



**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460**

**OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD**

XXXX XX, 2011

EPA-SAB-11-xxx

The Honorable Lisa P. Jackson
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Office of Research and Development (ORD) New Strategic Research
Directions: A Joint Report of the Science Advisory Board (SAB) and
ORD Board of Scientific Councilors (BOSC)

Dear Administrator Jackson:

The EPA Science Advisory Board (SAB) and Executive Committee of ORD's Board of Scientific Councilors (BOSC) held their first joint meeting on June 29-30, 2011. The meeting offered an extraordinary opportunity to discuss ORD's new strategic research plans and to provide early input for ORD research planned for FY 2012 and beyond.

ORD has realigned its research from 13 project areas, defined by specific problems and media type, into four integrated programs (Air, Climate and Energy; Safe and Sustainable Water Resources; Sustainable and Healthy Communities; and Chemical Safety for Sustainability) related to your major priorities plus two cross-cutting areas (Human Health Risk Assessment and Homeland Security Research). This consolidation and realignment of programs reflects an emphasis on integrated transdisciplinary research, multi-pollutant exposures and sustainability. ORD requested a joint meeting of the SAB, which traditionally has provided advice on ORD strategic research directions, and the ORD's Board of Scientific Councilors, which has traditionally focused on ORD's implementation of its research programs, to get the benefit of their combined advice at an early stage in the process of defining research plans.

Both the SAB and the BOSC enthusiastically support ORD's consolidation of research programs. Consolidation will bring efficiencies and promote a systems approach to sustainability as an overarching framework for ORD research. Consolidation of ORD research programs and adoption of such a systems approach to sustainability are bold and necessary steps. Environmental and public health protection requires a deep understanding of environmental problems and an ability to translate problem identification and understanding into information that can empower solutions. EPA science is likely to resonate with the public if it is framed in terms of actual environmental systems, rather than traditional scientific disciplines, and if ORD

1 can communicate how its science can be linked to preventing and solving environmental
2 problems.

3
4 The SAB and BOSC are impressed with ORD's progress in conceptualizing the new research
5 programs. There has been an impressive increase in transdisciplinary collaboration as well as
6 coordination across ORD programs with the restructuring. ORD has involved regional and
7 program office stakeholders in the design of the new programs. Program and regional support for
8 ORD's new approaches is evident. Although one of the research programs, the Safe and
9 Sustainable Water Resources program, has made more progress than others in formulating
10 problems in systems terms and in articulating clearly the science activities to be undertaken to
11 explore and address those problems, the ORD research frameworks, over time and taken
12 together, will help the EPA build a culture and environmental programs to promote
13 sustainability. Finally, ORD's efforts to foster innovative research are notable. The EPA has
14 thought seriously and operationally about ways to energize the creativity of ORD scientists and
15 has begun to explore ways of enhancing innovation as a fundamental part of ORD programs.

16
17 We recommend that ORD strengthen its research planning in several ways. ORD should describe
18 its research as six research programs, rather than as four programs plus two cross-cutting areas.
19 Human Health Risk Assessment and Homeland Security research are important ORD activities
20 and merit treatment as important programs. As EPA develops a common definition of
21 sustainability, the resulting definition should be used consistently across ORD. To advance
22 sustainability as a goal, the research frameworks for each program should include sustainability
23 as part of the research vision and identify clear metrics for assessing progress toward
24 sustainability goals.

25
26 The success of ORD's new research directions, of course, will depend upon implementation.
27 Planned research must be supported by the financial and human resources needed. We
28 recommend that the draft research frameworks each transparently describe the research goals and
29 activities that are within the scope of ORD resources or active collaboration with external
30 research partners. The SAB and BOSC recommend strongly that ORD plan for the resources
31 needed to sustain the communication, stakeholder involvement, and integrated transdisciplinary
32 collaboration that will be essential for its new approach to research. The SAB and BOSC also
33 underscore that all the systems of interest to EPA include human behavior. Research on relevant
34 aspects of human behavior is crucial to understanding the systems and implementing solutions or
35 programs that follow from them. Increased emphasis on social, behavioral and decision sciences
36 within ORD is needed for the new research programs to be successful. The SAB and BOSC
37 recommend that ORD take specific steps to enhance its expertise and research in these areas.

38
39 The SAB and BOSC seek continued dialogue with ORD as part of their mission to advice on the
40 science and research supporting EPA's decisions. We look forward to any comments you have at
41 this time on these reflections on ORD's new research directions.

42
43 Sincerely,

44
45
46 Dr. Deborah L. Swackhamer
47 Chair
48 Science Advisory Board

46 Dr. Martin Philbert
47 Chair
48 ORD Board of Scientific Counselors

49

NOTICE

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3 This report has been written as part of the activities of the EPA Science Advisory Board (SAB)
4 and the ORD Board of Scientific Counselors (BOSC), public advisory groups providing
5 extramural scientific information and advice to the Administrator, the Assistant Administrator of
6 the ORD Assistant Administrator, and other officials of the Environmental Protection Agency.
7 The SAB is structured to provide balanced, expert assessment of scientific matters related to
8 problems facing the agency. This report has not been reviewed for approval by the agency, and,
9 hence, the contents of this report do not necessarily represent the views and policies of the
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ORD's New Strategic Research Directions: SAB and BOSC Advice

1. Introduction and overarching comments

Introduction

On June 29-30, 2011, the EPA Science Advisory Board (SAB) and the EPA Office of Research and Development (ORD) Board of Scientific Counselors (BOSC) held their first joint meeting. At ORD's request, they discussed six draft research frameworks ORD had developed for its major research areas and a draft action plan for the Chemical Safety for Sustainability research program. ORD requested SAB and BOSC advice because it is restructuring its research programs for FY 2012 to better understand environmental problems and inform sustainable solutions to meet EPA's strategic goals. The restructured research program will be comprised of six program areas: Air, Climate, and Energy; Safe and Sustainable Water Resources; Sustainable and Healthy Communities; Chemical Safety for Sustainability; Human Health Risk Assessment; and Homeland Security. ORD had requested SAB and BOSC advice at an early stage in the process of defining strategic program directions to help ORD develop research plans to respond to EPA's strategic goals and high priority needs.

ORD requested the SAB and BOSC to address six charge questions for each of the major research areas:

- a. To what extent do the draft research frameworks describe EPA's National Program and Regional Offices strategic science priorities? How well do ORD's research programs align with those priorities? If resources allow, what are areas for increased emphasis? If resources decline, what areas might be appropriate for decreased emphasis?
- b. How can ORD enhance coordination among its research programs, and better ensure that they complement one another?
- c. How well do ORD's proposed research directions reflect its commitment to sustainably protecting human health and the environment?
- d. How do the six programs fit together as an integrated environmental research strategy, charged with informing decisions on the nation's most-critical environmental issues? Are these programs positioned to address the nation's highest priority, emerging environmental issues in the coming years?
- e. Based on Board members' familiarity with efforts in the broader scientific community, how well do ORD's research programs appear to catalyze and complement environmental science programs elsewhere? What suggestions do the members have for how EPA's research programs could improve upon their leveraging with those of others?

- 1 f. How does the SAB/BOSC view ORD's activities in stimulating innovative
2 research and what other suggestions would the SAB/BOSC have to promote
3 innovation in EPA research?
4

5 ***Overarching comments***
6

7 First, the SAB and BOSC strongly support the consolidation of research programs to align with
8 the Administrator's priorities. The maintenance of two additional mission-critical research
9 programs (Human Health Risk Assessment and Homeland Security) was viewed by both
10 advisory bodies as necessarily separate. The consolidation of research activities within large
11 thematic areas oriented to systems thinking and problem solving has created possibilities for
12 enhanced collaboration across ORD laboratories and centers and will stimulate
13 transdisciplinary research in ORD. This consolidation is positive and appropriate for an
14 organization that seeks to foster innovation and maintain a nimble, flexible structure for
15 research. Managed appropriately, these larger research programs will encourage ORD
16 researchers to reach beyond potentially narrow disciplinary limits to formulate and conduct
17 transdisciplinary research that meets EPA's current and future high priority needs.
18

19 Second, ORD requested advice both on how well its proposed research directions reflect a
20 commitment to sustainably protecting human health and the environment *and* how well ORD's
21 draft research frameworks describe and meet the strategic science priorities of EPA's national
22 program and regional offices. As a research organization in a mission-oriented agency, ORD
23 must strike a balance between vision and pragmatism, or better yet, find ways to have
24 pragmatic goals that align with a strategic vision. The concept of sustainability potentially has
25 great power to guide and help communicate ORD research. However, ORD's draft research
26 frameworks were not equally successful in describing how ORD research relates to
27 sustainability and how different research programs would serve regional and program needs.
28 This variation is understandable, because different frameworks reflected research areas with
29 varying scopes and histories. The Safe and Sustainable Water Resources program has a natural
30 focus on water systems, for example, while the Safe and Healthy Communities Program
31 reflected a broad and novel combination of human health and ecosystem-related research.
32

33 Ideally, each research framework would include sustainability explicitly in its research vision;
34 invoke a common definition of sustainability; demonstrate clearly how planned research relates
35 to the key components of sustainability (the environment, the economy, and society); and show
36 how regional and program office science needs will be met. As noted in the recently released
37 report, *Sustainability and the U.S. EPA* (National Research Council, 2011), it will take time
38 and culture change for EPA to adopt sustainability as a core principle to inform decisions and
39 actions.
40

41 Transparency will be essential to introducing sustainability at EPA. ORD's research
42 frameworks can advance EPA's adoption of sustainability as a core principle by more
43 consistently and clearly describing where and how ORD research relates to sustainability. They
44 also will need to identify more clearly legacy research that relates only tangentially to
45 sustainability. The framework documents should be revised to more clearly describe the
46 research goals and activities that can be accomplished by ORD within the scope of planned
47 resources, both human and financial. Readers of each document should be able to understand

