

**Summary Minutes**  
**US Environmental Protection Agency Science Advisory Board**  
**Meeting**

**Public Teleconference Meeting**

**July 28, 2008**

**1:00 pm – 5:00 pm (Eastern Time)**

**Meeting Location: Via Telephone Only**

**Purpose of the Meeting:** The Meeting was held to allow for the Chartered SAB to continue discussions of the topics on the agenda and as discussed further below, as well as to approve the one draft SAB report. The meeting agenda is in Attachment A. The list of SAB and other participants follows.

**Meeting Participants:**

**Members Participating in the Meeting:**

Dr. M. Granger Morgan, Chair

Dr. James Bus

Dr. David Dzombak

Dr. James Galloway

Dr. Rogene Henderson

Dr. Bernd Kahn

Dr. George Lambert

Dr. Mike McFarland

Dr. Jana Milford

Mr. David Rejeski

Dr. James Sanders

Dr. V. Kerry Smith

Dr. Thomas Theis

Dr. Lauren Zeise

Dr. Thomas Burke

Dr. Deborah Cory-Slechta

Dr. Baruch Fischhoff

Dr. Steve Heeringa

Dr. James Johnson

Dr. Cathy Kling

Dr. Jill Lipoti

Dr. Judith Meyer

Dr. Rebecca Parkin

Dr. Steve Roberts

Dr. Kristin Shrader-Frechette

Dr. Deborah Swackhamer

Dr. Valerie Thomas

**Members of the SAB Staff Office:**

Dr. Vanessa Vu,

Dr. Thomas Armitage

Mr. Thomas Miller

Dr. Angela Nugent

**Members of EPA and the Public:**

Dr. Rick Linthurst, US EPA ORD

Dr. Wayne Mounts, US EPA ORD

Dr. William Benson, US EPA ORD

Mr. Steve Via, AWWA

Dr. Kevin Teichman, US EPA ORD

Dr. Iris Goodman, US EPA ORD

Ms. Alicia Mariscal, US EPA OIG

## **MEETING SUMMARY**

**Monday, July 28, 2008**

This meeting was announced in the *Federal Register* (see 73 FR p 39961 of July 11, 2008 - Attachment B). The SAB Roster is in Attachment C.

**1. Convene the Meeting:** The DFO convened the meeting noting that it was a federal advisory committee meeting and that the Board's deliberations are held as "public meetings" pursuant to the Federal Advisory Committee Act (FACA), its regulations, and the policies of the US EPA for advisory activities. Mr. Miller noted that no member of the public had requested time to speak nor provided written input for the Board's consideration for the topics to be discussed at the meeting. He noted that SAB members must comply with Federal ethics and conflict-of-interest laws and that SAB ethics officials review relevant information to ensure that SAB panels reflect appropriate balance and that COI and bias issues are addressed and that the SAB members participating in this meeting had submitted information on whether they knew of any potential appearance of impartiality issues that could link them with the topics on the agenda. As a result of those responses, SAB Ethics Officials determined that Members on the call do not have any such issues within the meaning of the relevant ethics and conflict of interest requirements that apply to this advisory activity. One member did recuse himself from participating in the topic on the ecological services MYP review because of the potential for appearance concerns. Mr. Miller thanked the Board for their willingness to work in teleconference mode for such a long time and then turned the meeting over to the SAB Chair, Dr. M. Granger Morgan, to carry out the agenda.

**2. Discussion of the SAB Draft Advisory on EPA's Environmental Disaster Resposne**  
**Science Support:** After noting the items on the agenda for the day, Dr. Morgan started the Board's discussion of its draft report "Preparing for Environmental Disasters" (see Attachment D). Dr. Morgan noted that the previous draft had been revised to reflect comments received from Board members as well as some reflections and additional information from Ms. Debbie Dietrich, Director, EPA OEM. Additional SAB Member comments are in Attachment E. Dr. Morgan noted that he could do a revised document to respond to most of the comments given and asked those providing written comments if they had any issues to highlight for further discussion. Items raised were: a) a suggestion of a shorter letter; b) the need for the report even though EPA is doing quite a lot of additional work in this area; c) how inclusive to be in the SAB recommendations placed in the letter to the Administrator; d) the need for EPA to document more thoroughly the justification for certain advice given on "acceptable" levels of contaminants subsequent to an event; and the importance of sending the SAB advisory to make it clear that these are broader, and additional things that we are suggesting beyond what EPA is currently working on.

With that, the Chair asked for a motion and a vote on approval of the draft contingent upon further edits by Dr. Morgan to respond to the discussions and written comments provided by Members. A motion was made for such approval, seconded and voted upon with no members dissenting.

**ACTION:** Dr. Morgan will revise the draft, send it to Drs. Baruch Fischhoff, James Johnson, and Jill Lipoti for final review. Once they approve, the letter will be forwarded to the Administrator.

### **3. Quality Review of the Draft Report on EPA's Ecological Research Program Multi-Year**

**Plan:** The Board conducted its quality review of the draft SAB EPEC advisory on *EPA's Ecological Research Program Multi-Year Plan* (see Attachment F). At the Chair's request, Dr. Judy Meyer summarized the EPA Multi-year plan, the EPA charge, and highlights of the draft EPEC advisory report.

SAB Member comments are compiled in Attachment G. Dr. Morgan asked for the Lead Reviewers to highlight any concerns they had with the draft report. All Lead Reviewers referred to their written comments for more details and highlighted only several points from those comments. Dr. Judy Meyer noted that she, and the DFO, had prepared responses to the SAB Member comments in order to facilitate the discussion during this meeting. They are included in Attachment H. Comments that were highlighted for discussion by the lead reviewers follow.

- a) Dr. Swackhamer: The bullets in the executive summary don't map well to the letter and the text. Regarding LTG3, it appears from your responses that EPEC is backing off its stronger stance on reactive nitrogen. Dr. Meyer noted that work on consistency across the letter, executive summary and text would be done. Regarding reactive nitrogen, she noted that the original was done without the benefit of input from the EPEC panelists who also sit on the Integrated Nitrogen Committee. The revisions reflect input they provided during the Board comment period, as well as those from Drs. Galloway and Theis who are Chair and Member of the INC respectively. Drs. Galloway and Theis noted that they were more comfortable with the Panel's conclusions in view of the proposed changes in regard to reactive nitrogen.
- b) Dr. McFarland: He deferred to his written comments and noted that the responses provided by EPEC fully satisfied his concerns.
- c) Dr. Kling: She deferred to her written comments and noted that she was happy with the responses provided by EPEC.
- d) Dr. Morgan asked for clarification of the intent of the plan. Is it to convey an inclusive vision of research needs or just those things that EPA would do? The way in which we comment should vary depending on the intent. Dr. Linthurst, ORD, noted that the plan is intended to capture the vision of needs in the broad sense. The next EPA document, the implementation plan, will begin to reflect what EPA believes it can accomplish itself. The plan can provide information to others on what the full agency needs are in this regard.
- e) Other Comments: Dr. Morgan noted that from the body of comments provided by Members, a number of themes, which seem to have a common cause – under-investment – stand out. These are:
  - i) Negative comments regarding the potential value of decision support platforms: The main issue is whether EPA can successfully accomplish such a program with its limited in-house expertise in decision and behavioral sciences and additionally whether the strategy is a wise inclusion when there are many remaining research needs in ecological research itself. Some thought that the lack of expertise was reason to

suggest decision support platforms be dropped from the Plan altogether. However, Dr. Meyer pointed out that this would be counter to the EPEC desires for the topic which recognizes the limitations to EPA's ability to carry out the program, nonetheless its an important part of the vision of research needs in the broader sense. The panel will ensure that the reservations are clearly registered in the report.

- ii) Opportunity costs associated with the “new” directions proposed for EPA’s eco-research program deemphasize types of ecological research that is still needed: The EPEC responses handle much of the concern in this area; however, also using the terms “strongly support the plan” in the letter seems inconsistent with so many reservations that have been noted in the draft advisory. Factually, the Agency has stated that it has no extramural resources in its ecological grants area, thus it would seem that even if it was included as needed work that it could not be pursued. Dr. Meyer will note the “opportunity cost” issue in revisions to the report.
- iii) Whether the research vision described in the MYP truly could be transformative given the substantial reservations registered by the EPEC: Another issue linked to the severely limited resources associated with the plan is how the program can be transformative. Dr. Meyer noted that the vision reflected in the MYP describes ecological research (“eco-services”) that has not been broadly done before and, if it can be implemented, EPEC believes that it will have a transformative affect. Dr. Meyer will clarify that this transformation can only occur if EPA properly funds the program.
- iv) The justification for adding education and outreach topics to a plan that is already under funded in its core activities: Another related issues is with including “education and outreach” efforts to a program that is already under funded in the research phases. This will be clarified in the letter, along with the other items above that shed lights on a major factor that impacts the potential for success to this program --, that is, the severe resource constraints associated with the ecological research program at EPA. This will be done in a way that preserves EPEC’s view of the importance of these programs to the vision of ecological research needs at EPA.

Dr. Morgan asked for a motion in regard to the draft report. The motion was made and seconded to approve the draft advisory subject to edits to the report consistent with the comments provided herein. A vote was taken to approve the report. All but two members of the Board who participated in the call voted to approve. Two voted not to approve.

**ACTION:** Dr. Meyer, and Dr. Thomas Armitage (DFO), will revise the advisory to reflect the edits discussed in and the written comments and the agreements made during this conference call. Dr. Morgan will assist with changes to the letter to the Administrator. The revised advisory will be reviewed by the following Vectors: Drs. Swackhamer, McFarland, Kling, and Galloway. If the

Vettors agree that the revisions are consistent with the Boards approval conditions, it will be finalized and sent forward to the Administrator.

**4. Discussion of the SAB Draft Advisory on EPA's Strategic Research Directions:** The Board discussed its current draft advisory on EPA's strategic research directions (see Attachment I). Dr. Morgan noted that the draft needs one final revision to ensure clarity and completeness prior to sending it to the Administrator. In terms of timing, the Board decided the report would be sent forward as soon as completed and not delayed until later. Members noted that the Administrator's response to the SAB budget letter registered disagreement with the Board's conclusion that EPA was "...under investing in forward-looking research." Since the funding level is key to many of the Board's comments on the research vision it may indicate already that such advice will not to be taken. Members noted though that the "budget advisory" response could be taken as one relevant to the short term, i.e., the FY 2009 year, and that we are now working on advice directed to the long-term where it is even more relevant to EPA's mission success. The sense was that the Board should continue to press the issue.

Some Board members provided comments prior to the meeting (see Attachment J). During the teleconference, members emphasized some of these comments, including: a) the issue of the 80 Provisionary Advisory Levels (PALs) developed by EPA, their derivation, use and availability, as well as how they compared to other reference values; b) clarification that "policy" research was needed on the effectiveness of alternative policy instruments; c) the need to update the technology section that is on page 11-12 of the draft; d) ensuring that this document is consistent with the earlier discussed draft EPEC advisory on ecosystems research in regard to the notion of EPA's developing decision support platforms; and e) the need to reshape and possibly reincorporate what is now in the draft as Appendix A into the health section.

Dr. Teichman, EPA/ORD Deputy Assistant Administrator for Science, commented on several issues raised in the draft and meeting discussions. He noted that:

- a) in regard to the PAL issue, that he had recently seen a visual that provided an explanation of how PALs related to other acute reference values and he committed to determining if this could be made available to the SAB for information. He also noted that the PAL procedure and the current PALs were to be evaluated by the NAS soon. Dr. Vu noted that the SAB HSAC might also be looking at these PALS
- b) ORD remained committed to further interaction with the SAB on its strategic research vision so that the Board would have a deeper understanding of the program's components and interrelationships and allow it to provide more pointed comment in the future;
- c) Agreed with the value of having the SAB comments on the Eco MYP and ecosystems comments in the draft SAB report on strategic research needs should be made consistent;
- d) ORD was even now considering modifications to its research structure programs beyond the current 16 program areas – this might be a good topic for further ORD – SAB interaction; and
- e) There is a need for the SAB and ORD to discuss further how it can interact, involve additional advisory groups such as BOSC without being duplicative and overly distracting to the SAB scientists who would need to be involved.

The comments from this teleconference, as well as those in Attachment J, are to be considered and Lead Writers' are to revise their specific subsections in Section 3.5 of the draft advisory. Leads should consult their other Team Members as they see the need as they revise their sections and those sections should be sent to Tom Miller by close of business, August 15, 2008.

**ACTION:** The following actions will be pursued:

- a) **By August 15, 2008** -Dr. Morgan will revise the letter and add the 3 additional bullets on recommended changes to the research directions to the 6 now in the letter to ensure consistency with the final SAB report to EPA on the FY 2009 research budget. He will also add text to expand on those points.
- b) **By August 15, 2008** - Dr. Morgan will revise the introductory section to the draft [**DFO NOTE: I interpret this to mean sections 3.1 through 3.4 of the draft advisory.**]
- c) **By August 15, 2008** - Each of the SAB Team Lead Writers will revise their own subsections of section 3.5. Lead writers are indicated above and in Attachment K. They will involve their Team Members as they see the need to do so. Revisions are to be sent to the DFO at [miller.tom@epa.gov](mailto:miller.tom@epa.gov).
- d) **By August 19, 2008** – The DFO will compile a revised report and send it to the full SAB for reading, and to the four “Vettors” for careful reading and comment.<sup>1</sup> The Vettors are to be:
  - a. Dr. Burke
  - b. Dr. Johnson
  - c. Dr. Kling
  - d. Dr. Swackhamer
- e) **By August 26, 2008** – Vettors provide Comments and/or approval to Dr. Morgan and the DFO<sup>2</sup>.
- f) **By August 29, 2008** – Report undergoes final edits and is signed by the SAB Chair.

**5. Discussion of the SAB October 27-28, Meeting:** Dr. Angela Nugent Briefed the Members on the plan for the October meeting’s first day (see Attachment L). The meeting is to be held on October 27-28, 2008. Day 1 will focus on biofuels and epigenomics as important components of future science and research issues that will require EPA’s attention. The Board will receive presentations on both areas from outside experts and then will consider “What are the net environmental implications for increased production and use of biofuels?” In a similar manner, the SAB will think about “What are the implications for environmental health sciences and human health risk assessment associated with epigenomics?”

