop a strategy to study emergent materials.
- **Recommendation 1b.2**: HSRP should adapt mobile platforms for tools to apps for future users (next generations). HSRP should incorporate a means by which product updates, new versions of guidance, and changes to existing topic areas could be emailed to users of electronic tools, for which users could opt in.

Charge Question 1c: Does the StRAP, including the topics, research areas, and proposed outputs, clearly describe the strategic vision of the program? Given the environmental problems and research objectives articulated, please comment on the extent to which the StRAP provides a coherent structure toward making progress on these objectives in the 2019-2022 timeframe.

- **Recommendation 1c.1**: Further develop screening methods to rapidly identify and characterize "chemical unknown(s)" from contamination events.
- **Recommendation 1c.2**: Further establish means to isolate, decontaminate, and purge sections of drinking water distribution systems to limit and mitigate deliberate or accidental CBRN contamination events.

Charge Question 1d: ORD resources and scientist numbers and hiring have declined over recent years. With the objective of maintaining a dynamic research organization at the forefront of environmental science, and recognizing the importance of addressing the identified partner research needs, are there any other critical emerging environmental needs or fields of expertise and/or new research methods where this program should consider investing resources?

- **Recommendation 1d.1**: Develop a cross-cutting matrix of subject matter expertise that can be applied toward any novel issue. Which urgent issues have yet to surface is uncertain; what is certain, however, is the wide-ranging expertise that HSRP now commands and could apply to a newly emergent threat or exigent situation.

Charge Question 1e: What are some specific ideas for innovation (including prizes/challenges) and market-based approaches that the program could use to advance solutions to existing and emerging environmental problems?

- **Recommendation 1e.1**: Create an integrated plan for establishing an internal Innovation Council, reaching out to other agencies for interagency leveraging opportunities, and employing external crowdsourcing.
- **Recommendation 1e.2**: Perform some trial challenges. For example, a "hardware challenge" could advance one or more of the NHSRC's early stage concepts or inventions. Candidates could include completing the development of equipment and methods for (1) the wet-vac sampling and (2) the water volume reduction via microfiltration with soil analysis methods. Similarly, a "software challenge" could advance one or more of the HSRP's software-related projects. For example, an internal challenge with a modest prize could incentivize EPA employees to accelerate projects on their own time. Internal or external challenges might be especially helpful in modernizing legacy non-integrated applications that use different platforms.

Charge Question 2: (Homeland Security Subcommittee-specific): Homeland Security Research is designed to address known threats and vulnerabilities. At the same time, the Nation regularly faces unforeseen challenges in public health and the environment (e.g., Ebola and Zika viruses, opioid misuse). Please comment on the extent to which the Program's design enables use of its scientific contributions in also addressing unforeseen needs of the EPA programs and regions, states, and tribes. How can HSRP improve its applicability to unanticipated urgent threats?

- **Recommendation 2.1**: Refine or define what would constitute an unforeseen event that would fall outside current capabilities to address (outside of chemical space, biological space, environmental space). This document and/or matrix would serve as a guide for prioritizing what data gaps need to be addressed and how research priorities might change over the course of 3–5–10 years as unforeseen threats become actual threats.
- **Recommendation 2.2**: Engage and leverage CBRN horizon-scanning agencies to increase knowledge about potentially emerging threats, particularly in the rapidly changing biothreat and chemical threat space. Frame in the context of Recommendation 2.1.

CONCLUSIONS

The BOSC HSRP Subcommittee was charged with reviewing and providing input on the draft 2019–2022 StRAP documents and proposed research strategies. The emphasis is on advancing ORD research that can successfully address the needs identified by EPA programs and regions, states, and tribes. The HSRP Subcommittee reviewed the HSRP research over three days in December 2018. The overarching issue addressed by the committee was, Is HSRP doing the right research? In other words, how well does the HSRP's current research portfolio address high-priority Agency needs in this area? Taking resource limitations into consideration, should the HSRP increase or decrease the emphasis of certain areas of research?

The Subcommittee determined during the review that the HSRP's research is aligned with the StRAP and is poised to deliver research necessary to support EPA's overall mission to protect human health and the environment, fulfill the EPA's legislative mandates, and advance cross-agency priorities identified in the FY2018–FY2022 EPA Strategic Plan. HSRP has demonstrated many significant strengths and outputs. The Subcommittee has identified suggestions and recommendations that can further improve HSRP's research efforts in meeting key stakeholder and Agency needs. This review by the BOSC HSRP Subcommittee of the draft HSRP StRAP will be followed by regular BOSC reviews of research activities over the course of the StRAP implementation.