1 from each framework the research questions that will be addressed, the types of ORD products
2 that would be generated, the general time frame for that activity, and how the planned activities
3 relate to sustainability and/or science priorities of national program and regional offices.
4

5 Third, ORD must plan for the human resources needed for the ambitious research described in
6 the draft frameworks. Transdisciplinary, systems-oriented research requires coordination
7 within and across research teams and stakeholder involvement. Both these coordination
8 activities are time-intensive efforts. Anticipating the resources and the expertise set needed for
9 all the activities included in the research frameworks will be critical to their success. With an
10 increased systems emphasis, all the systems of interest to EPA include human behavior.
11 Research on relevant aspects of human behavior will be crucial to understanding relevant
12 systems and implementing solutions or programs that follow from them. Increased emphasis on
13 social, behavioral and decision sciences within ORD is needed for the new research programs
14 to be successful. Although ORD did not request advice about how to enhance its capacity in
15 these areas, the SAB and BOSC provide recommendations on this important topic in Section 3
16 of this report.
17

18 The body of this report provides responses to ORD charge questions that are relevant to all
19 ORD's new research programs. Sections 2.1-2.5 provide responses specific to each major ORD
20 research program.
21

22 *Alignment with regional and national program office needs*

23

24 The one-to-one mapping of ORD programs with the Administrator's priorities provides a
25 structure for aligning and understanding research programs in terms of EPA's strategic goals.
26 The SAB and BOSC commend ORD for involving regional and program offices as
27 stakeholders in the development of the research frameworks. ORD should continue to actively
28 involve these clients in implementation of ORD research programs and evaluation of research
29 results.
30

31 *ORD internal coordination*

32

33 The increase in the amount of communication among ORD's National Program Directors and
34 Directors of Laboratories and Centers in the development of ORD's research frameworks is
35 readily apparent and very positive. ORD should seek to expand formal mechanisms to promote
36 networking among internal researchers to improve research coordination throughout the
37 research process in the least time-intensive manner. Examples of such mechanisms might
38 include "speed dating" (i.e., a formal process whose purpose is to encourage people to meet a
39 large number of new people), use of social network technology and co-location of researchers
40 and exchange programs. Directed Requests for Applications (RFAs) that require coordination
41 of research projects across ORD research programs can also provide an incentive to ensure
42 coordination.
43

44 Cross-cutting issues that are a priority of the Administrator, such as environmental justice,
45 should be explicitly identified, wherever appropriate, as part of such RFAs to foster
46 coordination and advance the Administrator's goals.
47

1 For both intra-mural and extra-mural research, ORD should identify priority cross-program
2 research topics such as nitrogen and climate as vehicles for research coordination and building
3 of interdisciplinary culture. Additional cross-cutting research topics should be explored in the
4 future, such as multiple stressors, measures of ecosystem function, ecosystem services, energy
5 and green infrastructure. Interdisciplinary collaboration and research coordination across all
6 areas could be strengthened by development of community of practice “core” teams in areas
7 such as communication, decision tools and modeling that are engaged with all six ORD
8 research programs.

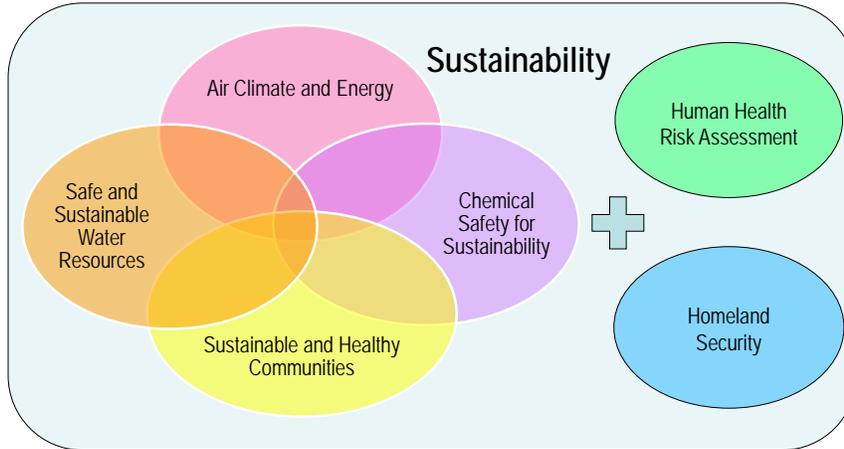
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10 Initial planning meetings that help to frame research problems properly at the outset will
11 enhance ORD program coordination. Internal and external stakeholders interested in or
12 affected by ORD’s research programs should participate in problem formulation. ORD
13 scientists from other research programs should also be present to identify issues and
14 opportunities for synergy across programs. Problem formulation that frames issues in terms of
15 systems and sustainability will foster increased coordination and identification of innovative
16 approaches to prevent environmental problems before they occur. Social, behavioral and
17 decision scientists provide expertise for problem formulation. Such experts can be especially
18 useful in identifying opportunities for institutional flexibility and framing environmental
19 problems in a larger social, economic, and institutional context.

20
21 ORD should also support research teams to enhance coordination among research programs as
22 research programs are implemented. It will take sustained effort to maintain communication
23 and coordination beyond the research planning phase.

24
25 As part of that ongoing coordination, ORD should identify its six research programs clearly
26 (and not refer to them as four programs plus two cross-cutting areas). Three different
27 conceptualizations of ORD research programs were presented graphically at the June 2011
28 SAB-BOSC meeting by the ORD Deputy Assistant Administrator for Science (Figure 1); the
29 National Program Directors for the Safe and Sustainable Water and Sustainable and Healthy
30 Communities programs (Figure 2); and the Chemical Safety for Sustainability draft research
31 framework (Figure 3)

32

Integrated ORD Research Programs



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Figure 1: Slide provided by the ORD Deputy Assistant Administrator for Science

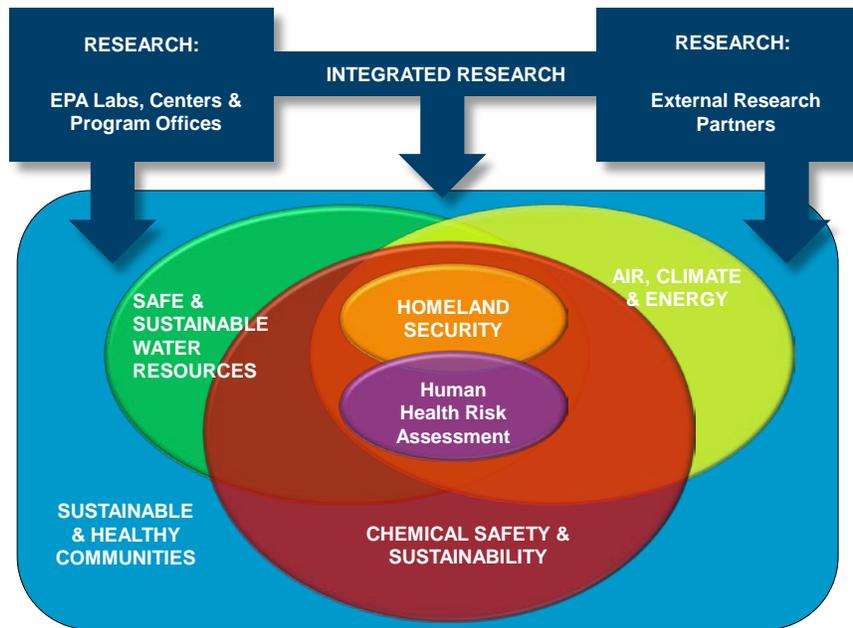
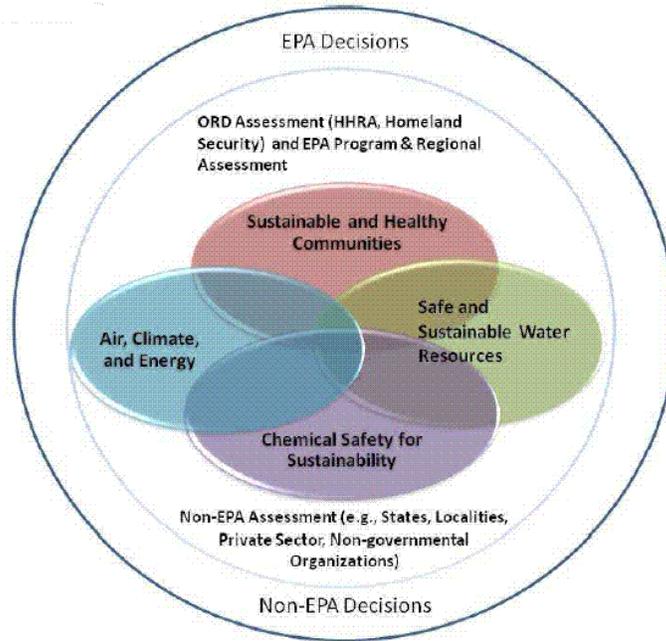


Figure 2 – Schematic used by the Safe and Sustainable Water and Sustainable and Health Communities Programs

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Integrated EPA Research Programs Within EPA and Non-EPA Partner and Stakeholder Contexts

Figure 3 – Schematic used by the Chemical Safety for Sustainability Research Program

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It is important to use a consistent diagram to clearly communicate how ORD research programs inter-relate and how they fit within larger EPA and stakeholder science contexts. As noted in the draft Safe and Sustainable Water framework, “To provide scientific information and tools that advance environmental sustainability, the four new national program areas must contribute to and reinforce one another, and jointly work with decision makers both inside and outside EPA.” Including a common diagram illustrating how ORD research programs inter-relate and relate to external science would be useful in all ORD research frameworks.