This seminar-style meeting of day 1 will be followed by a half-day advisory meeting of the Board on October 28<sup>th</sup>. On the 28<sup>th</sup>, the Board will consider and discuss how its learning and reflections during the day 1 presentations on epigenomics and biofuels, might enhance, inform, and modify its current strategic advice on EPA’s research vision for the future, especially how EPA might implement inter-disciplinary approaches that incorporate significant emerging research.

Members asked about the earlier idea of a 30<sup>th</sup> anniversary celebration: who the audience for the October meeting was to be; and whether the title of the day 1 activity might be changed to

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<sup>1</sup> If members have significant problems with the revised draft, these should be communicated by email to the Lead Writer of the appropriate section with a copy to the Chair and to the DFO in a timeframe consistent with their August 26<sup>th</sup> deadline for submitting final comments to the Chair.

<sup>2</sup> If Vettors or other members have significant problems with the revised draft, the Chair will consider holding a final teleconference to resolve any such issues.

reinforce its intention as something that will be informing the next Administrator about EPA's research needs for the future. Dr. Vu noted that the reception at the end of day one would incorporate elements of a 30<sup>th</sup> anniversary celebration. She also noted that she would welcome additional ideas from members on this. The audience is primarily the Board itself who will use the information in its continued strategic research discussions. There will likely also be invitees from EPA. Since the meeting will be noticed in the Federal Register, it is possible that some from the public will also want to attend.

**ACTION:** Staff will work with the Chair to finalize the meeting plan, especially that for day 2 during which the results of day 1 will be integrated into the SAB's delivery of strategic research advice.

With that, the Chair noted that the day's business was concluded and the Designated Federal Officer adjourned the meeting at 2:55 p.m.

Respectfully Submitted:

*/ Signed /*

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Mr. Thomas O. Miller  
Designated Federal Officer, Acting  
US EPA Science Advisory Board

Certified as True:

*/ Signed /*

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Dr. M. Granger Morgan  
Chair, EPA Science Advisory Board

Attachments:

List of Attachments – July 28, 2008 SAB Teleconference

- A Meeting Agenda
- B 73 FR 39961, July 11, 2008
- C Roster
- D Draft SAB document – *Preparing for Environmental Disasters*
- E SAB Member comments on ATT D
- F Draft EPEC Advisory – *EPA’s Ecological Research Program Multi-Year Plan*
- G SAB Member comments on ATT F
- H EPEC Chair’s response to SAB Member Comments on Draft Advisory
- I Draft SAB document – *Strategic Research Directions of the US EPA 2008*
- J SAB Member comments on ATT I
- K EPA SAB SRD Review Team Assignments
- L Draft Information on SAB October Workshop

ATTACHMENT A

**U.S. Environmental Protection Agency  
Science Advisory Board  
Teleconference  
Agenda  
July 28, 2008**

(For call-in information, please call the Staff Office at 202-343-9999)

*Purpose of the Meeting: The Board will meet to conduct one quality review, to discuss its advisory to EPA on the Agency's strategic research vision for 2012 and beyond, to discuss its environmental disasters advisory, and to discuss its planned October 27-28, 2008 SAB meeting.*

**Monday July 28, 2008**

- |           |  |   |
|-----------|--|---|
| 1:00 p.m. | <b>Convene the Meeting</b>   | <b>Thomas O. Miller</b><br><i>Designated Federal<br/>Officer, EPA SAB</i>   |
| 1:10 p.m. | <b>Purpose and Approach of the Meeting</b>   | <b>Dr. M. Granger Morgan</b><br><i>Chair<br/>EPA Science Advisory<br/>Board</i>   |
| 1:15 p.m. | <b>Discussion of the SAB Draft Advisory on EPA's<br/>Environmental Disaster Response Science<br/>Support</b>                 | <b>Dr. M. Granger Morgan</b><br><b>The Board</b>  |
| 2:00 p.m. | <b>Quality Review of the Draft SAB/EPEC Advisory on<br/>the EPA Ecological Research Program Multi-Year<br/>Plan</b>          | <b>Dr. M. Granger Morgan</b><br><b>The Board</b><br><b>Dr. Judith L. Meyer,</b><br><i>Chair SAB/EPEC</i>  |
| 2:45 p.m. | <b>Discussion of the SAB Draft Advisory on EPA's<br/>Strategic Research Directions</b>                                       | <b>Dr. M. Granger Morgan</b><br><b>The Board</b><br><b>Dr. Kevin Teichman</b><br><i>Deputy Assistant<br/>Administrator for Science<br/>EPA Office of Research</i> |
| 4:00 p.m. | <b>Discussion of the SAB October 27-28 Meeting:<br/>"Future Science and Research: Next Steps for<br/>Integrated Science"</b> | <b>Dr. M. Granger Morgan</b><br><b>Dr. Angela Nugent</b><br><b>The Board</b>  |
| 5:00 p.m. | <b>Adjourn the Meeting</b>   | <b>The DFO</b>  |

August 31, 2007 (72 FR 50107), and was reviewed by CASAC at a public meeting held on October 24–25, 2007. The second draft of this ISA was released for public comment and review by the CASAC in March 2008 (73 FR 11916), and was reviewed by CASAC at a public meeting held on May 1–2, 2008. EPA has considered comments by CASAC and the public in preparing this final ISA.

Dated: July 1, 2008.

**Rebecca M. Clark,**

*Acting Director, National Center for Environmental Assessment.*

[FR Doc. E8–15726 Filed 7–10–08; 8:45 am]

**BILLING CODE 6560–50–P**

## ENVIRONMENTAL PROTECTION AGENCY

[FRL–8690–9]

### EPA Science Advisory Board Staff Office; Notification of a Public Teleconference Meeting of the Chartered Science Advisory Board

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Notice.

**SUMMARY:** The EPA Science Advisory Board (SAB) Staff Office announces a public teleconference meeting of the chartered SAB to: (1) Conduct its quality review of the SAB draft report *SAB Advisory on the EPA Ecological Research Program Multi-year Plan*; (2) have follow-up discussions of EPA's strategic research directions; and (3) complete its discussions of science that supports EPA's disaster response programs.

**DATES:** The meeting date is Monday, July 28, 2008, from 1 p.m. to 5 p.m. (Eastern Time).

**Location:** The meeting will be conducted by telephone only.

**FOR FURTHER INFORMATION CONTACT:** Any member of the public wishing to obtain general information concerning this public teleconference meeting should contact Mr. Thomas O. Miller, Designated Federal Officer (DFO), EPA Science Advisory Board (1400F), 1200 Pennsylvania Ave., NW., Washington, DC 20460; via telephone/voice mail: (202) 343–9982; fax: (202) 233–0643; or e-mail at [miller.tom@epa.gov](mailto:miller.tom@epa.gov). General information concerning the EPA Science Advisory Board can be found on the SAB Web site at: <http://www.epa.gov/sab>.

**SUPPLEMENTARY INFORMATION:** The SAB was established by 42 U.S.C. 4365 to provide independent scientific and

technical advice to the Administrator on the technical basis for Agency positions and regulations. The SAB is a Federal advisory committee chartered under the Federal Advisory Committee Act (FACA), as amended, 5 U.S.C., App. The SAB will comply with the provisions of FACA and all appropriate SAB Staff Office procedural policies. Pursuant to the Federal Advisory Committee Act, Public Law 92–463, notice is hereby given that the EPA SAB will hold a public teleconference meeting to discuss several issues and to conduct a quality review of the SAB Panel's draft *Advisory on the EPA Ecological Research Program Multi-year Plan*.

**Background:** (a) SAB Quality Review of the Draft SAB Report *Advisory on the EPA Ecological Research Program Multi-year Plan*. The Chartered Science Advisory Board will conduct a quality review of the draft SAB committee report on EPA's Ecological Research Multi-Year Plan prepared by the SAB's Ecological Processes and Effects Committee (EPEC). The draft report is in response to an EPA Office of Research and Development (ORD) request that the SAB review the Agency's proposed Research Program Strategy and Multi-year Plan that focuses on research issues related to ecosystems and ecosystem services. The draft report is available on the SAB Web Site at: <http://yosemite.epa.gov/sab/sabproduct.nsf/0/EE66B20E1A20BBA18525734D005E6665?OpenDocument>.

(b) EPA Strategic Research Directions: The Science Advisory Board engaged with EPA in a continuing dialogue to evaluate and provide advice on the strategic directions for EPA's research program for the next five to fifteen years. This activity complements the annual SAB review of EPA's research budget, and permits a more critical evaluation of research programs than is possible during those research budget reviews. The SAB will continue its discussions at its July 28, 2008 meeting. Additional information on past discussions (e.g., October 3–5, 2007 meeting; see 72 FR 50105–50107) and other relevant information can be found on the EPA SAB Web site at: <http://yosemite.epa.gov/sab/sabproduct.nsf/36a1ca3f683ae57a85256ce9006a32d0/54b1d2e5f6dbb2b38525730c00624a96?OpenDocument>.

(c) Environmental Disasters. The SAB is formulating advice to EPA aimed at strengthening science underlying EPA's preparation for and response to environmental disasters. The SAB previously discussed this topic at its meetings on December 12–14, 2006 (see 71 FR 67566), June 19–20, 2007 (see 72 FR 27308) and October 3–5, 2007 (see

72 FR 50105–50107). The SAB has drafted an advisory to the Administrator as a result of these discussions. Discussions of those comments will be completed during the SAB meeting on July 28, 2008. Additional information about this topic is available on the SAB Web site at: <http://yosemite.epa.gov/sab/sabproduct.nsf/02ad90b136fc21ef85256eba00436459/75e560f8a00949fa8525714c00454e95!OpenDocument>.

**Availability of Meeting Materials:** The agenda and other materials in support of this meeting will be placed on the SAB Web site at <http://www.epa.gov/sab> in advance of this meeting.

**Procedures for Providing Public Input:** Interested members of the public may submit relevant written or oral information for the SAB to consider during this teleconference.

**Oral Statements:** In general, individuals or groups requesting time to make an oral presentation at a public SAB teleconference will be limited to three minutes, with no more than one-half hour for all speakers. At face-to-face meetings, presentations will be limited to five minutes, with no more than a total of one hour for all speakers. To be placed on the public speaker list, interested parties should contact Mr. Thomas Miller, DFO, in writing (preferably by e-mail), by July 21, 2008 at the contact information provided above. **Written Statements:** Written statements should be received in the SAB Staff Office by July 21, 2008, so that the information may be made available to the SAB for their consideration prior to this teleconference meeting. Written statements should be supplied to the DFO via e-mail to [miller.tom@epa.gov](mailto:miller.tom@epa.gov) (acceptable file format: Adobe Acrobat PDF, WordPerfect, MS Word, MS PowerPoint, or Rich Text files in IBM-PC/Windows 98/2000/XP format).

**Accessibility:** For information on access or services for individuals with disabilities, please contact Mr. Thomas Miller at (202) 343–9982 or [miller.tom@epa.gov](mailto:miller.tom@epa.gov). To request accommodation of a disability, please contact Mr. Miller, preferably at least 10 days prior to the meeting, to give EPA as much time as possible to process your request.

Dated: July 8, 2008.

**Anthony F. Maciorowski,**

*Deputy Director, EPA Science Advisory Board Staff Office.*

[FR Doc. E8–15798 Filed 7–10–08; 8:45 am]

**BILLING CODE 6560–50–P**

**ATTACHMENT C**

**U.S. Environmental Protection Agency  
Science Advisory Board  
BOARD  
Teleconference July 28, 2008**

**CHAIR**

**Dr. M. Granger Morgan**, Lord Chair Professor in Engineering, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA

**SAB MEMBERS**

**Dr. Gregory Biddinger**, Coordinator, Natural Land Management Programs, Toxicology and Environmental Sciences, ExxonMobil Biomedical Sciences, Inc., Houston, TX

**Dr. Thomas Burke**, Professor, Department of Health Policy and Management, Johns Hopkins Bloomberg School of Public Health, Johns Hopkins University, Baltimore, MD

**Dr. James Bus**, Director of External Technology, Toxicology and Environmental Research and Consulting, The Dow Chemical Company, Midland, MI

**Dr. Deborah Cory-Slechta**, Professor, Department of Environmental Medicine, School of Medicine and Dentistry, University of Rochester, Rochester, NY

**Dr. Maureen L. Cropper**, Professor, Department of Economics, University of Maryland, College Park, MD

**Dr. Virginia Dale**, Corporate Fellow, Environmental Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN

**Dr. Kenneth Dickson**, Regents Professor, Department of Biological Sciences, University of North Texas, Aubrey, TX

**Dr. David A. Dzombak**, Walter J. Blenko Sr. Professor of Environmental Engineering, Department of Civil and Environmental Engineering, College of Engineering, Carnegie Mellon University, Pittsburgh, PA

**Dr. Baruch Fischhoff**, Howard Heinz University Professor, Department of Social and Decision Sciences, Department of Engineering and Public Policy, Carnegie Mellon University, Pittsburgh, PA

**Dr. James Galloway**, Professor, Department of Environmental Sciences, University of Virginia, Charlottesville, VA

**Dr. James K. Hammitt**, Professor, Center for Risk Analysis, Harvard University, Boston, MA

**Dr. Rogene Henderson**, Senior Scientist Emeritus, Lovelace Respiratory Research Institute, Albuquerque, NM

**Dr. James H. Johnson**, Professor and Dean, College of Engineering, Architecture & Computer Sciences, Howard University, Washington, DC

**Dr. Bernd Kahn**, Professor Emeritus and Director, Environmental Radiation Center, Nuclear and Radiological Engineering Program, Georgia Institute of Technology, Atlanta, GA

**Dr. Agnes Kane**, Professor and Chair, Department of Pathology and Laboratory Medicine, Brown University, Providence, RI

**Dr. Meryl Karol**, Professor Emerita, Graduate School of Public Health, University of Pittsburgh, Pittsburgh, PA

**Dr. Catherine Kling**, Professor, Department of Economics, Iowa State University, Ames, IA

**Dr. George Lambert**, Associate Professor of Pediatrics, Director, Center for Childhood Neurotoxicology, Robert Wood Johnson Medical School-UMDNJ, Belle Mead, NJ

**Dr. Jill Lipoti**, Director, Division of Environmental Safety and Health, New Jersey Department of Environmental Protection, Trenton, NJ

**Dr. Michael J. McFarland**, Associate Professor, Department of Civil and Environmental Engineering, Utah State University, Logan, UT