APPENDIX A: MEETING AGENDA

Wednesday, December 12, 2018 EPA-RTP Main Building Room D101			
Time	**Topic**	**Presenter**	**Description**
8:00	Registration		
8:30	BOSC Introduction	Tom Tracy, EPA Designated Federal Official Bruce Rodan, ORD DAA for Science Paula Olsiewski, Chair Lance Brooks, Vice-Chair	• Introductions of the Subcommittee and EPA participants • BOSC and FACA rules review • Logistics • Agenda
8:50	HS Research Program Foundation and Purpose	Greg Sayles	• HS research priorities supporting EPA Strategic Plan • EPA HS roles/responsibilities • Coordination with federal, state, and local customers • Scenario examples
9:30	HS Research Program Design	Shawn Ryan	• Customer engagement and customer-driven research • Program organization • General research approach • Unanticipated and emerging needs
9:50	Break		
10:00	Review Charge Questions	Romy Campisano	• Review and clarification of charge questions
10:20	**Research Area Overview:** Contaminant, Fate, Transport and Exposure	Paul Lemieux	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
10:40	Travel to EPA Fluid Modelling Facility		
10:50	Research Area Demo	Paul Lemieux Tim Boe	• 3D city for fate/transport and visualization • Rainfall simulator and field work at Edison

		Anne Mikelonis	
11:40	Travel to EPA Main Campus		
12:00	Lunch Break		
12:45	**Research Area Overview:** Contaminant Detection/Environmental Sampling and Analysis	Sarah Taft	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
13:00	Travel to Aerosol Test Facility		
13:15	Research Area Demo	Sang Don Lee Worth Calfee John Archer Vince Gallardo	• Innovative sampling approaches • Application to wide area response • Activity-based air sampling • Water sampling and processing
14:00	Break		
14:15	**Research Area Overview:** Wide Area Decontamination	Sang Don Lee	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
14:30	Travel to High Bay		
14:45	Research Area Demo	Sang Don Lee Lukas Oudejans Joe Wood Worth Calfee	• Introduction • Bench-scale decontamination testing • Bench to pilot scale decontamination testing • Application to wide area decontamination
15:15	Travel to Conference Room		
15:30	Daily Wrap-up/Questions		
16:00	BOSC Subcommittee work time		

Thursday, December 13, 2018 **EPA-RTP Main Building Room D101**			
Time	**Topic**	**Presenter**	**Description**
8:30	Questions from Day 1		
9:00	**Research Area Overview:** Oil Spill Research	Robyn Conmy	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
9:45	**Research Area Overview:** Water Treatment and Infrastructure Decontamination	Kelly Dipolt	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
10:00	Research Area Demo: *Water Security Test Bed Video*	Jeff Szabo	EPA's Water Security Test Bed, full-scale studies of contaminated water infrastructure and treatment.
10:30	Break		
10:45	**Research Area Overview:** Waste Management	Emily Snyder	• Summary of research needs • General research planned to meet needs, including expertise involved, specialized facilities/equipment used, and novel/innovative methods developed • Research example(s)
11:15	Research Area Demo: On-Site Water Treatment Cart	Jim Goodrich	
11:30	Future Field-Scale Study and Demonstration (AnCOR)	Shawn Ryan	
11:45	Lunch		
12:30	**Research Area Overview:** Introduction to Tools	Kelly Dipolt	• Summary of research needs • Explanation of Tools Demonstration
12:45	Tools Demonstrations EPA-RTP Rooms C-500A and C-500C	Paul Lemieux Tim Boe Sarah Taft Jim Goodrich	• WEST • RADAR • ESAM • River Spill Tool

13:45	**Research Area Overview:** Future of Systems-Based Decision Support Tools	Kelly Dipolt	Systems-approach to decision support tool development
14:15	Break		
14:30	BOSC Subcommittee work time		
16:30	Daily Wrap-up/Questions		

Friday, December 14, 2018 **EPA-RTP Main Building Room D101**			
Time	**Topic**	**Presenter**	**Description**
8:30	Anticipated Accomplishments	Shawn Ryan	Highlight anticipated accomplishments
9:00	Public Comment	Tom Tracy	
9:15	Wrap-up/Questions	Tom Tracy	
9:30	BOSC Subcommittee work time		
11:30	Follow-up Question Session	Greg Sayles Shawn Ryan	
12:00	Adjourn		

APPENDIX B: MATERIALS

Material Provided in Advance of the Meeting

Materials to Support the Charge Questions

- Agenda
- Charge questions
- Pre-meeting notes
- Pre-meeting teleconference slides
- Draft HSRP StRAP (External Review Draft, November 15, 2018 version)
- EPA Strategic Plan https://www.epa.gov/planandbudget/strategicplan
- ORD Strategic Plan

Additional Material Provided During the Meeting

- BOSC HS Subcommittee roster