In addition, such a diagram is also needed to clarify the role of the Sustainable and Healthy Communities program as an integrating force within ORD. As the research program with the largest proposed investment and a holistic, systems perspective on human health and ecosystem protection, should it be an overarching program that other programs feed into or a research program relatively separate and co-equal with other ORD research programs? A diagram that clarifies the explicit role of the Sustainable and Health Community Program in problem formulation overall for ORD research; its role in evaluation of ORD research products, as they are used by communities; and its role integrating ORD research at community levels would help to better explain the unique aspects of the Sustainable and Healthy Communities program and enhance coordination across ORD programs.

1 ***Sustainability***
2

3 As noted in the general comments above, the SAB and BOSC recommend that ORD revise
4 each research framework to include sustainability explicitly in its research vision, invoke a
5 definition of sustainability shared across ORD, and demonstrate clearly how planned research
6 relates to the key components of sustainability (the environment, the economy, and society). It
7 may be appropriate for the shared definition to be consistent with the 2011 NRC report or to
8 explain why ORD has chosen a definition different from the NRC. The NRC derived its
9 definition from language in Executive Order 13514, which established the National
10 Environmental Policy Act (NEPA). The NRC defined sustainability as:

11
12 “to create and maintain conditions, under which humans and nature can exist in
13 productive harmony, that permit fulfilling the social, economic, and other
14 requirements of present and future generations” (NEPA[1969]; E.
15 O.13514[2009]4).
16

17 ORD leads EPA in efforts to build a sustainability-oriented culture within EPA. Sections 2.1-
18 2.5 of this report provide additional detail about how different frameworks might be revised to
19 better reflect ORD’s commitment to sustainability. Clear and consistent use of the term
20 sustainability in each research framework and clear linkages of the concept to research
21 programs as they develop will require careful, continued attention. It would be helpful for all
22 research frameworks to include a list of definitions of key terms that would be consistent
23 across ORD’s programs.
24

25 If sustainability is ORD’s goal, sustainability metrics for each research program will be needed
26 to gauge whether research helps attain sustainability goals, even if such metrics only provide
27 early markers of these long-term goals. Without metrics, resources may not be wisely allocated
28 and the long-term goals missed completely. This issue is complex and worthy of research in
29 itself, because there has been a historical disconnect” between the ideal of sustainability and
30 the practice of regulating human health and the environment. Sustainability metrics and how
31 they relate to regulations would help to better define sustainability in a realigned ORD.
32

33 Finally, for ORD to reflect its commitment to sustainably protecting human health and the
34 environment, the SAB and BOSC strongly recommends that ORD show leadership in two
35 areas of research. First, ecological research must be a strong priority for ORD. Sustainability
36 depends on understanding and protecting the ecosystems on which human life and all life on
37 earth depends. Ecosystem structure, function, and services are an integral part of sustainability.
38 Section 2.4 below discusses this topic in more detail. Second, because sustainability involves
39 policy and social dimensions, explicitly integrating social, behavioral, and decision science
40 research into ORD’s research frameworks is important to demonstrate commitment to the
41 sustainability theme.
42

1 ***Capacity to address current and future critical environmental issues***
2

3 ORD's involvement of stakeholders and other federal partners in research planning provides a
4 good mechanism to identify environmental issues and prioritize among them. Additional
5 formal mechanisms for peer review and regular consultation with the SAB and BOSC and
6 other external groups will help alert ORD to emerging issues. It may also be helpful for ORD
7 to form an internal committee of cross-program futurists, with representatives from each
8 research program to identify emerging issues and consult regularly with the SAB, BOSC and
9 other EPA groups and external stakeholders.

10
11 The most effective way for ORD to build capacity to develop responses to emerging
12 environmental issues is to evaluate how EPA has responded to science topics such as
13 nanomaterials, the Deepwater Horizon oil spill, hydraulic fracturing or natural disasters. EPA
14 could then identify which processes worked to anticipate those topics and to develop the
15 needed science and which processes were not effective. Environmental issues are not always
16 predictable. Therefore, the agency needs nimble research and assessment programs to address
17 these unpredictable issues and should strengthen its human resources and organization to
18 provide maximum resilience. Being nimble requires that the workforce be willing and able to
19 undertake new research tasks, work in teams and work in new ways. ORD's re-aligned
20 structure may enhance this by allowing a more free flow of personnel across programs to
21 provide the expertise where it is needed in a timely fashion. Workforce continuing education is
22 also a critical issue. The development of programs (visiting scholars, post-doctoral programs,
23 or other collaborative practices with outside scientists) designed to develop and maintain the
24 appropriate skill-sets within the agency are important.

25
26 One area where ORD can increase its capacity to address future critical environmental issues
27 involves the exploration of opportunities offered by computational analysis and modeling of
28 complex environmental data. Such analysis and modeling (sometimes called "Environomics"),
29 includes enhanced monitoring, technologies for understanding data-rich environments, data
30 mining and data simulation. These kinds of efforts may provide new opportunities for EPA to
31 understand the environment and pair this enhanced understanding with chemical forecasting
32 that can be useful for predicting public health and environmental impacts. Such an approach
33 could potentially provide new, creative and innovative approaches for preventing and
34 addressing the causes of complex environmental problems such as Gulf hypoxia and averting
35 water quantity and water quality problems likely to arise from current exploitation of
36 groundwater resources. Similarly, such research could help EPA attain a possible future where
37 EPA could work with the "exposome" (i.e., all cumulative risks to people) and match this
38 "exposome" information with genetic and epigenetic profiles to understand and manage
39 environmental risks.

40
41 ***Ability to catalyze and complement environmental science programs outside EPA***
42

43 Collaboration with other federal agencies and European partners is increasingly important for
44 ORD because of the ambitious scope of ORD's new research frameworks and the limitations
45 of EPA's budget and the budgets of all potential partners. The Chemical Safety for
46 Sustainability program offered a premiere model of collaborative and complementary efforts
47 with other federal agencies (i.e., Tox21) and European partners (e.g., the Joint Research Center

1 in Ispra, Italy). This level of effort and coordination needs to be extended to other ORD
2 research endeavors. ORD should actively explore formal and creative informal ways of
3 undertaking inter-agency and international collaboration.

4
5 ORD should continuously stimulate interactions between EPA and outside scientists. One
6 mechanism could involve a program of roundtables with outside experts. Visiting scientists
7 could be brought into the laboratories and centers for one year to cross-fertilize ideas on how to
8 make sustainability an organizing principle at EPA.

9
10 To ensure that ORD's new research directions develop deep roots, the office should develop a
11 mentoring and leadership development program. There will be a need to advise young
12 researchers about their projects, publications and career objectives and to foster the culture of
13 sustainability-related research at ORD. This internal human resource effort should complement
14 a strategy to recruit young scientists with expertise and interest in sustainability science.

15
16 ORD should set defined goals to catalyze and complement environmental science programs
17 outside EPA and seek BOSC review and assessment related to this topic every two years.

18 ***Innovation***

19
20
21 ORD's efforts to foster innovative research are impressive. The EPA has thought seriously and
22 operationally about ways of energizing the creative nature of ORD scientists and has begun to
23 explore ways of enhancing innovation as a fundamental part of ORD programs. Creating an
24 ORD Chief Innovation Officer position is a bold, positive step, and the Pathfinder Innovation
25 Program is a creative and important initiative. New approaches, such as "crowdsourcing," to
26 meet research challenges can be appropriate ways to tap creative research.

27
28 To further promote innovative research at EPA, ORD should develop metrics to evaluate
29 programs such as Pathfinder. ORD should define "failure" and "success" as it further develops
30 its innovation program and reach agreement on an acceptable failure rate for innovation efforts.
31 ORD should also develop and maintain a mentoring and scientist development program that
32 encourages creative and innovative approaches, as well as a reward system, perhaps similar to
33 the Scientific and Technological Achievements Award program to recognize successful
34 researchers who think outside the box. ORD should also look for opportunities to stimulate
35 innovative research in new fields related to the social, behavioral, and decision sciences.

36
37 In addition, EPA has a role in promoting innovative environmental research outside EPA and,
38 indeed, in leading the country toward the adoption of more sustainable practices. Innovation
39 could be enhanced by making EPA data easily accessible to the outside community of
40 scientists who could use these data in creative ways or by emphasizing innovation in EPA's
41 extramural grant programs. There are thousands of scientists at universities, colleges and
42 research institutions whose expertise can be solicited through extramural research support,
43 workshops and brainstorming sessions that bring EPA scientists together with the external
44 science community. Highly innovative external scientists can serve as reviewers for Pathfinder
45 proposals and projects. Consortia projects (extramural scientists working very closely with
46 agency scientists on a project) can help build an even greater resource of expertise and
47 innovation throughout the country and not just at EPA. ORD might also consider a multi-

1 agency Pathfinder Innovation Project that would tap the expertise of environmental scientists
2 from other federal agencies. EPA needs to drive innovative research not just inside the agency
3 but also within the external scientific community.

4
5 Innovation often comes through the coming together of scientists from different fields, as well
6 as scientists from different organizations (pure academic research, industry, non-governmental
7 organizations, other federal agencies, state and local governments). Thus, workshops where the
8 agency can present proposed approaches and ask for feedback from outside the agency would
9 be extremely helpful.

10
11 ***Social, behavioral and decision sciences***

12
13 The SAB and BOSC underscore that all the systems of interest to EPA include human
14 behavior. Research on relevant aspects of human behavior is crucial to understanding the
15 systems and implementing solutions or programs that follow from them. Increased emphasis on
16 social, behavioral and decision sciences within ORD is needed for the new research programs
17 to be successful. The SAB and BOSC took the initiative to develop Section 3 of this report to
18 outline ways ORD can expand its capabilities in these important scientific disciplines.