**Dr. Judith L. Meyer**, Distinguished Research Professor Emeritus, University of Georgia, Lopez Island, WA

**Dr. Jana Milford**, Associate Professor, Department of Mechanical Engineering, University of Colorado, Boulder, CO

**Dr. Rebecca Parkin**, Professor and Associate Dean, Environmental and Occupational Health, School of Public Health and Health Services, The George Washington University Medical Center, Washington, DC

**Mr. David Rejeski**, Director, Foresight and Governance Project, Woodrow Wilson International Center for Scholars, Washington, DC

**Dr. Stephen M. Roberts**, Professor, Department of Physiological Sciences, Director, Center for Environmental and Human Toxicology, University of Florida, Gainesville, FL

**Dr. Joan B. Rose**, Professor and Homer Nowlin Chair for Water Research, Department of Fisheries and Wildlife, Michigan State University, East Lansing, MI

**Dr. James Sanders**, Director and Professor, Skidaway Institute of Oceanography, Savannah, GA

**Dr. Jerald Schnoor**, Allen S. Henry Chair Professor, Department of Civil and Environmental Engineering, Co-Director, Center for Global and Regional Environmental Research, University of Iowa, Iowa City, IA

**Dr. Kathleen Segerson**, Professor, Department of Economics, University of Connecticut, Storrs, CT

**Dr. Kristin Shrader-Frechette**, O'Neil Professor of Philosophy, Department of Biological Sciences and Philosophy Department, University of Notre Dame, Notre Dame, IN

**Dr. V. Kerry Smith**, W.P. Carey Professor of Economics , Department of Economics , W.P Carey School of Business , Arizona State University, Tempe, AZ

**Dr. Deborah Swackhamer**, Interim Director and Professor, Institute on the Environment, University of Minnesota, St. Paul, MN

**Dr. Thomas L. Theis**, Director, Institute for Environmental Science and Policy, University of Illinois at Chicago, Chicago, IL

**Dr. Valerie Thomas**, Anderson Interface Associate Professor, School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA

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Draft of 2008 July 11+

### Preparing for Environmental Disasters

An Advisory Report from the  
Science Advisory Board  
of the  
U.S. Environmental Protection Agency

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### 1. Background

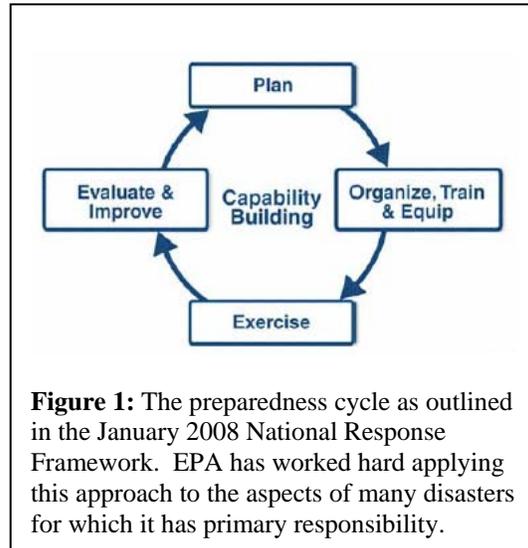
Even with improved preparation and careful advanced preventive actions, occasional environmental disasters are inevitable. They will arise from natural events such as storms, earthquakes, and volcanic eruptions which have significant human and environmental impacts (SAB, 1995, 1999). Unfortunately they may also result from accidental or intentional human events such as large spills, structural collapse, facility explosions or terrorist attacks.

When disasters with large environmental consequences occur, the public naturally looks to EPA to play a central role in characterizing environmental impacts, protecting human health and ecosystems, and in coordinating and overseeing post disaster clean-up.

However, EPA's authority covers only a subset of the issues that may arise in an environmental disaster (See Box 1). These include protection of drinking water supplies, the cleanup of contaminated buildings, and the development of a nationwide laboratory network to support response. EPA has developed an Emergency Response Business Plan<sup>1</sup> and continues to work hard to prepare for those aspects of disasters for which it has responsibility, following the general framework laid out in the National Response Framework (Figure 1.)

Other federal, state, and local agencies have primary responsibility for other aspects of dealing with environmental disasters, including First Response. When the scale of a disaster is large, or especially politically salient, senior political leaders also become involved. In such situations, EPA has found itself buffeted by forces over which it has little or no control or authority. At the same time the public may not understand, or in the face of a disaster care very much, about the intricacies of bureaucratic or political constraints and blame EPA for the shortcomings of others.

While no one can predict the future, we believe that it should be possible to identify, at least in general terms, the range of large-scale environmental disasters that could plausibly arise from natural causes (earthquakes, hurricanes), accidents (accidental explosions, structural collapse) and terrorist events. The EPA has already done some of this, partly in response to previous SAB investigations and recommendations (SAB, 1995, 1999) However, in crisis situations large organizations are rarely capable of rapid innovation. Rather, they respond with previously developed "standard operating



<sup>1</sup> The Emergency Response Business Plan is designed to facilitate readiness to deal with five simultaneous incidents of national significance (INS) while also maintaining effective "day-to-day" capabilities.

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DRAFT – please do not cite or quote because the final version may change - DRAFT procedures" (Allison and Zelikow, 1999). As a result, if EPA is to improve its response to future large-scale environmental disasters it must have performed needed research and developed plans in anticipation of the range of plausible contingencies. At least as important, Agency personnel must have practiced and refined these plans in "table-top" or other exercises that address both the risks and the likely complex institutional setting in which the Agency will likely have to execute its plans. The agency has already been doing these things for those aspects of a number of potential environmental disasters for which it has statutory authority. This report recommends that the Agency expand the range of those activities and invest modest resources in some broader efforts to scope and prioritize potential disasters with large environmental consequences. Indeed, if it does this well, EPA may even be able to assist other government and private sector entities to identify gaps and blind spots in their current thinking and improve their current preparation and response plans.

The purpose of this SAB self-initiated study has been to stimulate the agency to become less reactive and more anticipatory and to think more broadly about how it identifies and assesses possible future large-scale environmental disasters and develops plans for responding to and communicating about them. Clearly the SAB is *not* the right organization to develop detailed operational plans. Rather it is our hope that by taking a fresh independent look at the problem, and building on previous SAB efforts on the topic of preparedness for environmental disasters (SAB, 1995, 1999) we can persuade the Agency to begin to adopt the kind of broader, more anticipatory, approach we believe is needed. In the future, once the agency has developed a broader planning process and plans, the Science Advisory Board would be happy to provide thoughtful expert reviews and advice on the technical and behavioral dimensions of those processes and plans.

The Committee's work has been greatly facilitated by insights, critical commentary and assistance provided by Deborah Dietrich, Director of the Office of Emergency Management (OEM), within the Office of Solid Waste and Emergency Response (OSWER), and members of her staff.

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**BOX 1:** Summary of EPA's authorizations and responsibilities with respect to environmental disasters.

EPA has over 30 years experience in responding to releases of oil and hazardous materials under the National Contingency Plan (NCP) that was established and/or modified by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Water Act (CWA), and the Oil Pollution Act of 1990. Most of these responses do not rise to the level of Incidents of National Significance that are the focus of the National Response Framework (NRF) and the National Incident Management System (NIMS) which are required by various Homeland Security Presidential Directives (HSPDs). Typically, EPA receives over 30,000 release notifications per year (hazardous materials account for about 66% of the total notifications and oil spills for about 34%). Under this program EPA conducts 300 responses per year and assists in about 500 others. Specific EPA responses are to: i) environmental emergencies, ii) acutely hazardous sites/inland oil spills, iii) nationally-declared disasters, iv) terrorist incidents, and v) major national security events. Response activities include, but are not limited to: i) sampling and monitoring, ii) site screening, iii) decontamination, iv) disposal, v) dust mitigation, and vi) data management.

Under EPA's national approach to responses to Incidents of National Significance, the system that the Agency uses to respond to oil and hazardous material releases, under the NCP are integrated into the NRP and NIMS structure and are used when EPA responds within that structure as a part of the total national response to such incidents.

The National Response Framework provides a comprehensive and coordinated structure to prepare for and respond to all Incidents of National Significance. The NRP, coupled with the nationwide response template of the National Incident Management System (NIMS) provides the response structure and mechanisms that enable government and nongovernmental agencies and organizations to provide an all-hazards approach to emergency response activities. The system established is able to address large-scale events needing national leadership (e.g., the Departments of Homeland Security, Justice, Defense, and Agencies such as EPA) for incident management and smaller events where localized management is more appropriate (e.g., state and local officials and organizations).

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### 2. Learning from Others

In undertaking this self-initiated study, one of the first steps the SAB took was to invite a set of briefings from a range of organizations that have extensive experience in dealing with a wide variety of environmental disasters. We did this for two reasons:

- 1) We wanted to see if there were general lessons to be drawn that might be relevant to the EPA's needs; and,
- 2) We wanted to get ourselves "grounded" in examples of a number of real events so that our deliberations would not be too abstract.

People we heard from over the course of the study included:

<u>Name</u>	<u>Organization</u>
Mr. Joseph Becker	The American Red Cross
Mr. Patrick Brady	BNSF Railway
Ms. Debbie Dietrich	EPA Office of Emergency Management
Dr. Baruch Fischhoff	Carnegie Mellon University
Mr. Michael Lunsford	CSX Transportation
Ms. Suzanne Mattei	The Sierra Club
Dr. L.D. McMullen	Des Moines Water Works
Mr. Alan Nelson	Nuclear Energy Institute
Mr. Timothy Overton	Dow Chemical Company
Mr. Timothy Scott	Dow Chemical Company
Dr. Gayle Sugiyama	Lawrence Livermore National Laboratory
Ms. Dana Tulis	EPA Office of Emergency Management
Mr. William Wark	United States Chemical Safety and Hazard Investigation Board
Dr. Henry Willis	The Rand Corporation

In reviewing the most successful of the efforts we learned about, we identified a number of themes and approaches that we believe will likely be common to any effort to deal effectively with environmental disasters. These include:

- *Anticipating, assessing, planning and practicing* to deal with events that can reasonably be anticipated to occur. When this is done, previously developed operational and communication plans, trained personnel, and previously identified instrumentation and materials can all be rapidly and efficiently brought to bear on the problem.
- *Learning rapidly* about what is going on and developing a rapid and rough sense of what risks may exist to people and the environment. This means for example that field measurements made in the early stages of a disaster should probably be designed quite differently (different instruments, quality assurance, etc.) than measurements that are made for long-term monitoring and remediation. It means that one needs to have access to and prior experience with appropriate fast modeling and monitoring tools. It also means that with some prior geo-coded inventories of what materials

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(sewage, chemical stores, etc.) might be available for release in a disaster, one should be able to anticipate some aspect of likely exposures, and the consequent measurement and modeling needs.

- *Communication* with the general public and with non-technical decision makers in a meaningful way. There is clear empirical evidence that such communication will be much more effective if it is based on the prior development and iterative empirical testing of at least the kernels of key messages and disseminated by trusted organizations or individuals. There is also clear evidence that helping people figure out what numbers mean, what their choices are, and what they should do to protect themselves, their children, their employees, and the environment, are all critical.
- *Coordination* and communication with other key players. EPA has specific statutory responsibilities in terms of what it is and is not responsible for. However, in the context of an environmental emergency, "that's not my department" is not a satisfactory answer. The general public is likely to look at the Agency's name and expect it to take a wider range of responsibilities than it is likely to actually have. In order to avoid serious misunderstanding and inadequate response, there clearly needs to be coordination in both message and action. The SAB saw the briefings it received as strongly suggesting that such coordination and effective communication would almost certainly *not* happen unless there are pre-developed plans and messages that have been developed and rehearsed among relevant parties.
- *Flexibility*, including the ability to adapt procedures and make real-time decisions when previous plans are not working. It was clear from the briefings that the most successful private organizations the SAB heard from have been very good at identifying strategies that are not working and making improvement rapidly. Figuring out how to replicate this ability to adopt an iterative approach in Federal agencies clearly presents challenges that need to be addressed.
- *Delegation* to folks in the field, and the willingness of senior management to back their decisions, was another characteristic of the successful private organizations the SAB heard from. Again, figuring out how to replicate this capability in Federal agencies clearly presents challenges that need to be addressed.
- *Mobilization* of personnel and resources in a rapid and orderly way was a characteristic of the successful private organizations the SAB heard from. In the case of EPA, there is considerable expertise across the agency, including its laboratories, which might be mobilized if there were adequate prior planning, training and rehearsal. How much of this has already occurred is not clear to the SAB.

**The SAB recommends that as EPA works to improve the way in which it identifies, assesses, prepares for, and responds to possible future environmental disasters, it should examine and seek to learn from the best practices of other public and private organizations.**

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### 3. Identifying a Range of Potential Environmental Disasters

There is no way to know the future. Some enormous but imaginable environmental disasters, such as the impact of a large meteorite, or a continental-scale lava flow, are of such low probability that it would make little sense for EPA, with its limited resources and large set of obligations, to spend time thinking very much about them (Smil, 2008). Other environmental disasters will be sufficiently small or local in extent that it is unlikely that EPA would become involved. However, there are other regularly occurring environmental disasters, such as floods and hurricanes that have significant human health and environmental impacts (SAB, 1995, 1999).

When Agency staff now think about environmental disasters they often start with one of the 15 DHS National Planning Scenarios<sup>2</sup> and the Agency's authorities (Box 1) and go from there. While this is appropriate, the committee believes that it would *also* be wise for the Agency to develop a systematic taxonomy of plausible events and plausible combinations of events<sup>3</sup>, ask what would be the environmental consequences of each, and then in a systematic way, starting with those whose consequences are potentially most serious, ask:

- what agencies would deal with the various consequences?
- what responses and coordination would be needed?
- where are the gaps in authority and expertise?
- what other parties are likely to have key roles?
- what if any short term waivers to regulations and other rules might be needed and what mechanisms are needed to achieve these in a way that balances efficiency with protection and other objectives?
- what needs to be done to facilitate good coordination within EPA, with other Federal Agencies, with state and local government, and with the private sector?
- where are there commonalities across different types of environmental disasters that could be exploited to develop more efficient and effective response plans?
- what would the public expect of the EPA?

A very simple illustration of how such a taxonomy might be developed is provided in Table 1. Other structures are also possible. The key point is to first develop some way to think systematically about the full range of plausible disasters the Agency might be called upon to address.