1 **2. ADVICE SPECIFIC TO ORD’S MAJOR RESEARCH PROGRAMS**

2 2.1. **Air, Climate and Energy**

3 ***Background***

4
5 ORD is reorganizing this research program around sustainability and environmental solutions.
6 The draft research framework identified the following problem statement:

7
8 Protecting human health and the environment from the effects of air pollution
9 and climate change, while sustainably meeting the demands of a growing
10 population and economy is critical to the well-being of the Nation and the
11 world. As we explore solutions to prevent and reduce emissions, we are
12 challenged by uncertainties surrounding the complex interplay between air
13 quality, a changing climate, and a changing energy landscape, and the
14 subsequent human health and ecological effects attributed to exposure to an
15 evolving array of pollutants in the atmosphere.

16
17 The draft framework identified the following problems as the focus of attention:

- 18
19 • The multipollutant nature of air pollution in order to develop effective air
20 quality strategies;
- 21 • The impacts of climate change and the interactions between adaptation and
22 mitigation;
- 23 • The human health and environmental impacts of current and future energy
24 options;
- 25 • The populations most susceptible to poor air quality and the populations and
26 ecosystems most vulnerable to climate change;
- 27 • The expanding and contracting scales of environmental problems that range
28 from global to local; and,
- 29 • The social, behavioral, and economic factors that influence the effectiveness of
30 air quality and climate policies.

31
32 The vision articulated in the framework is:

33
34 To provide cutting-edge scientific information and tools to support EPA’s
35 strategic goals to take action on climate change and improve air quality.

36
37 The draft framework proposed that ORD would provide the policy-relevant research needed by
38 EPA partners to assess impacts, prevent and reduce emissions, and respond to changes in
39 climate and air policy.

1 ***General observations:***
2

3 The vision for the Air, Climate and Energy program includes sustainability as a paradigm for
4 research, but there exists a fundamental disconnect between sustainability and the legislative
5 mandates of the Clean Air Act. ORD should address clearly how it will integrate the two needs
6 for research and how it will trade off between them. This tension will grow and may
7 increasingly need to be addressed if EPA's budget is constrained. One possibility is to build on
8 EPA's historic strengths. Air quality monitoring has been a major strength of ORD in the past
9 and it contains a unique opportunity for changing the future. Sensor development and reporting
10 networks provide opportunities that are ripe if research is undertaken wisely. In the past, the
11 EPA has conducted monitoring for the sake of compliance. EPA might consider shifting or
12 using some of that monitoring for decision-making and hypothesis testing as well.
13

14 In the climate arena, biofuels is one area where EPA has a mandate to prepare an annual report
15 to Congress on green house gas effects from biofuels and the Renewable Fuel Standard.
16 Although EPA has little authority related to energy and little authority on climate other than
17 that provided through the Supreme Court ruling and the Endangerment Finding, the lack of
18 legislative authority and regulatory responsibilities could free ORD to pursue unfettered and
19 innovative, creative research that may support voluntary and/or information-based programs.
20

21 ***Alignment with regional and national program office needs.***
22

23 In general, the draft framework reflects the strategic science priorities of programs and regions.
24 The SAB and BOSC support the increased emphasis on energy choices and the nexus between
25 air, climate, and water. A focus on multi-pollutants also integrates well with this emphasis.
26 Research directed at single pollutants is being restructured within the multipollutant framework
27 and that is appropriate. The framework should be revised to describe more clearly where multi-
28 pollutant efforts were under way and the sequencing of different multi-pollutant activities.
29

30 Despite its obvious strengths, however, the framework could better describe the
31 transdisciplinary nature of the research needed. Greater emphasis is needed on climate change
32 research to reduce greenhouse gas emissions, both from a technological standpoint (like carbon
33 sequestration) and also from a social and behavioral standpoint (how to get the desired
34 environmental behavior from people and industry without mandates or command-and-control
35 legislation). Research in the social, behavioral and decision sciences is needed on how people
36 come to understand climate change, their risk perceptions and what motivates them to take
37 action. How do these attitudes develop? People value present goods far more than future goods
38 (discounting). What would make technologies be perceived as being viable? How do we ensure
39 adoption of sustainable technologies? In addition, the intersection of science and policy should
40 be a distinct research area within the Air, Climate and Energy program. This topic has been a
41 lively focus of research for the past ten years (Mitchell et al 2006; Clark et al. in press;
42 Sarewitz & Pielke 2007; Graffy 2008; Weible et al. 2010). The example of the
43 Intergovernmental Program on Climate Change, among others, has stimulated research on the
44 relationship of policy to science that could be useful to ORD.
45

46 It will be important for the Air, Climate and Energy program to regularly check that its
47 research is aligned with regional and national program office needs. Research should begin

1 with the question in mind, clearly stated and properly framed. The National Research Council
2 “Silver Book,” *Science and Decisions* (National Research Council 2009), provides a good
3 guide in this respect. ORD should conduct regular synthesis activities to determine whether the
4 research conducted has solved the problem and to identify additional knowledge gaps. In this
5 effort, ORD should formulate the question (hypothesis) clearly and then research its every
6 aspect holistically. One example might be: “black carbon should be the first pollutant to be
7 regulated for overall Air, Climate and Energy program effectiveness including air
8 quality/human health, climate change mitigation, and energy choices.” EPA may find that
9 some programs that have fulfilled their original objectives, like the near road program, and can
10 leave room for other program areas, such as biomass, to grow. Some modeling exercises (e.g.,
11 source apportionment) may be ready for decreased emphasis. Biomass could be emphasized for
12 a period, perhaps, and then be phased out. However, ORD synthesis activities could help
13 illuminate unintended consequences, such as when biomass programs result in wood burning in
14 a school boiler. Smoke exposure to children presents potential hazards that need to be
15 examined.

16

17 ***ORD internal coordination.***

18

19 The Air, Climate and Energy program is closely related to the Sustainable and Healthy
20 Communities and the Safe and Sustainable Water Resources research programs. Integrated
21 assessments, driven by particular problems at the community, regional or national levels can be
22 used to bring them together. Addressing problems related to climate change or water quantity
23 may provide useful foci for assessments.

24

25 ***Sustainability.***

26

27 ORD should reference sustainability as a new paradigm for driving research in the Air, Climate
28 and Energy framework. The vision statement for this research program as well as the problem
29 statement should explicitly reference sustainability. The framework should explicitly address
30 the possible disconnect between the ideal of sustainability and the practice of regulating human
31 health and the environment, as required by the Clean Air Act. Sustainability metrics and how
32 they articulate with regulations would help to better define sustainability in a realigned ORD
33 and how to achieve sustainability. The SAB and BOSC recommend that ORD undertake
34 research to define the benefits of moving from a more technology-based regulatory system to a
35 performance-based regulatory system that provides incentives for sustainable solutions. There
36 may be solutions that result in ancillary benefits of decreasing the cost of regulations to the
37 regulated community and stimulating innovation. ORD can help EPA change the paradigm for
38 environmental protection through identifying sustainable alternatives for risk managers’
39 consideration. ORD should expand its current portfolio to help decision makers identify and
40 understand decision options related to sustainability. ORD could design and analyze scenarios
41 related to changing air quality and different strategies for adapting to climate change. Any
42 adaptation strategy will almost certainly be accompanied by environmental consequences that
43 might be the focus of future research.

44

45 ORD should consider programs to sponsor senior academic researchers for one-year visiting
46 sabbaticals to seek their suggestions about how to transform the Air, Climate and Energy
47 program into a program fully integrating sustainability.

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Capacity to address current and future critical environmental issues.

ORD’s six research programs fit together and offer the possibility of addressing environmental issues that go beyond EPA’s direct statutory mandates. The appendix to the draft Air, Climate and Energy draft framework articulates science questions and areas of integration within the research program and across ORD programs. Cross-cutting issues such as nutrients (i.e., reactive nitrogen) and climate change are highlighted in the discussion. This design provides an effective roadmap for current and future critical issues and collaboration across ORD research programs. The appendix could even be more effective if it were extended to include collaboration with other key research partners, such as the Department of Energy.

Innovation.

The Air, Climate and Energy program should encourage and stimulate relevant behavioral, social, cognitive and decision research both within the agency and extramurally. As an example, research is needed on how to persuade people to change their behaviors regarding energy use. Examples include being receptive to conversion to energy-efficient technologies for lighting, buying higher mileage cars, etc. There is a substantial amount of basic research to be conducted on the psychology of persuasion, on the subjective time-discounting factors that affect people's willingness to spend resources now for future gains and on risk communication. The SAB and BOSC recommend that the Air, Climate and Energy program bring in a few senior behavioral, social, cognitive, and decision science experts for one year visiting sabbaticals to cross-fertilize this new area.

1 **2.2. Safe and Sustainable Water Resources**

2 ***Background***

3

4 ORD has restructured its historical Drinking Water and Water Quality research programs into a
5 single research program called Safe and Sustainable Water Resources. The new program
6 strives “to develop sustainable solutions to 21st century water resource problems by integrating
7 research on social, environmental, and economic outcomes to provide lasting solutions.” The
8 draft research framework identified the following problem statement:

9

10

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15

Increasing demands for sources of clean water, combined with changing land use practices, growth, aging infrastructure, and climate change and variability, pose significant threats to our Nation's water resources. Failure to manage our Nation's waters in an integrated, sustainable manner will limit economic prosperity and jeopardize both human and aquatic ecosystem health.

16

The draft framework explicitly identified two major challenges:

17

18

19

20

21

22

23

1. Provide the best science in a timely manner to allow faster, smarter management decisions on our existing problems; and
2. Get our science out in front of tomorrow's problems by developing and applying new approaches that better inform and guide environmentally sustainable behavior.

24

Two research themes are identified:

25

26

27

28

29

30

31

32

Research Theme 1 – Sustainable Water Resources: Ensure safe and sustainable water quality and availability to protect human and ecosystem health by integrating social, economic and environmental research for use in protecting and restoring water resources and their designated uses (e.g., drinking water, aquatic life, recreation, industrial processes, and other designated uses) on a watershed scale.

33

34

35

36

37

38

Research Theme 2 – Sustainable Water Infrastructure Systems: Ensure the sustainability of critical water resources using systems-integrated water resource management where the natural, green and built water infrastructure is capable of producing, storing and delivering safe and high-quality drinking water, and providing transport and use-specific treatment of wastewater and storm water.

39

The framework articulates the vision for this research program as follows:

40

41

42

43

44

45

46

Safe and Sustainable Water Resources uses an integrated, systems approach to research for the identification and development of the scientific, technological and behavioral innovations needed to ensure clean and adequate and equitable supplies of water that support human well-being and resilient aquatic ecosystems.

1 ***Alignment with regional and national program office needs.***
2

3 The Safe and Sustainable Water Resources draft framework effectively describes the alignment
4 of ORD's research with regional and national strategic goals. It also describes an appropriate
5 prioritization process for identification of research focus areas. The prioritization process was
6 notable for its engagement with a wide range of internal and external stakeholders. It will be
7 important for this research program to continue to engage a wide range of stakeholder groups,
8 including EPA programs and regions, as research activities develop. If budget cuts require
9 future reductions, the prioritization process now in place should enable determination of the
10 highest priority needs and activities that can be deferred or cut.

11
12 The integration of the drinking water and water quality research programs is a very positive
13 development and will provide important new synergies especially with respect to water
14 treatment technologies relevant to drinking water, wastewater, and storm water; evaluation of
15 microbial risks; and evaluation of aquifer storage and recovery.

16
17 ***ORD internal coordination.***
18

19 The framework includes a section describing how the research program is designed within the
20 context of ORD's restructured research programs. As part of that description, the Safe and
21 Sustainable Water Resources draft framework contains a diagram reproduced as Figure 2 in
22 this report (page 5). This figure provides an effective way to communicate how the research
23 program inter-relates with ORD science and science generated outside ORD.
24

25 ***Sustainability.***
26

27 The Safe and Sustainable Water research topics were clearly formulated with the sustainability
28 theme as guide. The framework provides a useful list of definitions that explain what is meant
29 by sustainability and a "sustainable solution."
30

31 ***Ability to catalyze and complement environmental science programs outside EPA.***
32

33 The draft framework provides an excellent, detailed description of research needs, objectives
34 and science questions. The description identifies where science activities of EPA's partners
35 complement ORD's efforts and where collaboration with EPA is needed to stimulate partner's
36 research on topics of importance to EPA.
37

38 ORD should evaluate existing mechanisms for inter-agency collaboration and build on them to
39 maximize the potential to catalyze and complement environmental science programs outside
40 EPA. Programs such as the Strategic Environmental Research and Development Program, the
41 Food Emergency Response Network, the Chesapeake Bay Program and a variety of programs
42 created by U.S. Department of Agriculture's Natural Resource Conservation Service (e.g., the
43 Mississippi River Healthy Basins Initiative, rural programs for small communities and animal
44 feedlot management programs) offer opportunities to learn from and build upon. Such
45 mechanisms can be used to promote networking with external researchers.
46

1 ***Innovation***

2

3 The draft framework identifies opportunities to use the Science to Achieve Results (STAR)
4 grant program to support technical development and innovation goals. Specific detail is
5 provided within the overall context of objectives and science questions. Innovative
6 technologies are especially important to the water infrastructure theme. The Small Business
7 Innovation Research program may be a resource for this particular area.

8

9 ***Social, behavioral and decision sciences.***

10

11 Social science issues permeate all of the priority research topics for the Safe and Sustainable
12 Water Research program. Social science research should be integrated in all of the programs in
13 explicit ways. Section 3 of this report provides more detail on the types of science and research
14 that might be most useful and how ORD might undertake or collaborate to obtain the science
15 and research needed.

16

1 **2.3. Homeland Security**

2 ***Background***

3
4 ORD’s Homeland Security Research Program has a focused mission and did not provide a
5 draft research framework that included a “problem statement” or “vision statement.” The draft
6 framework described the mission of the program in this way: “to conduct research resulting in
7 science and technology products that increase the EPA’s capability to meet its homeland
8 security responsibilities, thereby assisting communities’ (sic) build their resilience. The
9 program’s goal is to plan, execute and produce these products in close concert with our agency
10 partners so that the results of this program are used by these partners in implementing their
11 homeland security programs. A secondary goal of the program is to design research and it (sic)
12 products so that they address natural and inadvertent disasters to the greatest extent possible.”
13

14 The research framework identified five major themes:

- 15
- 16 A. Research to Help Protect Water Infrastructure against Attacks
- 17 B. Research to Improve Detection of Contamination and Mitigation of Exposure in
18 Water Systems
- 19 C. Research to Improve Characterization of the Nature and Extent of
20 Contamination
- 21 D. Research to Improve Risk Assessments and Communication
- 22 E. Research to Improve Cleanup of Contamination.
23

24 ***Alignment with regional and national program office needs.***

25
26 The Homeland Security program aligns with program and regional strategic goals within the
27 specific scope of the program’s mission and the framework describes an effective prioritization
28 process for identification of research focus areas. The Homeland Security program has
29 developed effective ongoing engagements with numerous stakeholders and partners, including
30 a formal program of continuous partner engagement. If budget cuts require effort reductions,
31 the prioritization process now in place should enable determination of what can be cut while
32 ensuring that the program continues to meet highest priority needs.
33

34 The Homeland Security Program is not as far along in developing its framework as the Safe
35 and Sustainable Water Resources program.
36

37 Regions that experience disasters, natural or anthropogenic in origin, can help with
38 identification of research needs for the Homeland Security Research Program in unique ways.
39 The program is well positioned to address natural disasters and is doing so in some ways
40 already. The program should consider expanding research and capabilities in relation to natural
41 disasters. There appear to be important needs and opportunities in several areas, including
42 climate change and adaptation.
43

1 ***ORD internal coordination and ability to catalyze and complement environmental science***
2 ***programs outside EPA.***
3

4 The Homeland Security model of coordination within and outside the EPA can be a model for
5 other areas. Within EPA, the program works with agency clients to plan, implement and
6 deliver useful science products. By the nature of its mission, the program actively coordinates
7 with the Department of Homeland Security, the Department of Defense, and the Centers for
8 Disease Control and Prevention. ORD should evaluate these processes to develop lessons
9 learned to apply to other ORD research programs.

10
11 ***Sustainability.***
12

13 The linkage of the Homeland Security research topics with sustainability is not transparent, but
14 the overall program objective of helping communities become more resilient is the
15 sustainability link. ORD should revise the research framework to explain this linkage more
16 clearly.
17

1 2.4. **Safe and Healthy Communities**

2 ***Background***

3
4 The draft research framework identified the following goal:

5
6 to inform and empower decision-makers to equitably weigh and integrate
7 human health, socio-economic, environmental, and ecological factors into their
8 decisions in a way that fosters community sustainability.

9
10 To achieve this goal SHC will provide information, approaches, and tools that
11 will help decision-makers in communities and in federal, state and tribal
12 regulatory and community-driven programs to more effectively and
13 transparently assess current conditions in the built and natural environments, to
14 evaluate the implications of alternative policies and management actions, and to
15 identify indicators to measure results.

16
17 The draft framework identified the following problems as the focus of attention:

18
19 Current trends in population and the way we use of energy, food, and materials
20 have created environmental threats to sustainability that include the erosion of
21 critical ecosystem services and the compromised ability of the environment to
22 tolerate increasing levels of pollution. While technological breakthroughs will
23 likely continue to slow some negative environmental trends, we still face many
24 challenging problems. Not only are human health and ecosystem services
25 negatively affected by cumulative exposures to multiple toxic pollutants and a
26 changing physical environment, these effects also have economic and social
27 implications, such as resultant costs for health care, cost for technologies to
28 replace some ecosystem services, and costs to enhance social justice, at scales
29 ranging from local to international. Because of the increasing pressures on the
30 environment, it is clear that future approaches to protecting human health and
31 the environment will not support sustainability over the long term if they:

- 32 • Fail to adequately consider the inextricable link between our natural
33 environment and human well-being, including economic and social
34 aspects;
 - 35 • Focus on regulating one energy or materials stream or chemical at a
36 time, rather than on preventative strategies or strategies that optimize
37 management of multiple chemical and energy streams in order to
38 achieve the most environmentally beneficial, cost-effective and socially
39 acceptable outcome; or
 - 40 • Lead to unintended consequences, or fail to produce valuable co-
41 benefits, because of a lack of systems thinking.
- 42

1 The draft framework identified three major themes:

2
3 Theme 1: Working with communities to develop comprehensive approaches to become
4 more sustainable.

5
6 Theme 2: Developing decision analysis methods, tools, models, data, and metrics that
7 support community sustainability.

8
9 Theme 3: Targeting high-priority agency research, i.e., Contaminated Site Management
10 and Restoration; Waste and Materials Management- Support for Regulations, Policy,
11 and Guidance; Nitrogen- Support for Regulation; Environmental Justice Topic;
12 Children’s Health; and the Report on the Environment.

13
14 ***General comments.***

15
16 The Sustainable and Health Communities research program is visionary; community-based
17 outreach and interactions are essential to sustainability. The new research area frames
18 environmental issues in positive terms and is not bound by narrow regulatory constraints. The
19 program has the potential to catalyze public support for environmental protection and for the
20 EPA. Several other aspects of the program also are unique: 1) it focuses on the local or
21 community level (rather than on national-level issues) because it is place-based; 2) it takes a
22 holistic, systems perspective; and 3) it focuses on stakeholder participation and collaboration.
23 Because this program is novel and ambitious, it requires a great deal of new and challenging
24 research on place-based environmental problems and social, behavioral, and decision science
25 issues. However, ORD does not possess the required expertise, especially in social, behavioral
26 and decision sciences to address this need.