The entries in Table 1 are still abstract. The next step, once a taxonomy of this sort has been developed, would be to select a range of specific events and think through their

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<sup>2</sup> EPA is an active participant in the DHS-coordinated incident planning management team (IMPT), which, among other activities, is conducting detailed planning related to the National Planning Scenarios.

<sup>3</sup> By combinations of event we mean things such as a large earthquake combined with wild fires, a consideration of whether key infrastructures such as power and communication continue to operate, or whether there are cross linkages between infrastructures (e.g. power available to run compressor stations in natural gas supply systems or to run pumps in water and sewer systems), etc.

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Figure 3 presents an illustrative time line for pre- and post-event planning and action. The main features of pre-event analysis include: identifying likely measurement needs; developing measurement tools and protocols, and risk analysis and consequence analysis tools; identifying likely communication needs and developing pre-tested communication modules that can be modified once the specifics of an event are known; identifying issues of jurisdiction/coordination; planning for longer term remediation needs; and identifying and implementing mitigating actions and strategies that could reduce or eliminate risks. Illustrations of a few post-event actions are shown on the right hand side of Figure 3.

Over the course of the past two years, the SAB has had occasion to review a number of geographical information systems being developed by different regional EPA offices. If these efforts were better coordinated, the result could be a very useful tool for pre-event analysis to identify and assess the various facilities that could result in sources of difficulty (such as chemical or other contamination). The availability of such a system or systems could also prove invaluable during the actual management of an event once it had happened.

Clearly developing such assessments will take time and care. The agency will not be able to do this for a large number of potential natural, accidental and terrorist-cause disasters all at once. Accordingly **the SAB recommends that the EPA establish a small interdisciplinary Environmental Disaster Assessment Team of five to seven fulltime professionals who are charged with working across the agency to identify, prioritize and assess potential environmental disasters.**

We believe that with the right people, resources, and mandate, such a group could make very substantial progress in just a few years. After developing a taxonomy of possible risk events, and working up a modest number of example assessments, such a group could then use these results as a basis to consult with Regional Offices, The National Homeland Security Research Center, key mission Offices across the Agency, and the Agency's Office of Research and Development, in order to set priorities across potential disaster scenarios (some of which would be generic in nature, some of which, like earthquakes or volcanic events, would be specific to geographical regions). As the work of such a small assessment team progressed, they would certainly find many situations in

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As noted in Box 1, EPA does not have a mandate to deal with all aspects of environmental disasters. Indeed, in many cases the legal mandate is limited to only a modest sub-set of all the issues that may arise. However, **the SAB recommends that the small Environmental Disaster Assessment Team recommended above start by prioritizing a systematically developed list of potential disasters and then that it perform, or arrange for others to perform, a reasonably comprehensive assessment of those that are deemed to be of greatest concern.** We make this recommendation for three reasons:

- 1) Without such a comprehensive anticipatory approach, the EPA runs a high risk of finding itself unprepared and playing catch-up in the face of future environmental disasters.
- 2) Without such an approach, coordination with other Agencies may be spotty
- 3) Without such a systematic approach, eventualities will likely arise in which no clear preparation has been made by *any* Federal agency to deal with at least some aspect of an acute environmental problem and, even if EPA's mission does not encompass that contingency, the public will likely look to the Agency for leadership, or blame the Agency for an inadequate response.

Of course, there are others at EPA's Homeland Security Research Center, EPA ORD, regional EPA offices, in DHS research centers, at DoE National Labs, in Universities, and in other research and operational entities, who have done portions of such assessments. Clearly the proposed Environmental Disaster Assessment Team should build upon the prior work of such groups as it precedes with this effort.

Having put in place an ongoing process to perform such assessments (starting with the highest priority issues) the Agency will be in a much better position to:

- prepare and practice response plans for a range of high probability events;
- identify likely gaps in expertise and develop prior arrangements with experts and organizations who can provide the needed knowledge and skills;
- develop a geo-coded list of this expertise so that these connections can be made rapidly in an emergency;
- identify short term waivers to regulations and other rules that might be needed and prearrange mechanisms to achieve these waivers in a way that balances efficiency with protection and other objectives;
- develop and pre-test public communications messages, that can be easily modified to meet the specific needs of different contexts, to deal with those events;
- engage in coordination activities with other Federal, State and private parties;
- develop measurement and quality assurance protocols that will allow rapid dissemination and use of field measurements in the early stages of a disaster.

While the Agency's Office of Emergency Management is already doing many of these things in the context of specific risk scenarios and legislative authority, the SAB believes

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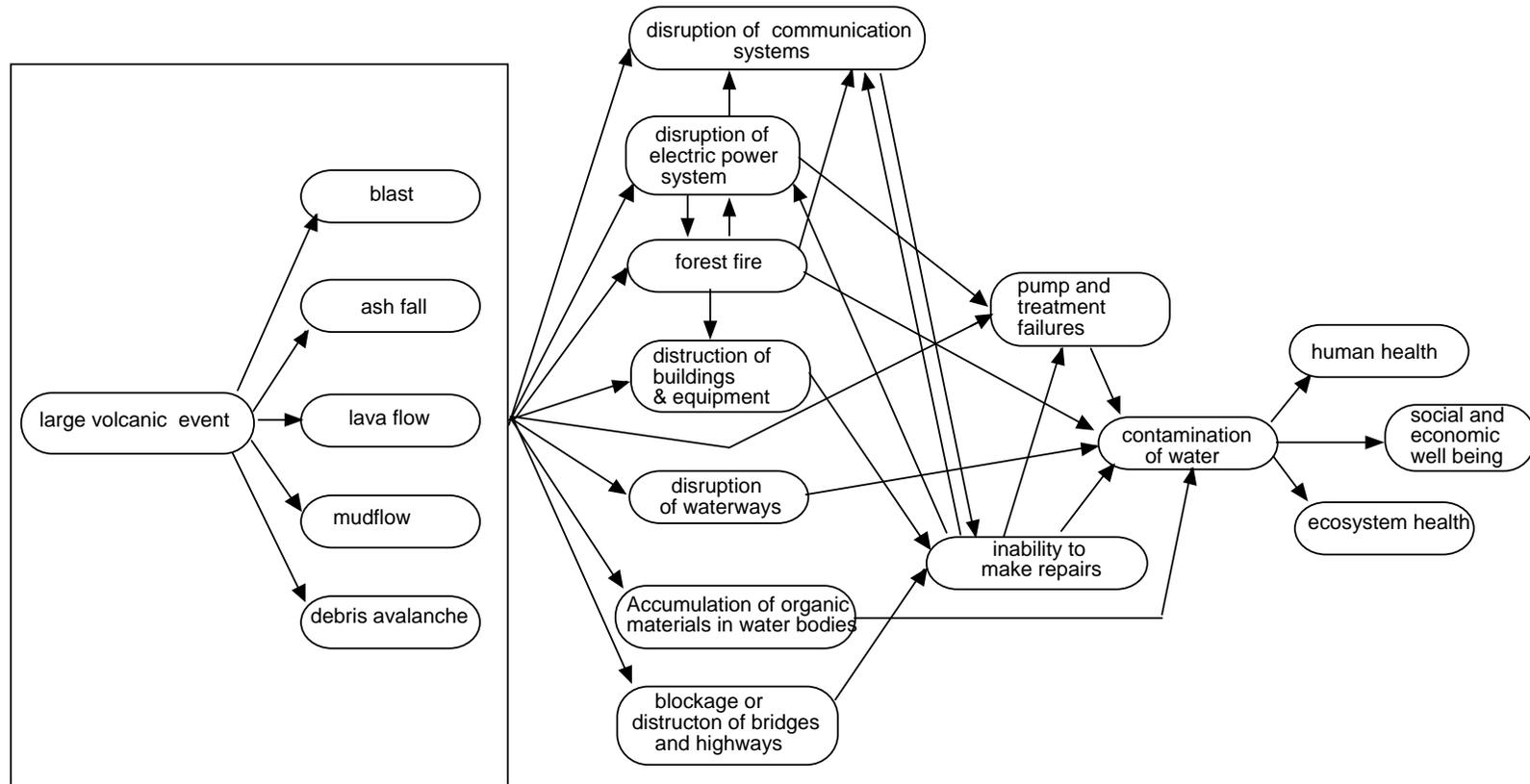
DRAFT – please do not cite or quote because the final version may change - DRAFT that great benefit could be obtained from a parallel effort that adopts a more holistic and comprehensive approach of the sort outlined.

**Table 1:** One possible example of a structure that EPA might use to develop a taxonomy of potential environmental disasters. While many of these involve precipitating events that happen suddenly, for completeness any such taxonomy should also include events that develop more gradually (e.g. droughts, invasive species) whose consequences are never-the-less disastrous. When more than one disturbance occurs, the response may be more extreme than would occur when these disturbances occur singly. (Paine et al., 1998)

Natural events	Events With Humans or their Systems in the Causal Chain
Biologically related Disease (natural) Invasive species (natural) Geologically related Earthquake Flood plain events Volcanic eruptions Weather related Drought Flood (e.g., Tsunami, storm surge) Lightening Wild Fire Wind (e.g., hurricane, tornado)	Complex network system failures Dam, levee, dike failures Disruption of network infrastructures (e.g., power, water, sewer, highways, rail, pipelines, etc.) Large structural collapse Nuclear events  Human induced (unintentional/intentional) Biological Chemical release Explosions Fire Invasive species Radiological Water, air, food contamination

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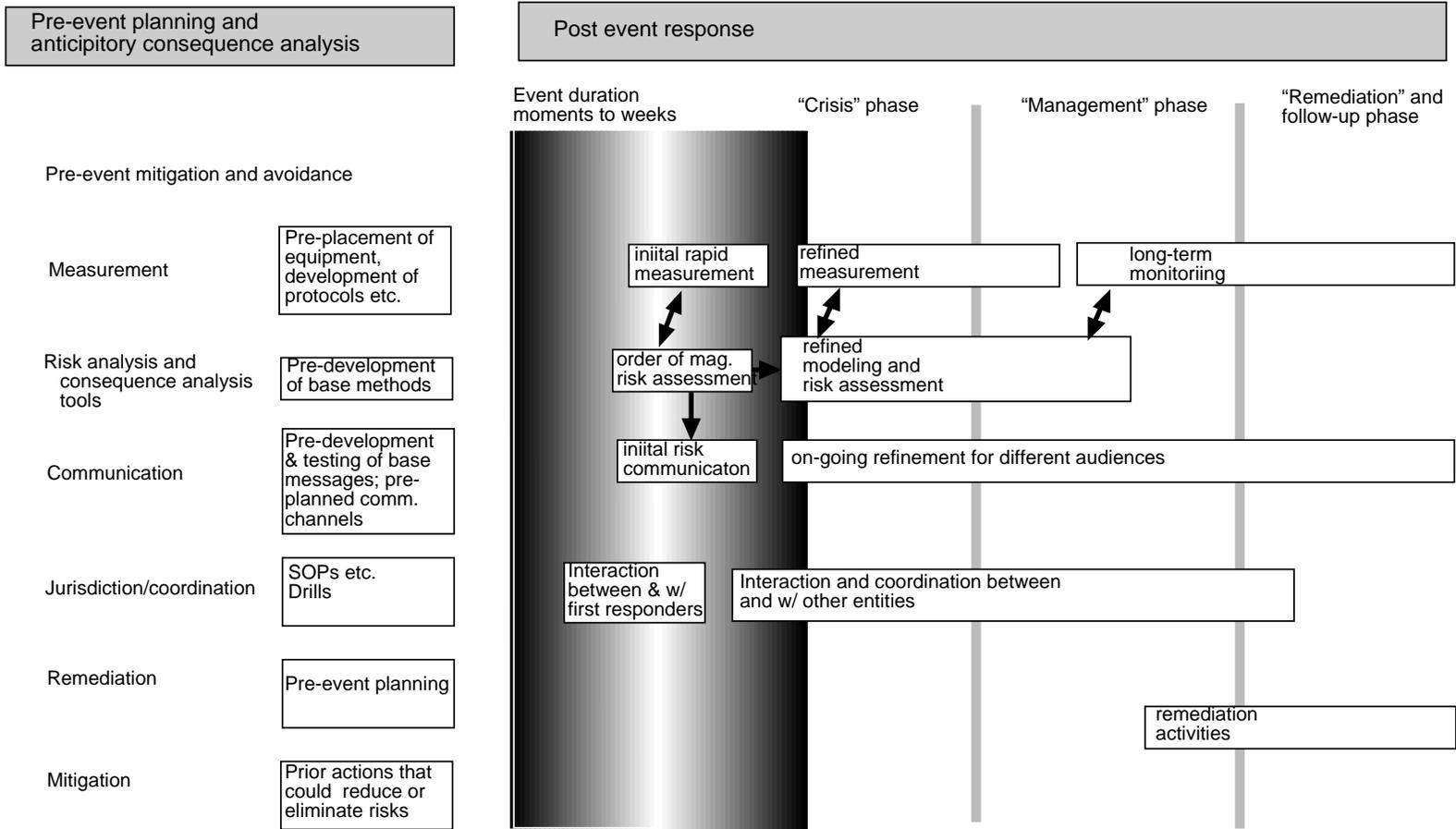


**Figure 2:** Simplified illustration of an influence diagram tracing some of the routes by which a volcanic event might result in sustained contamination of water supply.

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For an event of a given type:



**Figure 3:** Pre- and post-event tasks for an environmental disaster. Many of the actions noted need to be performed at the regional level.

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### 4. Geographically Specific Tools for Data Display and Analysis

In this and the following section we turn to a more detailed set of issues, some of which relate to the small Environmental Disaster Assessment Team proposed in Section 3, but most of which are more relevant to the ongoing work of the EPA's Office of Emergency Management.

Assessing potential future disasters, planning for response, and executing an effective response once a disaster has occurred, all require information and modeling and analysis capabilities at a variety of scales (local, regional, and national). Local first responders such as fire, emergency services or police can respond and often immediately address needs created by a small special disaster. However, as the spatial scale of the disaster increases additional resources, information and tools are needed to respond and address the consequences of the disaster.

EPA has developed a variety of spatial analysis tools incorporating GIS and fate and transport models, that, while developed for other purposes, could be made applicable to the needs of emergency responders by providing information helpful in identifying vulnerable populations and environmental resources at the state, regional and national scales. These tools incorporate GIS data layers such as land use, infrastructure, location of chemical storage facilities, industrial facilities, human census tract data, sensitive environmental and public health receptors and a myriad of other spatially explicit databases into decision support systems. EPA has also developed and uses transport and fate models capable of estimating the dispersion of chemicals, particles, microorganisms, and radiation released by a disaster into the air and water. If modified for use in disaster setting, some of these tools could be particularly valuable for disaster managers responding to incidents at the regional scale.