27
28 The SAB and BOSC understand the value of providing decision support for communities
29 (“empowering” local decision making), but find that the draft framework is vague, lacks focus
30 and does not describe the decision-makers/stakeholders or discuss whether the objectives of
31 decision-makers necessarily reflect community objectives. Essential questions regarding the
32 definition of the relevant community and whether community objectives align with broader
33 national objectives are not identified, much less answered, in the document.

34
35 The framework should articulate a clearer vision for ORD’s role in providing assistance to
36 communities. In its current form, it is not clear whether ORD plans to provide decision tools or
37 technical support at some initial phase or whether it plans to be an active participant in
38 implementing tools. ORD does not currently have experience or expertise in community-based
39 implementation. ORD will need to develop both if it intends to be active implementing
40 environmental tools in communities. The framework should describe clear expectations for
41 ORD’s planned community work, as well as an exit strategy so readers will understand the
42 extent of the commitment by ORD to actively engage with communities.

43
44 The nature and level of integration of research across the three themes within the Sustainable
45 and Health Communities program is unclear. The three themes represent very different kinds
46 of activities and include “cutting edge” research, as well as support of “conventional”
47 regulatory mandates. Theme 1 is the most innovative but will receive less than ten percent of

1 the program's resources initially. EPA's commitment to this novel activity must be robust and
2 sustained for the program to take root and grow.

3
4 Finally, the Sustainable and Healthy Communities program includes essentially all of the
5 ecological research in ORD. As such, there is a need to support ecosystem science within this
6 program. Ecosystem services and benefits are contained as one component, among others, in
7 Theme 2 of the SHC Research Program. The draft framework contains no discussion of
8 ecosystem science apart from ecosystem services and benefits. This particular branch of
9 science is necessary to understand ecosystem services and benefits and appears to be under-
10 funded and under-emphasized in the proposed research structure.

11
12 Ecosystem science, which has seen a continued decline over the past decade, has been reduced
13 to only \$60 million, about ten percent of the ORD budget. Ecosystem science is vitally
14 important for understanding how ecosystems function. From the perspective of EPA,
15 ecological research is important for understanding ecological processes that underlie healthy
16 ecosystems and the quality and quantity of the services offered by ecosystems to communities.
17 In addition to understanding ecological processes, there is important ecological and social
18 science research needed to translate ecological processes to ecosystem services, to analyze the
19 benefits to the community of these services and to predict the changes in the provision of
20 services that would result from various actions/policies/behaviors.

21
22 Consequently, the SAB and BOSC strongly recommend increased support for ecosystem
23 research by ORD.

24
25 ***Alignment with regional and national program office needs.***

26
27 The Sustainable and Health Communities program clearly reflects an effort to integrate the
28 Administrator's top priorities at the community level. Within the program, areas for increased
29 emphasis might include children's health; social, behavioral and decision science research; and
30 epigenetics to provide markers of exposure to chemicals. Integrated transdisciplinary research
31 and coordination across ORD programs should provide efficiency. ORD may identify areas for
32 reduced emphasis if it finds that other agencies' environmental research programs can
33 complement EPA's research efforts.

34
35 ***ORD internal coordination.***

36
37 The Sustainable and Health Communities program can serve an essential coordinating role for
38 ORD by working with communities to define sustainability goals and framing problems in
39 terms of a broad systems approach that reduces media-specific and disciplinary silos. One
40 vision for the program is for it to use, test, and evaluate research products from other ORD
41 programs and provide feedback to guide more focused research from those programs in the
42 future. The program can help integrate environmental research and problem solving at the
43 national and local levels. ORD should revise the draft framework for the Sustainable and
44 Health Communities program to describe its role within ORD more clearly and consider some
45 of the functions described above.

1 ***Sustainability.***
2

3 At a theoretical level, the Sustainable and Health Community program directly reflects ORD's
4 commitment to sustainably protect human health and the environment. The SAB and BOSC's
5 introductory general comments in this section, however, identify concerns about how this
6 program will be operationalized at the community level and concerns about possible
7 misalignment between local and national perspectives.
8

9 ***Capacity to address current and future critical environmental issues.***
10

11 This visionary program potentially would have the capacity to address current and future
12 critical environmental issues, but it will need to identify clearly where ORD will provide
13 leadership and where it will play a supporting role in addressing issues. Success in
14 implementing activities related to Theme 1 depends on effective partnerships with other
15 agencies and nongovernmental organizations as they work with communities to address high
16 priority issues.
17

18 As noted above, the Sustainable and Health Communities program may not necessarily align
19 with national priorities if goals of communities differ from national priorities.
20

21 ***Ability to catalyze and complement environmental science programs outside EPA.***
22

23 ORD's progress in adopting integrated transdisciplinary research is consistent with momentum
24 elsewhere to pursue such integrated approaches. ORD has made a positive commitment to
25 focus on ecosystem services and has developed important partnerships with other agencies and
26 nongovernment organizations. There are, however, significant additional opportunities to work
27 with other countries and international research organizations to advance ecosystem science and
28 research and bring these results to EPA and local decision makers. Current and emerging
29 international initiatives are described in the recent Report to the President *Sustaining*
30 *Environmental Capital, Protecting Society and the Economy* (President's Council of Advisors
31 on Science and Technology, 2011).
32

33 There are also opportunities to complement and leverage research with the Department of
34 Energy and Department of Defense on site contamination and cleanup issues and to explore
35 partnerships with non-governmental organizations that that work closely with communities.
36

37 One area for focus is to develop effective mechanism for catalyzing, complementing and
38 leveraging research in the social, behavioral and decision sciences. ORD should explore new
39 opportunities to partner with the National Science Foundation to support extramural research in
40 this area and to serve as a clearinghouse for community-level data and metrics related to
41 sustainability (e.g., "urban metabolism").
42

1 ***Innovation.***
2

3 Community-based research offers a wide variety of new opportunities for innovation. ORD
4 should promote opportunities for community-based data collection, monitoring and reporting,
5 subject to standard quality controls. The Sustainable and Healthy Communities program would
6 benefit from investments in related technological innovation, such as hand-held monitoring
7 devices or mobile phone applications for collecting and transmitting environmental or public
8 health data. Such new technologies would involve new ways to engage communities, which
9 would be a focus of innovative social, behavioral and decision science research in itself.
10

11 ***Social, behavioral and decision sciences.***
12

13 The Sustainable and Healthy Communities program offers many potential roles for social,
14 behavioral, and decision sciences. Such sciences can help with: 1) problem formulation,
15 development of systems perspectives, and identification of alternatives; 2) engagement in
16 participatory processes; 3) understanding behavior, behavioral responses and incentives; and 4)
17 evaluation of alternative options and tradeoffs (e.g., impact analysis, benefit-cost analysis).
18 Research on this topic is essential to the success of the program. ORD, however, does not
19 currently have the capacity, internally or through external funding, to conduct this research.
20

21 It will be important for ORD to explore how other agencies (e.g., the Forest Service; U.S.
22 Department of Agriculture; the Department of the Interior management of wildfire risks; and
23 the National Oceanic and Atmospheric Administration and the National Park Service) have
24 engaged social, behavioral, and decision scientists in place-based environmental decisions.
25 Section 3 of this report describes how ORD might begin to develop a capability in these
26 disciplines and access expertise outside EPA.
27

1 **2.5. Chemical Safety for Sustainability and Human Health Risk Assessment**

2 ***Background***

3
4 Because these two research programs are so closely inter-related and such significant overlap,
5 the SAB and BOSC provide the following consolidated discussion of ORD’s draft frameworks
6 for these programs.

7
8 The draft research framework for the Chemical Safety for Sustainability program identified the
9 following problem statement:

10
11 Although chemicals are essential to modern life, we lack innovative, systematic,
12 effective, and efficient approaches and tools to inform decisions that reduce the
13 environmental and societal impact of chemicals while increasing economic
14 value.

15
16 The vision articulated in the framework is:

17
18 EPA science will lead the sustainable development, use, and assessment of
19 chemicals by developing and applying integrated chemical evaluation strategies
20 and decision-support tools.

21
22 The Chemical Safety for Sustainability identified the following objectives:

- 23
24
- Creating tools that inform sustainable chemical/material design and use
 - Developing methods for much faster screening and prioritizing
 - Providing the scientific knowledge and tools to effectively understand real-world risks
 - Developing assessment approaches that are tailored to specific decision contexts
 - Considering where impacts may occur throughout a chemical’s life cycle.
- 28
29
30

31 The draft framework for the Human Health Risk Assessment program identified the following
32 problem statement:

33
34 Agency decisions must be based on defensible scientific evaluations of data
35 relevant to assessing human health impacts. Currently, the demand for such
36 assessments is not being fully met, particularly in terms of the number of
37 existing and new chemicals in need of assessment, the types of risk
38 characterization outputs needed to inform decision making, and the tools and
39 data needed to support assessments.

40
41 The vision articulated in the framework is:

42
43 The Agency will generate timely, credible human health risk assessments to
44 support all priority Agency risk management decisions, thereby enabling the
45 Agency to better predict and prevent risk.

1 The four primary themes of the Human Health Risk Assessment program are:

- 2
- 3 • Integrated Risk Information System (IRIS) health hazard and dose-response
- 4 assessments;
- 5 • Integrated Science Assessments (ISA) of Criteria Air Pollutants;
- 6 • Community Risk and Technical Support for exposure and health assessments;
- 7 and
- 8 • Methods, models, and approaches to modernize risk assessment for the 21st
- 9 century

10

11 *Alignment with regional and national program office needs.*

12

13 In general, the draft framework documents were written from a theoretical perspective. The

14 SAB and BOSC recommend that ORD revise the documents so they more clearly

15 communicate the intended research and its strategic science priorities. The term “sustainable”

16 and its derivative forms were used in different ways in the draft documents and there was little

17 explanation of their meaning. It would be useful to define this term as it is employed in the

18 documents. In addition, there were several other definitional problems, e.g., inherency, etc.,

19 that have internal meaning at EPA but are not well known to others. The SAB and BOSC

20 recommend that the terms employed in the framework documents be fully defined in concise,

21 operational ways.

22

23 It is evident that ORD is increasing efforts to collaborate internally across research programs

24 and across program and regional offices. This collaboration promotes alignment between

25 ORD’s programs and regional and program office needs. To illustrate this alignment, ORD

26 should identify more clearly where there are novel science products that will be developed

27 because of this coordination/alignment with regional and program office stakeholders and how

28 these outputs would be measured.

29

30 Regarding prioritizing programs for increased or decreased emphasis, the SAB and BOSC

31 recommend that ORD conduct analyses to help develop criteria for prioritization. One type of

32 analysis could help identify data gaps and prioritize research based on scheduled regulatory

33 needs and other deadlines. Once such analyses are conducted, ORD should define clear short-

34 term and long-term goals that can be measured with respect to what is to be achieved, the

35 resources required and the timetable needed. In addition, because it is difficult to predict

36 specific environmental issues for the future, it will be important to have a focused and well-

37 defined path for strategic and rapid responses to emergencies. An analysis of the lessons

38 learned from the 2010 Deepwater Horizon oil spill may help identify gaps. ORD should also

39 conduct or support social, behavioral and decision science research and analyses to understand

40 the public’s perception of uncertainty and risk assessment. Shedding light on public attitudes

41 and knowledge will enable the agency to communicate environmental science more

42 effectively.

43

44 The draft frameworks should better articulate social, behavioral, economic and decision

45 science needs because these will assist the agency in linking priorities to desired outcomes.

46 This should be emphasized regardless of resources.

47

1 Streamlining across agencies (e.g., Food and Drug Administration, U.S. Department of
2 Agriculture; Food and Drug Administration; U.S. Geological Survey, National Institutes of
3 Health; National Center for Toxicological Research; National Toxicology Program, and
4 National Institutes of Health) should continue so that redundancy is minimized. Collaborative
5 efforts need to be defined and the process transparent to minimize any tendency for
6 compartmentalization (i.e., creating ‘turf lines’ or stovepipes). Collaborations such as Tox21
7 will provide a better ability to leverage the resources of various agencies toward the EPA
8 mission. This may require a common lexicon to be developed across agencies.

9
10 Given EPA’s role as a leader in environmental research, extramural research is an important
11 way for the agency to tap the talent and enhance innovation at universities and other research
12 institutions. Extramural research will increase the EPA’s ability to react flexibly to changes in
13 priorities and associated personnel expertise needs. SAB and BOSC, however, note that
14 extramural programs should not be undertaken in *lieu* of or at the expense of EPA’s intramural
15 research activities.

16
17 ***ORD internal coordination.***

18
19 Social, behavioral and decision sciences should be specifically articulated in both the Chemical
20 Safety for Sustainability and Human Health Risk Assessment frameworks. For instance, in
21 sections discussing risk assessment, it should be noted that research could provide some
22 answers to the agency’s understanding of how the public perceives “exposure” versus
23 “contamination.” The EPA has spent a great deal of time and effort to get the technical science
24 right, but if the public does not understand the basics of how the agency makes its decisions
25 and misunderstands concepts like “uncertainty,” the agency will work against the very public it
26 seeks to protect. The Human Health Research Assessment program may be able to foster
27 greater public understanding of EPA risk assessment by adding new information to the
28 Integrated Risk Information System process, as recommended by the NRC 2009 report *Science*
29 *and Decisions*. Providing for public input into the design of a risk assessment in its formative
30 stages or exploring how assessments can be used to evaluate the relative merits of various
31 options for managing risk can help people understand ORD products and use them more
32 effectively. The first step is to understand where citizens are with their thinking about chemical
33 safety and risk assessment. The next steps are to address those gaps appropriately.

34
35 ***Ability to catalyze and complement environmental science programs outside EPA.***

36
37 EPA is a clear leader in the fields of environmental sciences – both in terms of technology
38 development and in terms of research in a wide variety of fields that support the technology.
39 For a variety of reasons, academia and industry have fallen behind and it is important for EPA
40 to support and enhance current efforts. This could be enhanced with focused extramural grants
41 on topics of translational or targeted science. In the area of toxicity testing, the National Center
42 for Computational Toxicology (NCCT) has made a significant effort to develop collaborative
43 and complementary efforts with other federal agencies (i.e., Tox21) and European partners
44 (e.g., the Joint Research Center in Ispra, Italy). This level of effort and coordination needs to be
45 extended to other ORD research endeavors.

1 ORD's research programs are generating novel scientific information that is not yet used in
2 regulatory programs. Mechanisms need be developed to bridge this gap between ORD's
3 innovative work and the scientific information actually used for decision making. There is a
4 need for both the translation of this work into risk assessment as well as the incorporation of
5 this work into guidelines employed by risk assessors. There should also be more coordination
6 between the Chemical Safety for Sustainability program with programs such as Design for the
7 Environment to enhance the activities of each.

8

9 The SAB and BOSC recommend that ORD explore mechanisms for industry-government
10 collaboration. There are good examples of industry-government collaboration in Europe,
11 Australia and New Zealand (see the website for the European Union Enterprise and Industry
12 and Australian Government 2011 innovation report). Such collaboration might be a useful
13 model for the agency to explore. For a U.S. example of effective collaboration, see the
14 American Council for Technology Industry Advisory Council 2011 website. The Human
15 Health Risk Assessment program might also seek ways to reduce controversy between industry
16 and government over individual risk assessments. New procedures and/or communicate efforts
17 to inform and engage industry could have benefits could possibly stimulate industry funding of
18 toxicology research programs in academic institutions and strengthen the nation's overall
19 environmental research capability.

3. Expanding ORD Capabilities in Social, Behavioral, and Decision Sciences

The SAB,¹ BOSC and other science advisory bodies² have over several decades repeatedly recommended expansion of social, behavioral and decision sciences expertise at EPA. To protect human health and the environment, the EPA has traditionally focused on risks from single pollutants in a single medium addressed through end-of-pipe technical controls and the specification of standards. As the focus has shifted to mixtures of multiple-pollutants interacting through multiple environmental media to affect particular individuals and communities, new research is needed to support appropriate and effective policies. This research must, for example, address the impacts of human behavior on the production, use, dispersion and disposal of pollutant mixtures, variations in individual and community

¹ Recent advice related to social, behavioral, and decision science from the SAB:

- *Science Advisory Board Comments on the President's Requested FY 2012 Research Budget* (EPA-SAB-11-007)
- *Office of Research and Development Strategic Research Directions and Integrated Transdisciplinary Research* (EPA-SAB-10-010);
- *Valuing the Protection of Ecological Systems and Services* (EPA-SAB-09-012);
- EPA's Strategic Research Directions 2008: An Advisory by the EPA Science Advisory Board (EPA-SAB-09-006);
- *Comments on EPA's Strategic Research Directions and Research Budget for FY 2008 - An Advisory Report of the U.S. Environmental Protection Agency Science Advisory Board* (EPA-SAB-07-004);
- *Science and Research Budgets for the U.S. Environmental Protection Agency for Fiscal Year 2007; An Advisory Report by the Science Advisory Board* (EPA-SAB-ADV-06-003);
- *Science and Research Budgets for the U.S. Environmental Protection Agency (EPA) for Fiscal Year 2006 - An Advisory Report by the EPA Science Advisory Board* (EPA-SAB-ADV-05-002);
- *Advisory Report on the Science and Research Budgets for the U.S. Environmental Protection Agency Fiscal Year 2005; A Report by the EPA Science Advisory Board* (EPA-SAB-ADV-04-003);
- *Toward Integrated Environmental Decision-Making* (EPA-SAB-EC-00-011)

² Selected National Research Council reports related to social, behavioral and decision science at EPA:

- *New Directions in Climate Change Vulnerability, Impacts, and Adaptation Assessment: Summary of a Workshop* (2008) With effective climate change mitigation policies still under development, and with even the most aggressive proposals unable to halt climate change immediately, many decision makers are focusing unprecedented attention on the need for strategies to adapt to climate changes that are now unavoidable.
- *Population, Land Use, and Environment: Research Directions* (2005) reviews knowledge on interactions between demographic and environmental changes mediated by land use and recommends research directions.
- *Decision Making for the Environment: Social and Behavioral Science Research Priorities* (2005) identifies five areas of high priority research that can contribute to improved decisions affecting environmental quality.
- *Human Interactions with the Carbon Cycle: Summary of a Workshop* (2002) reports on discussions of promising research issues linking social science and natural science analyses of the carbon cycle.
- *Human Dimensions of Global Environmental Change: Research Pathways for the Next Decade* (1999) presents a state-of-the-field review and set of research imperatives.
- *Research Needs and Modes of Support for the Human Dimensions of Global Change* (1994) led NSF to support a collection of centers and research teams.

1 exposures and susceptibility to toxins, and impacts on the capacity of supporting ecosystems to
2 absorb and transform toxins to less hazardous or even beneficial forms.