*Models, Tools, and Resources.* Maximum preparedness for short- and long-term emergency response actions requires development and maintenance and deployment of a variety of models, tools and other resources (resource systems). Consultations by EPA with SAB and HSAC have addressed specific elements of this overall system resource portfolio but have not provided the overall context for SAB and SAB's Homeland Security Advisory Committee (HSAC) consideration of these reviews.

**SAB recommends that EPA compile an inventory of existing models, tools and resources, including those that, while developed for other purposes, might be made useful for disaster response.** Once these "assets" have been listed (including applicable assets from other agencies) they should be mapped against the list of disasters identified in National Planning Scenarios and by the proposed Environmental Disaster Assessment Team and their applicability to each should be established. EPA has special expertise in risk assessment of building disasters and building decontamination, water and wastewater infrastructure assessment, surface water and groundwater quality modeling, air quality modeling, emission locations and databases, municipal and industrial site locations, and

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One example where this may already have happened is the Water Security Initiative (WSI), successor to the Water Sentinel Model, that EPA has developed for assessing the vulnerability of water distribution systems under various contamination scenarios. WSI consists of models and other tools to provide: enhanced physical security monitoring; water quality monitoring; routine and triggered sampling of high priority contaminants; public health surveillance, and; consumer complaint surveillance.

Identification of Gaps and Prioritization of Research Needs. Following completion of such an inventory of models and other tools, **SAB recommends a comprehensive assessment and report of the gaps in the available resource systems, and a listing of needs for further development and research.** The list of gaps in the resource system inventory should be prioritized. This prioritization process should consider the environmental and human health consequences caused by missing tools or information, the impacts of related consequences (including spatial and temporal scales), and other relevant criteria. This analysis should enable optimization of the allocation of EPA resources to fill these gaps over the short-, intermediate- and long-term. **SAB recommends that the listing of development and research needs (identified in the gap analysis) be prioritized and conveyed across the Agency.**

Once gaps and research needs have been identified, the SAB would be pleased to review the results and offer its advice.

Characteristics of Models, Tools and Resources. Effective use of resource systems requires functionality and reliability under a wide variety of circumstances and conditions, including disaster response situations. These characteristics should include:

- *Portability.* To the extent possible, resource systems should be portable to allow transportation and usage in difficult field conditions. The systems should be designed to be field-ready.
- *Redundancy.* There should not be any single expert or expert-system that cannot be replaced in an emergency. Duplication of function is a necessity.
- *Interoperability.* Models and databases must be compatible with those from other agencies. Personnel with various backgrounds, and from other agencies, should be able to use them.
- *Resiliency.* These systems should be robust and have limited vulnerability. To the extent possible, resource systems should be able to operate when central power sources and direct internet access are not available, and they should not rely solely on standard communication lines to function.

Dissemination and Maintenance of Resource Systems. To achieve maximum effectiveness, resource systems must be disseminated to the full range of potential users, including first responders and long term-managers at the local and State level, in addition to EPA central office and regional staff and other federal agencies. Relevant databases such as the Toxics Release Inventory (TRI), which is under threat of losing essential data

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DRAFT – please do not cite or quote because the final version may change - DRAFT due to changes in thresholds of reporting, is nationally computerized and available and should be preserved. The Chemical Storage Inventory under the Clean Air Act 112(r) is another example of data that can be helpful in emergency disaster planning and response and should be digitized for ready access by first responders. Resource systems should be maintained to keep their contents current, reliable and easily searchable. **The SAB recommends that EPA solicit feedback from users, particularly local and State personnel including first responders, and regional EPA managers, regarding resource systems and were necessary digitized data bases to support improved disaster response decisions.** Periodic updates of resource systems should consider comments and criticisms from users. The results of audits of response performance following actual events and trials should also be used in maintenance and updating of resource systems.

*Audits of Event Response Performance.* **SAB recommends that EPA perform and encourage performance audits of event responses by its staff at the local, State and regional level.** EPA should play a special role as compiler and synthesizer of performance results and characteristics. The Agency often identifies problems which are commonly referred to as “lessons learned”, but "lessons" are not really "learned" and have little value until procedures and behaviors are changed (continuous improvement) While we are aware of and have read the reports by the Agency's Auditor General on EPA's performance during several recent environmental disasters, we are not persuaded that these sufficiently meet this need.

*Sensitivity of Resource Systems.* In some cases, components of resource systems developed by EPA may be too sensitive to warrant general release to the public or to local and state entities. **SAB recommends that EPA carefully assess the content of its resource systems to evaluate the security risks associated with their release.** Criteria recommended by SAB for this evaluation include the ability of system resources to be used to implement an attack, or to optimize consequences of an attack. Examples of resource systems that have components with considerable risk associated with release include the “consequence modeling” component of the Water Sentinel program and, to a lesser extent, the incident modeling in ECAT. For example, if a calibrated Water Sentinel model for a specific utility falls into the wrong hands, it could be used against that utility by attacking them at their most vulnerable distribution system locations.

*Development of Resource Clearinghouse.* **SAB recommends that EPA emphasize its role in the development of centralized and streamlined virtual libraries of references, guidance materials and models, and other resources.** The SAB endorses efforts like those in ECAT to compile a wide breadth of information in a user-friendly form. This work should also include Internet enabled tools (with and without security-related access controls) and coordination of spatial data bases (land use, land cover, census data, chemical plants). It is presumed that all counties in the US have an inventory of all chemical facilities, power plants, water and wastewater treatment facilities, hazardous waste generators, storage facilities, hospitals, research labs, universities, etc. located within their jurisdictional boundaries, in terms of types and

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DRAFT – please do not cite or quote because the final version may change - DRAFT amounts of potential contaminants and their coordinates. These inventories, as well as Federal databases in which EPA has primary authority, need to be updated annually.

Completion of the tasks outlined in this section should prove valuable to the small interdisciplinary Environmental Disaster Assessment Team recommended above in Part 3 of this report, and that team should be consulted in the formulation and completion of these tasks. However, this team should not be given primary responsibility for completing these tasks so as not to divert its attention from the critically important job of identifying, ranking, assessing and planning for possible future environmental disasters.

### 5. QA/QC for Data During Emergencies

Field measurements made during the early stages of a disaster have a different purpose than field measurements made for long-term monitoring and remediation. Emergency responders and citizens need fast order-of-magnitude indications of the nature and level of hazards they may face. Accordingly instrumentation, quality assurance procedures for authorizing the release of data, and measurement priorities need to be designed to appropriately meet those needs.

Many existing EPA data protocols do not emphasize rapid response, because they have been developed to meet the needs of long-term monitoring and regulatory activities. Especially in the early stages of an emergency, the quality of data may have to be balanced against the need to get information to users on the time scale they require. This balance should be worked out in advance, so that procedures are already developed and approved before the emergency occurs, and a graceful transition can be achieved from rapid order-of-magnitude assessment to increasingly more time consuming and accurate characterizations as time goes by (See Figure 2). While the SAB is pleased to see the creation of the Agency's Environmental Response Laboratory Network, with its focus on "screening/sentinel laboratories", "confirmatory laboratories", and "reference laboratories" this is an issue that warrants additional attention.

**The SAB recommends that EPA develop procedures for rapid field measurement, data analysis and data release to the public during the early stages of emergencies, as well as protocols for how those procedures will be modified to assure greater precision and quality control as needed in later stages of the life cycle of an environmental disaster.**

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### 6. Improved Communication and Public Consultation

Communication needs and content are highly context dependent. Before, during and after events, the goals and methods for effective communications should be different. For example, during an event when immediate protective actions are needed, rapid one-way approaches are critical. However, before and after events, these methods are rarely appropriate. In these periods, dialogues with decision makers, stakeholders and representatives of the public are key ways for building knowledge about current contexts and information needs and preferences. Development of messages based on knowledge and empirical testing enhances the probability of effective decisions and actions during events. Without such fundamental and current knowledge, communications may create problems where few or none existed.

Effective communication between many different parties is essential:

- in performing assessments and making plans before an environmental disaster occurs,
- in protecting human health and ecosystems during the initial stages of an environmental disaster, and
- in managing long term protection, clean-up and recovery from an environmental disaster.

Communications about environmental disaster requires two-way interactions within the US EPA, across agencies, and with partners and the public.<sup>4</sup> In designing any communications program, one must ask the question: "How can information be transmitted to elicit well informed decisions and behavior by individuals, first responders, decision makers and organizations?"

Communications need to occur throughout the process of assessing, preparing for, and responding to environmental disasters. Of course the purpose and form of the communication often needs to change at different stages along the life cycle of an event (Figure 2). For example, immediate protective guidance is often necessary during the initial response phase while there is great uncertainty, while more specific guidance is provided during later stages when more information is available and uncertainties have been reduced.

No aspect of communication is more important than communication with the public – including both those directly affected by the event and the general public. Too often, communication is seen as the one-way conveyance of facts, guidance and decisions from experts and those in charge to a passive receiving public. Sometimes in a crisis situation such one-way communication is necessary ("You need to stay in your house and seal the

---

<sup>4</sup> In this connection the Office of Emergency Management is developing and deploying an emergency management data architecture known as Emergency Management Portal (EMP). The office is also working closely with regions to establish communication standards and assure that needed equipment is available. Finally the Agency has developed a Crisis Communication Plan. However, none of these activities appear to be well informed by modern behavioral social science.

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DRAFT – please do not cite or quote because the final version may change - DRAFT doors and window because a cloud of toxic gas is rapidly approaching."). As elaborated below, even in such situations communications are likely to be far more effective if generic versions have been carefully developed, empirically evaluated and refined ahead of time through careful two-way interaction with individual who are typical of the intended audience.

Recent years have witnessed considerable progress in developing a scientific basis for risk communication. The key insight from this work is that *a priori* there is no such thing as an expert in the design of the content of effective risk communication messages. It is essential to adopt an empirical approach. Unless one understands the way in which a recipient will interpret and understand a message, even as simple a message as "Take a wet cloth to cover your face in the event you find yourself being exposed," one can have no confidence that it will be properly understood.

Behavioral social scientists have developed a variety of strategies to determine, through empirical studies, the "mental models" that people adopt in thinking about risks (Fischhoff, 2005; Morgan et al, 2002). They have also developed empirical strategies for testing and refining possible messages (Fischhoff, in press). Unfortunately, with almost no behavioral social scientists on staff, EPA does not possess the expertise to make use of such methods.<sup>5</sup>

This absence of understanding and expertise also has implications for other aspects of EPA's mission. For this reason the SAB makes two related recommendations:

**First, ORD should re-establish its program in behavioral social science and risk communication research, perhaps by reinvigorating the very successful collaboration it once had with the NSF program in Decision Research and Management Science (DRMS).**

**Second, in assembling the small interdisciplinary Environmental Disaster Assessment Team proposed above in Part 3, at least one or two of the members should have a strong working understanding of, and ability to apply, modern methods of empirical social science for developing risk communication strategies, and the design, testing and refinement of risk communication messages.**

Frequent, transparent interactions with partners (within the Agency, across agencies, and with others) in advance of events are an important part of building communication readiness. Purposes of these interactions and related research include:

- Determination of how *people form their concepts of risk* and related issues, as well as how people make decisions and what information influences their decisions.

---

<sup>5</sup> EPA's National Homeland Security Research Center has run a series of workshops on "message mapping" (Covello et al., 2007). While these have identified many issues that that deserve consideration in the event of possible water security emergencies, no empirical studies are included of how various audiences might understand and interpret alternative messages.

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- Development and rigorous *pre-testing of consistent messages* for a variety of scenarios and receivers. Scenarios formulation should include representatives of the public and mass media to ensure that exercises involve their perspectives and gauge the likelihood of behaviors that would have significant impacts in real events. Representatives of other partners appropriate to the scenario should also be involved both in drills as well as in debriefings after exercises. During an event, zero tolerance for false positives often works against providing the public with timely and useful protective information. The tradeoffs in risks (e.g., public health and environmental vs. organizational) are important considerations that should be clearly identified and articulated by decision makers. When uncertainty prevents a definitive decision, warnings that include protective actions and specific guidance should be issued with a caveat to “stay tuned” for more certain information. Pre-testing such messages would yield considerable insights about what will and will not work well in eliciting desirable behaviors.
- Anticipation of how *people would respond to communication initiatives* (messages and interactive engagements), especially under stressful conditions. Research is needed to identify how first responders, decision makers and the public are most likely to respond to communication initiatives.
- Empirical research involving formative and summative *evaluations* of risk communication activities is essential to ensure continuing progress.

In environmental disasters EPA should endeavor to ensure that information the Agency has developed gets to the persons or organization that are trusted by the intended receivers (in crisis conditions) or partners (in routine conditions). In some situations, another entity or person (e.g., local official or community leader) will be seen as a more trusted source of information. In those circumstances, the EPA should focus on getting the best possible information to that party and helping him/her promptly interpret and use the information correctly. In preparation for an event, EPA should:

- Recognize and be in contact with trusted *social networks* within a community
- Discover the ways in which information is currently and rapidly *disseminated* (e.g., reverse 911, e-mail, instant messaging, YouTube and other networks)

There is an urgent need to improve consultation with the public on a variety of tough choices that many environmental disasters can present. An obvious example is decisions about "how clean is clean enough" when restoration to pre-disaster conditions is neither technically nor economically feasible. Effective mechanisms to perform such consultation are lacking. **The SAB recommends that the development, demonstration and evaluation of mechanisms for better including public values and preferences in clean-up decisions should be an element of the reinvigorated program of behavior research in ORD.**

The SAB understands that EPA has developed a Crisis Communication Plan and already participates in a wide variety of multi-agency drills and exercises on disaster response. SAB also recognizes that selected employees within EPA have been assigned to red or blue response teams, and they are already recognized for their capabilities in specialized areas of disaster response. These employees are expected to stop all other duties in the

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event of a disaster and devote themselves solely to the response for however long it takes. Such employees have laptop computers especially dedicated for disaster response, and drills in “bunker” locations have been successfully executed. However, it is our belief that shortcomings may still exist in the area of communications, and that the ability to locate and contact each person in the network during a disaster has not been given proper attention by the agency or by Homeland Security. **The SAB recommends that a failsafe method for communication among key members of the disaster response team be designed, implemented and tested on a regular basis.** Obviously, responders must be able also to communicate with critical models, databases, and decision support tools and convey the results of their analysis to responsible parties.