3
4 The SAB and BOSC review of ORD's draft 2011 research frameworks reinforces prior
5 recommendations for expansion of ORD's social, behavioral, and decision science capabilities.
6 The transformation of ORD to a transdisciplinary systems-oriented approach centered on
7 sustainability requires a balanced program of research that integrates environmental (natural)
8 sciences with economic and social sciences, and ORD capabilities in the last two areas
9 continue to be grossly inadequate. Specific needs for social, behavioral and decision sciences
10 were identified for each of the individual program areas along with "cross-cutting" needs
11 relevant to all program areas. The following summarizes SAB and BOSC responses to four key
12 questions relating to social, behavioral and decision sciences in ORD:

- 14 1. What specific roles should social, behavioral and decision sciences fill in
15 meeting science/decision support responsibilities relevant to the realigned ORD
16 research programs (i.e., what might social, behavioral and decision scientists
17 do)?
- 18 2. What specific sub-disciplines/fields of social, behavioral and decision sciences
19 might best meet identified research and decision support needs?
- 20 3. Where might individuals having the relevant types of training, experience and
21 expertise be found (e.g., what types of academic programs, research
22 organizations, etc)?
- 23 4. How might social, behavioral and decision sciences best be organized and
24 supported within the EPA/ORD research and development programs and
25 systems?

27 ***Specific roles social, behavioral and decision scientist might play in ORD***

28
29 At the broadest level two general roles were identified for social, behavioral and decision
30 scientists. First, as addressed by the ORD/BOSC workshop on applications of decision
31 sciences (March 2009), social, behavioral, and decision science principles and expertise could
32 be used to improve the way ORD decides, plans and implements its own research activities.
33 For example, social, behavioral, and decision science could be productively applied to
34 elucidate and manage the often problematic boundary between science and policy and to
35 identify and investigate alternative innovative ways to achieve policy goals. Second, social,
36 behavioral, and decision science expertise is needed to support the various specific ORD
37 research and decision support activities carried out within and across the six major program
38 areas by systematically investigating individual, community and institutional values,
39 perceptions, motivations, knowledge, beliefs and behaviors that affect, and are affected by,
40 EPA efforts to protect human health and the environment.

41
42 There are numerous areas in which specific social, behavioral, and decision science research
43 and expertise are needed. The most common areas for application of these sciences were:

- 44
45 • Perception/understanding of environmental risks and of mitigation alternatives,
46 including awareness, knowledge and feelings associated with particular
47 environmental risks and policy situations;

- 1 • Communication/education affecting understandings, feelings and actions
2 relevant to protecting human health and the environment generally and for
3 particular environmental policy contexts;
- 4 • Judgment and decision making, including both rational and emotional
5 components;
- 6 • Behavior change for individuals, communities and institutions to foster and
7 sustain support for agreed upon policy goals; and
- 8 • Values, motives and world views that discriminate among various
9 constituencies/stakeholders and affect their preferences for and reactions to
10 alternative environmental policies.

11
12 These potential roles for social, behavioral, and decision sciences are quite consistent with and
13 reinforce the conclusions arrived at independently by an ORD National Center for
14 Environmental Research Behavioral/Social Science Town Hall held on June 7-8, 2011.

15
16 ***Specific sub-disciplines/fields of social, behavioral and decision science that might best meet***
17 ***identified research and decision support needs***

18 Social, behavioral, and decision sciences encompass a large and diverse set of disciplines. Each
19 major discipline includes many sub-disciplines and only a small portion of any social,
20 behavioral, and decision science capabilities discipline is devoted to (or relevant to) the
21 protection of human health and the environment as defined within the authorities and
22 aspirations of EPA. Thus, ORD should be quite selective in recruiting the social, behavioral,
23 and decision scientists to help meet the research and decision support needs identified above.
24 Moreover, the social, behavioral and decision scientists must be capable of working effectively
25 in a professional context that by tradition and by legislative authority emphasizes
26 physical/chemical/biological sciences. The success of the ORD effort to effectively develop,
27 integrate and nourish social, behavioral and decision science capabilities depends jointly on the
28 general success of the transformation toward a truly transdisciplinary systems oriented research
29 organization and on the selection of the individual social, behavioral and decision scientists
30 who will enthusiastically join and effectively work within that organization.

31 A list of disciplines and sub-disciplines potentially appropriate to ORD social, behavioral and
32 decision science needs is presented below in Table 1. This list is not comprehensive, but at the
33 same time it is also too long to be of much use in actual recruitment efforts, especially given
34 current constraints. The availability of scientists with relevant expertise and interests within
35 each sub-discipline varies as does the current representation within ORD (ranging from none in
36 most cases to a few in the case of economics, for example). Additional ORD interactions with
37 the SAB and BOSC could help to extend, prune, refine and most importantly prioritize this list.

38

1 **Table 1: Initial list of relevant social, behavioral and decision science disciplines and sub-**
 2 **disciplines**

Discipline	Sub-disciplines
Psychology	environmental perception, pro-environmental behavior, risk perception, attitude assessment, attitude-behavior associations, environmental beliefs
Sociology	social impact analysis, diffusion of innovation, social networking, social capital assessment/development, social influence, compliance processes, community involvement
Decision sciences	judgment, decision making, value construction, deliberative group decision making, tradeoff identification/negotiation,
Communication	persuasive communications, science communication, strategic communications, public relations/affairs
Education	environmental education, environmental interpretation
Political science	public policy, environmental policy, institutional behavior, inter-governmental relations
Geography	hazard perception, environmental hazard mitigation, demographics,
Economics	applied economics, ecological economics, resource economics, agricultural economics, behavioral economics

3
 4 ***Where ORD might find scientists with the relevant types of training, experience, expertise***
 5 ***and interests be found (e.g., what types of academic programs, government agencies,***
 6 ***research organizations, etc)?***

7
 8 There are social, behavioral and decision scientists working in many academic, government
 9 and private research and application contexts, any of which might be a productive source for
 10 filling ORD’s needs. However, it is more likely that appropriate individuals will be found in
 11 interdisciplinary programs that specifically include collaborative education, research and
 12 applications related to environmental science and policy. Several federal agencies have
 13 considerably more experience with the development and use of social, behavioral and decision
 14 science, including the Department of Agriculture (notably the Agricultural Extension Service
 15 and the Forest Service) and the National Oceanic and Atmospheric Administration, which
 16 recently expanded and integrated social, behavioral and decision science into its Sea Grant
 17 program and its Regional Integrated Science and Assessment (RISA) grants program. Applied
 18 economics departments, integrated environmental science and policy/management programs,
 19 engineering programs that provide opportunities for minors in sustainability/social
 20 sciences/law, as well as the National Science Foundation-funded Integrated Graduate
 21 Education and Research Training (IGERT) programs are likely sources. A few specific
 22 programs (by no means a comprehensive list) that could be sources of relevant social,
 23 behavioral and decision scientists include Columbia University’s Center for Research on
 24 Environmental Decisions (CRED), the Annenberg School of Communications at the University
 25 of Southern California, a program in behavior change theory at the University of Minnesota,
 26 and several programs at Carnegie Mellon University that allow natural scientists and engineers
 27 to add social science skills (or social scientists to add engineering or natural science skills).
 28 Several members suggested scanning the editorial boards and the authors publishing in relevant
 29 interdisciplinary journals, including but not limited to *Journal of Environmental Psychology*,
 30 *Journal of Environmental Economics and Management*, *Society and Natural Resources*,

1 *Journal of Risk and Uncertainty*, and *Risk Analysis* as a way to develop lists of potential
2 individuals and institutions.

3
4 ***How might social, behavioral and decision science best be organized and supported within***
5 ***ORD?***
6

7 The SAB and BOSC recommend that ORD have some full time, in-house expertise in social,
8 behavioral and decision science. At the very least, such individuals are needed to access and
9 properly interpret existing social, behavioral and decision science principles and data relevant
10 to ORD’s mission, as well as to guide ORD toward the development of useful new social,
11 behavioral and decision science information and science. The SAB and BOSC have little
12 enthusiasm (or optimism) for the development of a separate social, behavioral and decision
13 science program within ORD. The greatest consensus was for a cross-cutting organization,
14 with social, behavioral and decision science supported within each of the major programs.
15 Several members suggested that there should be at least one social, behavioral and decision
16 scientist at a relatively senior level in each of the six ORD research program areas. These
17 individuals would be charged with directing social, behavioral and decision science activities
18 in their assigned program and work regularly with the social, behavioral and decision scientists
19 in other programs to coordinate social, behavioral and decision science activities across ORD.
20 To effectively integrate social, behavioral and decision science in the realigned ORD research
21 programs, social scientists will need to be involved in problem formulation and in the design,
22 development and implementation of all research and decision support efforts. The SAB and
23 BOSC recommend that ORD address the needs for a “critical mass” and for physical proximity
24 and effective communication among the social, behavioral and decision scientists. Performance
25 evaluation and reward programs should recognize the special cross-cutting roles of social,
26 behavioral and decision scientists.

27
28 Additional social, behavioral and decision scientists for specific projects could be recruited
29 through post doctoral appointments and, at a more senior level, through targeted sabbatical
30 leave support and/or special government employee programs or other visiting or temporary
31 appointment procedures. For longer-term development of social, behavioral and decision
32 science capacity directly relevant to EPA, ORD should increase its support of relevant extra-
33 mural social, behavioral and decision science research grants and other programs that
34 encourage development of educational programs that provide skills and experiences needed by
35 social, behavioral and decision scientists who might work in the EPA context.

36
37 It was generally assumed, and generally supported, that ORD should develop and shape its
38 social, behavioral and decision science capabilities over time, learning as it goes about EPA’s
39 greatest social, behavioral, and decision science needs are and how best to fill them. At the
40 same time, consensus was very strong that this process needs to start now! Members of the
41 SAB and the BOSC expressed a strong interest and willingness to assist ORD in meeting
42 social, behavioral and decision science needs that have been apparent for some time.
43

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