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### 7. Summary and Restatement of Key Recommendations

Thinking broadly and becoming more anticipatory should be a goal of every agency. While it is doing a good job of addressing those aspects of environmental disasters for which it is responsible in the context of DHS National Planning Scenarios EPA would be well advised to *also* think more broadly and in a more anticipatory way about the full range of possible environmental disaster that could arise from natural causes, accidents or the actions of terrorists. To this end the Science Advisory Board recommends that the EPA:

1. Establish a small interdisciplinary Environmental Disaster Assessment Team of five to seven professionals who are charged with identifying, prioritizing and assessing potential environmental disasters. This team should develop a system to identify potential environmental disasters, prioritize them based on probability and consequence, and identify common attributes and response strategies that could improve the efficiency and effectiveness of agency responses.
2. The Environmental Disaster Assessment Team should perform, or arrange for others to perform, reasonably comprehensive assessments of those disasters deemed to be of greatest concern. It should then help and advise the Agency to further:
  - Identify gaps in coverage by Federal, State and Local authorities and needs for improved coverage, coordination and preplanning;
  - Develop prior arrangements with experts and organizations who can provide the needed knowledge and skills and develop a geo-coded list of this expertise so that these connections can be made rapidly in an emergency.
  - Identify short term waivers to regulations and other rules that might be needed and prearranged mechanisms to achieve these waivers in a way that balances efficiency with protection and other objectives.

In support of the mission of the Agency's Office of Emergency Management, the SAB recommends that the EPA:

3. Examine and seek to learn from the best practices of other public and private organizations. In so doing it should seek strategies by which it, and other responsible parties, might better:
  - *anticipate, assess, plan for, and practice responses* to deal with major events that plausibly might occur in coming years;
  - *learn rapidly* what is going on and developing a rapid and rough sense of what risks may exist to people and the environment;
  - *effectively coordinate and communicate* with other key players including first responders and the public;
  - *respond with flexibility* to the specific needs and circumstances of the event at hand, including the ability to adapt procedures and make real-time decisions when previous plans are not working;
  - *delegate* decision authority to responsible individual in the field; and
  - *mobilize* personnel and resources in a rapid and orderly way.

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4. Compile an inventory of existing models, tools, data and resources, *including those that, while developed for other purposes, might be made useful for disaster response*; perform a comprehensive assessment and develop a report on the gaps in the available resource systems; solicit feedback from users of these tools, particularly local and state personnel and regional EPA managers, regarding resource systems; and, identify further development and research needs. Since some of these tools may involve sensitive information, their content, and associated access policies should be carefully reviewed to assure an appropriate balance between needs of local and regional responder and the public and the necessity for protection against misuse. Emphasize EPA's role in development of centralized and streamlined virtual libraries of references, guidance materials and models, and other resources.
5. Develop procedures for rapid field measurement, data analysis and data release during the early stages of emergencies, as well as protocols for how those procedures will be modified to assure greater precision and quality control as needed in later stages of the life cycle of an environmental disaster.
6. Conduct performance audits of event responses by EPA staff at the local and State level.

Finally, to better ground its work on communication in modern behavioral social science, the SAB recommends that the EPA:

7. Reinvigorate its program in behavioral social science research and application, perhaps by reestablishing the very successful collaboration it once had with NSF-DRMS. This should include:
  - A strong program in empirically based methods of risk communication.
  - Development, demonstration and evaluation of mechanisms for better including public values and preferences in post-disaster clean-up decisions.

## ATTACHMENT D

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**References**

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## ATTACHMENT E

### **Compilation of SAB Comments on the Environmental Disasters Draft**

(7-28-2008)

#### **1. Dr. Rebecca Parkin**

##### *Letter*

- In large part, this letter includes or paraphrases the bolded points in the report. However, a few points are missing from the letter (e.g., pp.15 (last point) and 20). It is not clear why these should be omitted and other points should be included. Inclusion of all bolded points will increase consistency between the letter and report.
- Second page, first bullet under “2.” at the top of the page: This reviewer could not find mention of “Federal, State and Local authorities” and of the “needs for improved coverage, coordination and preplanning” in the report. If this is a key point that merits inclusion in the letter, more obvious inclusion of this point should be in the report.

##### *Draft report*

- P. 13, second paragraph, line 5: What is a “small special disaster?” What makes a disaster “special?” Is the intent here to convey “unique hazards” or “local?”
- P. 18, second complete paragraph, line 4: Update this citation, or replace with the last published edition of this book.

##### *Edits*

- There are a number of typos in the text and Figure 3 that need attention.
- Some acronyms (e.g., GIS) seem to be used before they are defined.
- Pg. 5, first line under the list of people: Insert “of” at the end of the line.
- P. 7 and elsewhere: “Wildfires” should be one word.
- P. 10: The title for Table 1 is too long. Some of the content here would be better placed in a footnote to the table.

##### Ms. Dietrich’s Letter

- Are there more than 3 pages to this item? My set seems to have pages 1-2 and last only. The last bullet on page 2 does not continue on the next (last) page.

[DFO NOTE: In creating the attachment, several lines were omitted in error. The paragraph ending page two and starting page three should read as follows:

“EPA is implementing its Crisis Communication Plan and has formed a Crisis Communication Workgroup that is co-chaired by the Office of Public Affairs and the Office of Emergency Management. The workgroup is currently working on a companion resource guide that will include message maps, fact sheets and templates for communication of sampling data, job aids, and other tools to assist the public information staff during response.” ]

## **2. Dr. Jill Lipoti**

- Letter page 2, line 9 provide instead of provided
- Letter page 2, line 22 deleted “too would be well advise to more systematically examine and seek to learn from the best practices of other public and private organizations. In so doing it”
- Letter page 2, line 28, delete “ing” in developing a rapid and...
- Report body, page 9, line 24 “proceeds” not “precedes”
- Report body, page 9, line 29 “provide” not “provided”
- Figure 3 page 12 has typos: Risk Anaysis; pior; initial; and; monitoring
- Report body, page 21, second bullet under item 2 end of first line, “provide” not “provided”
- Report body, page 21, second bullet under item 3, first line, “develop” not “developing”

### General comment re: EPA memo:

Deborah Dietrich's memo described a number of useful activities undertaken by EPA, but the recommendations in our Advisory Report are more comprehensive and broader than the summation of all of the EPA activities. It is important that we convey our thoughts to EPA.

As an example, the Emergency Management Portal (EMP) and the environmental Laboratory Response Network (eLRN) described in Deborah's memo looks useful. There is an identified gap in consolidating and displaying data from the field and analyzing a multitude of environmental samples in different media. However, what is not included in the EMP and eLRN is how you get from field data to exposure data, and then how you make decisions about how to prioritize remediation. The presence of a contaminant in the environment is an important input for the assessment of human health risk, but you need to use some modeling for exposure assessment. Once you have identified the human health risks, then you can identify the risk reduction opportunities. Then the costs and benefits can be calculated for each option, for better consideration of priorities. Prioritization is not something that can be carried out in a vacuum. This is where you need to include social values. What are the most serious risks affecting this population? Some risks may affect future generations, so you need to balance the costs and benefits over the long term. EPA's Crisis Communication Plan falls far short of addressing the needs for eliciting stakeholder values and including them in decision-making.

To summarize, gaps exist in tools for:

- Ø Readily consolidating and accessing raw data
- Ø Rapid analysis and display of comparisons to standards, maps, etc
- Ø Flexible and comprehensive method to convert raw data into estimates of human health risk for communication
- Ø Conducting technical analyses
- Ø Presenting risk comparisons
- Ø Identifying risk reduction opportunities
- Ø Quantifying costs and benefits for each option
- Ø Addressing equity concerns and balancing costs and benefits across generations
- Ø Of all the risks affecting this population, which are most serious?
- Ø Which are we most capable of limiting?  
(economically, technologically, politically)
- Ø How to allocate resources and set goals for risk reduction
- Ø How to accommodate competing goals
- Ø Use of this information above in a documented decision making strategy
- Ø How to document the basis for the decisions made.

Our Advisory points the EPA in the right direction for assembling tools to do all of these things, without being prescriptive.

The only point that has not been addressed in our Advisory is the issue of documentation. As we know from the World Trade Center air sampling experience, questions may arise years after an event about the basis for making certain decisions. It would be wise to document the basis for decision-making at each point in time. Decisions may change over time, based on new data or shifting priorities. Making sure that there is a record of the options considered, stakeholders consulted, concerns voiced and how they were resolved, and the ultimate decision made at each critical decision point will be important. Can we insert a sentence about documentation in the advisory?

3. **Dr. Baruch Fischhoff**

Thanks for your continuing leadership here. I think that the letter does a very nice job of making the case for EPA's involvement.

Two items: (a) There is a typo on the last line of p. 2 (should be "Office"), which I assume that someone would have caught. (b) From what I've seen elsewhere, EPA has a unique ability to do science-based work, whatever the topic, and could lead by example, if asked. Taking the initiatives recommended here would position it to assume national leadership on the application of science to disaster management. Unless it's written in a code that I don't understand, the current National Response Framework (attached) has little place for evidence. However, one can hope that that will change, in which case, EPA should be able to show the way for agencies without its scientific tradition.

**4. Dr. Rogene Henderson**

Note on the NRF: One thing I noticed in the 15 scenarios that were given was that all chemical incidents were listed as "attacks" as if terrorist attacks were the only source of such incidents. I think it more likely that such chemical incidents would be the result of industrial accidents, such as the Bhopal incident. Since Bhopal, industries have established rather good emergency response guidelines which I believe

**5. Dr. Valerie Thomas**

Overall the Disaster Response document is excellent. However, there are a couple of points in the full report that do not come through in the Letter to the Administrator. These are:

(1) that our recommendations are IN ADDITION to what EPA is already doing. The letter to the administrator reads as if these are our generic recommendations for disaster preparation.

(2) that the briefings strongly suggested to us that EPA could benefit from doing more than it is already doing, learning from effective organizations.

To fix this, I suggest adding, on the first page of the letter, after "... that there are not gaps in responsibility or response" a new sentence such as

"The SAB saw the briefings it received as suggesting that there are a number of actions EPA can take now to be better prepared for disasters. The agency has already undertaken extensive preparations for disasters. This report recommends that the Agency expand the range of those activities and invest modest resources in some broader efforts."

In addition, there are a few minor typographical errors:

Letter to Administrator, p. 2

change "advise" to "advised"

change "individual" to "individuals"

Letter to Administrator, p. 3

put comma after Network

eliminate comma after anticipatory (and also where this is repeated on p. 3 of the report).

Report p. 14

eliminated ; before "consumer complaint surveillance"

Report, p. 15

"were necessary digitized" - perhaps this is supposed to be "where"?

Report p. 21

change advice to advised

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



ATTACHMENT F

OFFICE OF THE ADMINISTRATOR  
SCIENCE ADVISORY BOARD

1 Honorable Stephen L. Johnson  
2 Administrator  
3 U.S. Environmental Protection Agency  
4 1200 Pennsylvania Avenue, N.W.  
5 Washington, D.C. 20460

6  
7 Subject: SAB Advisory on the EPA Ecological Research Program Multi-Year Plan

8  
9  
10 Dear Administrator Johnson:

11  
12 EPA's Office of Research and Development requested that the Science Advisory  
13 Board (SAB) provide advice on the Agency's draft *Ecological Research Program Multi-*  
14 *Year Plan FY 2008 – 2014 (Plan)*. The Plan presents proposed goals, objectives, and  
15 research questions for EPA's Ecological Research Program and also lays out an  
16 implementation strategy for the Program. In response to the Agency's advisory request,  
17 the SAB Ecological Processes and Effects Committee (Committee) reviewed the draft  
18 Plan. To augment the expertise on the Committee for this advisory activity, several SAB  
19 committee members with expertise in valuation of ecosystem services also participated in  
20 the review. The enclosed advisory report provides the advice and recommendations of  
21 the Committee.

22  
23 EPA's draft Plan articulates a new strategic direction that focuses on quantifying  
24 ecosystem services and their contribution to human health and well-being. The SAB  
25 strongly supports this strategic direction and commends the Agency for developing a  
26 research program that has the potential to be transformative for environmental decision  
27 making as well as for ecological science. The SAB finds that the research focus on  
28 ecosystem services represents a suitable approach to integrate ecological processes and  
29 human welfare. The Ecological Research Program's focus on ecosystem services can  
30 provide a sound foundation for environmental decisions and regulation based on the  
31 dependence of humans on ecological conditions and processes.

32  
33 Although the SAB strongly supports the new strategic direction of the Ecological  
34 Research Program, we have a number of concerns about the draft Plan. Most of these are  
35 related to the tension between stating an important and ambitious vision and producing a

1 practical implementation plan for a future that includes a limited and uncertain budget.  
2 The SAB is extremely concerned that the resource allocation for the Ecological Research  
3 Program is too small to accomplish the ambitious program goals. Studying ecosystem  
4 services is a new field and the ORD staff skill set may be insufficient to conduct all of the  
5 research proposed in the Plan. Most notable is the lack of in-house expertise in  
6 ecosystem services valuation. The Agency could be better served by acquiring outside  
7 expertise in this area to supplement the research program. We therefore strongly  
8 encourage EPA to provide additional intramural and extramural support (e.g., through  
9 STAR grants) for the Ecological Research Program, not only for technical elements but  
10 also for critical outreach/education efforts.

11  
12 The SAB also finds that the decadal overview of proposed ecological research would  
13 be most useful if it included more detailed information concerning the knowledge gaps,  
14 research questions, variables, geographic scales, and sites to be investigated. Similarly,  
15 clear identification of the Agency's research partners and clients would facilitate  
16 collaborative interactions. We therefore recommend that EPA revise the Plan according  
17 to the following suggestions:

- 18  
19 • Describe the linkages between EPA's ecological risk assessment research and the  
20 proposed new research direction of quantifying ecosystem services and their  
21 contribution to human health and well-being.
- 22  
23 • More clearly articulate the ways in which the concept of ecosystem services could  
24 provide guidance to the Agency's environmental programs.
- 25  
26 • Clarify why and how various research products will be developed and used;
- 27  
28 • Clearly identify EPA and other clients of the research program and focus outreach  
29 efforts to educate those clients;
- 30  
31 • Clarify existing and planned interactions among proposed research program  
32 components and with other federal agencies involved in assessment of ecosystem  
33 services to avoid duplication of effort and promote coordination and synergy;
- 34  
35 • Describe how partnerships with non-governmental organizations, professional  
36 societies, private businesses, and foundations, including international  
37 partnerships, can be enhanced to accomplish stated goals and objectives;
- 38  
39 • Incorporate into the Plan research with international partners to understand  
40 transboundary conditions and connections that extend across national borders;
- 41  
42 • Provide a more transparent explanation of the process and criteria used to select  
43 sites for place-based demonstration projects, following the procedure  
44 recommended in the body of this report to assure a sufficient number and  
45 diversity of sites;
- 46

This draft SAB committee report has been prepared for final review and approval of the chartered SAB. This draft report does not represent EPA policy.

- 1 • Explicitly recognize the role that emerging new ideas will play in the  
2 development of an adaptive program that stays on the cutting edge to respond to a  
3 rapidly changing arena for environmental and human welfare; and  
4
- 5 • Explain how program success will be evaluated on the basis of progress toward  
6 specifying relevant ecological endpoints and production functions, not on the  
7 basis of achieving the ultimate goals of EPA’s research and regulatory mission.  
8

9 Thank you for the opportunity to provide advice on this important topic. The SAB  
10 looks forward to receiving your response to this advisory.

11  
12 Sincerely,

13  
14  
15  
16 Dr. M. Granger Morgan, Chair  
17 Science Advisory Board

Dr. Judith L. Meyer, Chair  
Ecological Processes and Effects  
Committee

1  
2 **U.S. Environmental Protection Agency**  
3 **Science Advisory Board**  
4 **Ecological Processes and Effects Committee**  
5

6 **Augmented for the Advisory on the EPA Ecological Research Program**  
7 **Multi-Year Plan**  
8

9  
10 **CHAIR**

11 **Dr. Judith L. Meyer**, Distinguished Research Professor Emeritus, Institute of Ecology,  
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23 **Dr. Kathleen Segerson**, Professor, Department of Economics, University of  
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26  
27 **SCIENCE ADVISORY BOARD STAFF**

28  
29 **Dr. Thomas Armitage**, Designated Federal Officer, U.S. Environmental Protection  
30 Agency, Washington, DC

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**APPENDIX A. SPECIFIC COMMENTS ON THE ECOLOGICAL  
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1 **1. EXECUTIVE SUMMARY**  
2

3 EPA's Office of Research and Development requested that the Science Advisory  
4 Board (SAB) provide advice on the Agency's draft *Ecological Research Program Multi-*  
5 *Year Plan FY 2008 – 2014* (Plan). The draft Plan was reviewed by the SAB Ecological  
6 Processes and Effects Committee (Committee). To augment the expertise on the  
7 Committee for this advisory activity, several SAB committee members with expertise in  
8 valuation of ecosystem services also participated in the review. The draft Plan presents  
9 proposed goals, objectives, and research questions for EPA's Ecological Research  
10 Program (Program) and also lays out an implementation strategy for the Program. The  
11 Plan articulates a new strategic direction that focuses on quantifying ecosystem services  
12 and their contribution to human health and well-being. EPA has stated that the overall  
13 goal of the Program is to change the way decision makers understand and respond to  
14 environmental issues by making clear the ways in which policy and management choices  
15 affect the type, quality, and magnitude of goods and services that are received from  
16 ecosystems.

17  
18 EPA sought the SAB's advice on: 1) the appropriateness and utility of the new  
19 strategic direction in offering meaningful contributions to ecological sciences and  
20 providing research that will be useful to decision makers; 2) the adequacy of the goals,  
21 objectives, and research questions in contributing significantly to meeting the overall  
22 purpose of the Program; 3) the logic model and implementation approach in the Plan; 4)  
23 anticipated challenges to achieving the overall goal of the Ecological Research Program;  
24 5) suggestions for measuring annually over the next five years the progress, productivity,  
25 efficiency, and effectiveness of the Ecological Research Program; and 6)  
26 recommendations to enhance EPA's ability to leverage available resources within and  
27 outside the Agency. In response to the charge questions, the Committee has provided  
28 comments and recommendations to improve the Plan. Our recommendations are listed as  
29 bullets throughout this advisory report.

30  
31 ***Strategic direction and focus of the Program***  
32

33 The Committee strongly supports the new strategic direction of the Ecological  
34 Research Program. We commend the Agency for developing a research program that has  
35 the potential to be transformative for environmental decision making as well as for  
36 ecological science. The research program's focus on ecosystem services advances the  
37 desirable integration of ecological processes and human welfare and serves well the  
38 purposes of a public environmental management agency. This research focus can, if  
39 properly funded, provide a sound foundation for environmental decisions and regulation  
40 based on the dependence of humans on ecological conditions and processes. Although  
41 the Committee supports the overall strategic direction of the Program, we have a number  
42 of concerns about EPA's draft Plan. Most of these are related to the tension between  
43 stating an important and ambitious vision and producing a practical implementation plan  
44 for a future that includes a limited and uncertain budget. The following  
45 recommendations are provided to improve the discussion of the strategic vision and how  
46 it will be accomplished:

1

2 • The Committee finds that the long-term goals of the program are unlikely to be  
3 accomplished in the proposed time frame with current resources. We find the lack of  
4 grant support to be particularly worrisome given the limited EPA expertise available  
5 in certain areas and the fact that ecosystem services is a relatively young and rapidly  
6 developing field of science; we therefore strongly encourage EPA to provide  
7 additional funds for research on ecosystem services through the Agency’s STAR  
8 program.

9

10 • To strengthen the justification of research priorities and clarify how work will be  
11 accomplished, we recommend that the discussion of priorities in the Plan include the  
12 logic leading to: a) accomplishing initial goals; b) selecting geographic locations for  
13 research; and c) identifying the scales of efforts.

14

15 • The overarching goals of the Program cannot be accomplished without basic  
16 ecological research. We therefore recommend that more information be provided in  
17 the plan to identify knowledge gaps along with the basic research needed to fill these  
18 gaps, and that completion of this basic research be encouraged (e.g., through grants to  
19 researchers).

20

21 • The intended audience of the Plan (decision makers of whom the general public are  
22 the ultimate decision makers) and the range of decision types supported by the  
23 Ecological Research Program should be explicitly described “up front” in the Plan.

24

25 • The Plan should provide greater detail on how EPA will accomplish intra-program  
26 coordination and inter-institutional collaboration on the proposed research.

27

28 • The Plan would do well to recognize that the environment, institutions, and human  
29 welfare are changing at an unprecedented rate, and as new situations, new priorities,  
30 and new ideas develop, EPA should remain nimble enough to identify new  
31 “services,” ask new questions, and apply new measurement techniques.

32

33 • The ways in which the concept of ecosystem services could provide guidance to the  
34 Agency’s regulatory and non-regulatory programs need to be more fully explored and  
35 more clearly articulated in the Plan.

36

37 • The relationship between ecosystem service valuation and the application of  
38 ecological risk assessment should be described in the Plan. There is a strong  
39 connection between the current vision outlined in the Plan and EPA’s long history of  
40 engagement in ecological risk assessment.

41

#### 42 *Research goals and questions*

43

44 In the Plan, EPA has identified five long-term goals to guide its research agenda. The  
45 Committee has provided comments and recommendations on the goals, related research  
46 questions and objectives.

1  
2 Long-term Goal 1 envisages development of a decision support platform that offers  
3 EPA, states, local communities, and resource managers the ability to integrate, visualize,  
4 and maximize the use of diverse data, models, and tools at multiple scales for decision  
5 making. The Committee supports Long-term Goal 1 and offers the following  
6 recommendations for improvement.  
7

- 8 • Long-term Goal 1 should be restructured to integrate the elements of human health  
9 and well-being and ecosystem services valuation into one effort that must rely heavily  
10 on individuals and agencies outside of the core ecological research proposed;  
11 similarly, outreach and education should be integrated with the decision support  
12 platform into one effort addressing how decision makers would be targeted for  
13 outreach and education. A more comprehensive outreach and education plan should  
14 be developed to address human capital and resource needs. In addition, EPA should  
15 explicitly identify potential clients who will use the decision support platform.  
16
- 17 • The discussion of Long-term Goal 1 does not clearly describe how EPA will find the  
18 expertise to accomplish valuation of ecosystem services, development of the decision  
19 support platform, and outreach and education, including coordination and  
20 collaboration with other units in EPA and/or through outside cooperators. In the  
21 Plan, the discussion of the key role of ecosystem services value information should be  
22 clarified to indicate what original valuation research will, and will not, be conducted  
23 within the ecological research plan.  
24
- 25 • The Committee recommends that EPA focus on research that will be conducted to  
26 predict changes in ecosystem services rather than evaluating alternative valuation  
27 methods. This approach will take advantage of the available expertise within EPA's  
28 Office of Research and Development (ORD).  
29
- 30 • The Committee recommends that EPA more thoroughly describe how the decision  
31 platform would work. This description should indicate whether the decision support  
32 platform is intended to support actual decisions or to teach decision makers about the  
33 importance of ecosystem services using illustrative case studies. EPA should also  
34 describe how mapping, monitoring, and modeling research accomplished in other  
35 components of the research plan would be coordinated with work to develop the  
36 decision support platform.  
37
- 38 • As further discussed in Section 4.2 of this advisory report, the Committee is  
39 concerned about the overall feasibility of accomplishing Long-term Goal 1. We  
40 therefore recommend that development of the decision support platform be identified  
41 as a long-term objective, not a short run test of the Ecological Research Program's  
42 effectiveness.  
43

44 Long-term Goal 2 envisages developing a publicly accessible, scalable national atlas,  
45 an inventory system, and models for selected ecosystem services. The Committee finds  
46 that the work to be conducted under this goal may be one of the strongest parts of the

1 Ecological Research Program given that EPA has extensive experience in mapping and  
2 monitoring. We note that more detailed information is needed to understand how the  
3 maps and models developed under Long-term Goal 2 would be incorporated into the  
4 decision support tool. We offer three key recommendations concerning Long-term Goal  
5 2:

- 6
- 7 • The Committee recommends that EPA focus effort on developing forecasting models  
8 from information in available databases.
- 9
- 10 • The atlas of selected ecosystem services should be linked to models that can predict  
11 changes in ecosystem services. Monitoring data should lead directly into the atlas  
12 and support the forecasting models.
- 13
- 14 • The Committee recommends that EPA coordinate with other federal agencies to  
15 identify and review all federal agency projects to inventory, map, and monitor  
16 ecosystems. This review should be undertaken in order to determine how such  
17 projects can provide data to meet the objectives of the Ecological Research Program.  
18 The review could be conducted through a workshop, with the aim of coordinating all  
19 of the federal agency components to provide synergy and avoid duplication of effort.  
20 Subsequent to the workshop, a regular assessment of ecosystem services in time and  
21 space would be a very important product.
- 22

23 Long-term Goal 3 calls for an assessment of the positive and negative impacts on  
24 ecosystem services resulting from changes in nitrogen levels at select locations and  
25 within select ecosystems. The Committee finds that this is an important area of  
26 ecological research. However, given the relatively modest effort that can be undertaken  
27 with available resources, we are concerned about substantial stand-alone investments in  
28 this area. The following recommendations are provided:

- 29
- 30 • The fundamental question to be addressed by the nitrogen assessment is not clearly  
31 articulated. A more detailed description and justification of the research to be  
32 conducted should be developed.
- 33
- 34 • Opportunities for coordination and collaboration with research conducted in the  
35 place-based and wetlands components of the ecological research plan should be  
36 vigorously pursued, including systematic replications of nitrogen studies across the  
37 different places and systems.
- 38
- 39 • The Committee recommends that EPA reduce duplication of effort by partnering with  
40 other federal agencies conducting research on reactive nitrogen as related to human  
41 health issues.
- 42

43 Long-term Goal 4 of the Plan focuses on investigation of the dynamics of ecosystem  
44 service flows in two priority ecosystems, wetlands and coral reefs. The Committee finds  
45 that the long-term goal of assessing ecosystem services in wetland ecosystems is  
46 appropriate, but notes that it will be a challenge to address the complex spatial and

1 temporal issues of ecosystem processes and their linkages to ecosystem services (and  
2 ultimately to valuation of those services). In this regard it will be important to coordinate  
3 research activities across many research entities (e.g., EPA, universities, and other federal  
4 agencies). Chances of success could be improved by initially undertaking pilot projects  
5 where tangible products can be developed within a three-year period.  
6

- 7 • The Committee recommends that detailed implementation plans be developed by  
8 EPA to accomplish Long-term Goal 4 and that these plans receive outside peer  
9 review. It is particularly important to undertake projects related to multi-stressor  
10 diagnosis and subsequent ranking and linkage to ecosystem attributes and services.  
11
- 12 • Initial projects to accomplish Long-term Goal 4 should focus on a small set of  
13 representative wetland systems and perhaps also include a national assessment.  
14
- 15 • Although coral reef ecosystems are globally important, the Committee finds that they  
16 are a relatively low priority in the U.S. We recommend that EPA undertake projects  
17 in other more common “human dominated” ecosystems that provide services to more  
18 U.S. citizens, and greater opportunities for coordination and collaboration with other  
19 studies within the ecological research program.  
20

21 Long-term Goal 5 calls for place-based research to investigate ecosystem services.  
22 The Committee finds that there is a lack of adequate and transparent explanation in the  
23 Plan regarding the selection of areas where this research will be conducted. We therefore  
24 recommend that:  
25

- 26 • The Plan should contain a transparent explanation of the process used to select  
27 sites for place-based demonstration projects. In Section 4.1 of this advisory report  
28 we have suggested principles that could guide selection of these sites.  
29
- 30 • The Committee also recommends that transboundary issues be explicitly  
31 considered in the place-based projects.  
32

### 33 *Implementation Strategy*

34

35 The Plan contains a logic model that describes how the Ecological Research Program  
36 will be designed, planned, implemented and managed. The Committee has provided a  
37 number of comments and recommendations concerning: 1) the logic model; 2)  
38 anticipated challenges to achieving the overall program goal; 3) measuring program  
39 progress, productivity, efficiency, and effectiveness; and 3) enhancing EPA’s ability to  
40 leverage available resources.  
41

#### 42 *Logic model*

43

44 The Committee finds that the construct of the logic model in the Plan is a sensible way  
45 to represent program activities, products, and outputs. A similar approach has been  
46 suggested in a recent National Research Council (NRC, 2008) report.

- 1  
2 • As discussed in Section 4.3 of this advisory report, the Committee recommends that  
3 EPA consider adapting some of the terminology and structure of the NRC logic  
4 model and more clearly identify the role of partnerships in accomplishing research  
5 goals.

6  
7 *Challenges to achieving goals*

8  
9 The Committee has identified the following four broad categories of challenges facing  
10 the Ecological Research Program: 1) the ambitious nature of the overarching research  
11 questions and annual performance goals; 2) scientific and technical issues to be overcome  
12 in developing specific methodological or tactical approaches; 3) difficulties that may be  
13 encountered in extending program outputs to partners to support decision making  
14 processes; and 4) availability of resources (including institutional capabilities).

15  
16 The Committee finds that the most serious challenge facing the Ecological Research  
17 Program is the limited availability of resources. The long-term goals of the program are  
18 unlikely to be accomplished in the proposed time frame with current resources. The  
19 ORD staff skill set may not be sufficient to address the issues and conduct all of the work  
20 needed to achieve long-term program goals. Valuation and benefit assessment is one  
21 particular area where additional expertise is needed. If ecosystem services are to be  
22 properly evaluated, EPA will need expertise to ensure that well-being is parameterized in  
23 an accurate multidimensional manner. This should include consideration of non-Western  
24 value systems, notably those of native Americans. Furthermore, assessing ecosystem  
25 services is a new and rapidly developing area of research that will benefit from the  
26 diversity of insights and approaches provided by independent investigators. Given these  
27 conditions, we find the lack of grant support to be particularly problematic, and therefore  
28 strongly encourage EPA to provide additional funds for ecological research through the  
29 Agency's STAR program.

30  
31 *Suggestions for measuring progress, productivity, efficiency, and effectiveness*

32  
33 The Committee notes that the recent NRC (2008) report cited above provides relevant  
34 recommendations for evaluation of research and development programs at EPA. In  
35 Section 4.5 of this advisory report we have offered some additional recommendations.  
36 We generally find that, given the visionary intentions of the Plan and the current lack of  
37 detailed research implementation plans, it is premature to prescribe specific measures to  
38 evaluate annual performance and progress goals. However, we recommend that:

- 39  
40 • At this formative stage an assessment of the Plan as it develops should include  
41 monitoring, evaluation, and adjustment of objectives as partnerships and  
42 collaborations within and outside EPA evolve. Such an adaptive management  
43 approach requires flexibility and vigilance to capitalize on opportunities that arise.

44  
45 *Recommendations for enhancing EPA's ability to leverage available resources within*  
46 *and outside the Agency*

1  
2 The Committee finds that the success of the Ecological Research Program is likely to  
3 depend in large measure upon its ability to leverage available resources within and  
4 outside of EPA. In Section 4.6 of this advisory report we have offered a number of  
5 specific recommendations in this regard, summarized below.  
6

- 7 • The Memoranda of Understanding to be developed with federal partners should be  
8 more than agreements to cooperate. The memoranda should state who will do  
9 specific work when there is overlap, and how resources will be shared.  
10
- 11 • ORD should use its available people, infrastructure, and data to leverage in-kind  
12 services and collaborate with other groups/agencies. In this regard, there are ample  
13 partnership opportunities. ORD can partner with other agencies within the U.S. (e.g.,  
14 U.S. Fish and Wildlife Service, U.S. Forest Service, and National Park Service).  
15
- 16 • ORD should consider working with professional societies to sponsor sessions or  
17 symposia for: 1) presenting results of work to accomplish the goals in the Plan, and 2)  
18 soliciting feedback from stakeholders and end users. In addition, ORD should  
19 consider partnerships with private business, non governmental organizations (NGOs),  
20 and organizations such as non-profit foundations to raise funds to conduct research  
21 and development activities.  
22
- 23 • ORD should make the STAR program a priority in efforts to leverage resources. The  
24 following will help achieve the Plan's goals: enhancing the STAR Graduate  
25 Fellowships program; providing funds for non-targeted, exploratory extramural  
26 research to develop tools and procedures to accomplish the goals of the Plan; and  
27 developing a competitive grants program to run summer credit workshops for  
28 teachers through STAR.  
29
- 30 • ORD should partner with professional societies, publishing companies, media outlets,  
31 and NGOs to develop and disseminate education and outreach materials to  
32 professionals, teachers, and the lay public. Some suggested approaches that could be  
33 developed in partnership with other organizations include: workshops, symposia, and  
34 sessions at meetings, WIKI blogs, presentation materials for educators and public  
35 forums, media resources including cable television educational networks, and 10-15  
36 minute video clips that can be used in classroom settings.  
37
- 38 • ORD should also incorporate into the Plan research with international partners to  
39 understand transboundary conditions and connections that extend across national  
40 borders. Examples of such systems include the coastal waters of British Columbia,  
41 Canada and the Puget Sound/Georgia Basin in Washington and the prairie grassland  
42 ecosystems of the Midwestern United States and central Canada. A successful model  
43 of such an interaction is the long-standing research and management collaboration for  
44 the Great Lakes of North America.  
45

1 **2. INTRODUCTION**

2  
3 EPA’s Office of Research and Development requested that the Science Advisory  
4 Board (SAB) provide advice on the Agency’s draft *Ecological Research Program Multi-*  
5 *Year Plan FY 2008 – 2014* (Plan). The draft Plan was reviewed by the SAB Ecological  
6 Processes and Effects Committee (Committee). To augment the expertise on the  
7 Committee for this advisory activity, several SAB committee members with expertise in  
8 valuation of ecosystem services also participated in the review. The draft Plan presents  
9 proposed goals, objectives, and research questions for EPA’s Ecological Research  
10 Program and also lays out an implementation strategy for the Program.

11  
12 For the past ten years the EPA Ecological Research Program has focused on: 1)  
13 developing monitoring tools and indicators to determine the status of and trends in  
14 ecological resources and the effectiveness of national programs and priorities; 2)  
15 developing diagnostic tools and methods to determine causes of ecological degradation;  
16 3) developing tools and methods to forecast the ecological impacts of actions taken by  
17 states, tribes, and EPA offices; and 4) developing environmental restoration tools and  
18 methods to improve the ability of states, tribes, and EPA offices to protect and restore  
19 ecological condition. EPA’s draft *Ecological Research Program Multi-Year Plan FY*  
20 *2008 - 2014* articulates a new strategic direction for the Program that focuses on  
21 quantifying ecosystem services and their contribution to human health and well-being.  
22 This new approach takes the focus of the Program beyond traditional ecological  
23 endpoints such as biological, chemical, and physical condition. EPA has stated that the  
24 overall goal of the new Program is to change the way decision makers understand and  
25 respond to environmental issues by making clear the ways in which policy and  
26 management choices affect the type, quality, and magnitude of goods and services that  
27 are received from ecosystems.

28  
29 The Committee strongly supports the new strategic direction of the Ecological  
30 Research Program. We commend the Agency for developing a research program that has  
31 the potential to be transformative for environmental decision making as well as  
32 ecological science. The research focus on ecosystem services advances the desirable  
33 integration of ecological processes and human welfare and serves well the purposes of a  
34 public environmental management agency. The research program’s focus on ecosystem  
35 services can provide a sound foundation for environmental decisions and regulation  
36 based on the dependence of humans upon ecological condition and processes. While the  
37 Committee supports the overall strategic direction, we have a number of concerns about  
38 EPA’s draft Plan. These concerns are further discussed in various sections of this  
39 advisory report. The Committee has provided comments and recommendations to  
40 improve the Plan in response to the charge questions. Our recommendations are listed as  
41 bullets throughout this advisory report.

42  
43 **3. CHARGE TO THE COMMITTEE**

44  
45 EPA’s Office of Research and Development sought advice from the Science Advisory  
46 Board on the strategic direction and focus of the Ecological Research Program, the

1 research goals and objectives in the Plan, and the Agency's strategy for implementation.  
2 The following specific charge questions were provided to the Committee.

3  
4 ***Focus of the Program***

- 5  
6 1. The strategic direction of the Ecological Research Program (Program) is to: a)  
7 characterize and quantify the type, quality, and magnitude of services that ecosystems  
8 provide; b) develop new methods to quantify and forecast how services respond to  
9 stressors; and c) combine these and existing tools for assessing the benefits of  
10 alternative management decisions. Please comment on the appropriateness and utility  
11 of this strategic direction in: 1) offering meaningful contributions to the ecological  
12 sciences and 2) providing research that will be useful to decision makers at EPA and  
13 other levels of governance.

14  
15 ***Research Goals and Questions***

- 16  
17 2. The Ecological Research Program includes five long-term goals, associated  
18 objectives, and research questions. Please comment on the adequacy of the goals,  
19 objectives, and questions in contributing significantly to meeting the overall purpose  
20 of the program. In reviewing each research goal please consider the following:  
21  
22 • Are the research questions appropriate? If changes are needed in the research  
23 questions, please indicate how they should be changed.  
24 • Are the descriptions of planned research adequate to characterize the intended  
25 results, and is the planned research appropriate for accomplishing the goals?  
26 • Please comment on needed improvements in and clarification of the goals and  
27 objectives as well as additions or eliminations to be considered in future program  
28 development.

29  
30 ***Implementation Strategy***

- 31  
32 3. The Ecological Research Multi-Year Plan lays out the process by which ORD intends  
33 to accomplish research. Please comment on the logic model approach and provide  
34 any recommendations that should be considered in developing implementation plans.  
35  
36 4. Please comment on anticipated challenges to achieving the overall goal of the  
37 Ecological Research Program Multi-Year Plan based on the Program as presented.  
38 What recommendations does the Committee have to overcome the most significant of  
39 these challenges?  
40  
41 5. What suggestions does the committee have for measuring annually over the next five  
42 years the progress, productivity, efficiency, and effectiveness of the Ecological  
43 Research Program?  
44  
45 6. Does the Committee have any recommendations on how EPA can better enhance its  
46 ability to leverage available resources within and outside the Agency?

1  
2  
3 **4. RESPONSE TO CHARGE QUESTIONS**  
4

5 **4.1 Charge Question 1. Please comment on the appropriateness and utility of the**  
6 **strategic direction of the Plan in: 1) offering meaningful contributions to the**  
7 **ecological sciences; and 2) providing research that will be useful to decision**  
8 **makers at EPA and other levels of governance.**  
9

10 The Committee unanimously supports the conceptual framework of EPA’s draft  
11 Ecological Research Program Multi-year Plan. The conceptual framework of the Plan  
12 focuses on creation of an integrated systems-based approach to identify, inventory,  
13 monitor, map, and model ecosystem services. In addition, the conceptual framework  
14 focuses on quantifying ecosystem services and their contribution to human health and  
15 well-being. The research focus on ecosystem services represents a suitable approach to  
16 the integration of ecological processes and human welfare. The Committee finds that  
17 EPA’s focus on ecosystem services provides an appropriate foundation for environmental  
18 decisions and regulation based upon the dependence of humans upon ecological  
19 condition and processes. The conceptual framework for the program is thus tightly  
20 linked to the mission and agenda of EPA, and represents the leading ideas of the  
21 international ecological community. The vision outlined by EPA is a plan to develop the  
22 next generation of environmental management support technologies that build on risk  
23 assessment. The Committee finds that the resulting knowledge and tools will more  
24 completely support effective evaluation of management alternatives and improved  
25 communication of benefits to the public than is presently the case.  
26

27 However, the Committee has a number of concerns about EPA’s draft Plan. Most of  
28 these are related to the tension between stating an important and ambitious vision and  
29 producing a practical implementation plan for a future that includes a limited and  
30 uncertain budget. Our suggestions for improvement are related to maintaining the large  
31 and influential vision while appropriately defining the most pressing questions, scales,  
32 variables, and geographic locations to be investigated. We have nine major  
33 recommendations related to the overall adequacy and appropriateness of the strategic  
34 direction outlined in the Plan. These recommendations are aimed at improving the  
35 potential for contribution to ecological science and providing research that will be highly  
36 useful to decision makers.  
37

38 ***Recommendations to improve the potential contribution of the ecological research***  
39 ***program to ecological science and decision making***  
40

- 41 • The vision and direction described in the Plan are sufficiently important to merit  
42 substantial investment by EPA. The long-term goals of the program cannot be  
43 accomplished with current resources (funding and personnel) dedicated to this effort.  
44 It is our understanding that EPA is dedicating approximately \$68 million per year of  
45 Office of Research and Development staff time to support the ecological research  
46 program but is not providing any grant funding or other additional extramural

1 support. We recommend that Science to Achieve Results (STAR) program funds and  
2 other EPA resources be directed toward the ecological research program. The  
3 research program is advancing an area of ecological science that is new, where  
4 innovative and exploratory research will be needed to accomplish the important goals  
5 of the Program, and it is appropriate that extramural funding be focused there. The  
6 Plan is closely related to all five of the strategic goals defined in EPA's 2006 – 2011  
7 Strategic Plan (U.S. EPA, 2006), and the Committee recommends that those  
8 connections be communicated clearly in order to support substantially increased EPA  
9 investment in the Ecological Research Program.

- 10
- 11 • The vision outlined in the Plan is ambitious and important, and we recommend that  
12 the title of the document reflect this vision. In addition, as a challenge, we  
13 recommend that long-term goals (stretch goals) be clearly identified as such and  
14 presented in the Plan first, followed by a sequence of short-term priorities and  
15 measurable outcomes (i.e. an implementation plan). These measurable outcomes  
16 should be the basis for program evaluation criteria and metrics. The discussion of  
17 priorities in the Plan should include the logic leading to: a) accomplishing initial  
18 goals for first efforts at addressing ecosystem services; b) selecting geographic  
19 locations for research; and c) identifying the scales of the planned efforts. The  
20 discussion of the priorities should be clear and honest about current resources and  
21 leveraging past investments.  
22
  - 23 • The Program goals cannot be accomplished without answering basic science  
24 questions. It is recommended that knowledge gaps be identified in the Plan, and that  
25 EPA plan and appropriately fund the basic research needed to fill these gaps. In  
26 particular, empirical data are needed to test hypotheses regarding why changes in  
27 ecosystem services are occurring, and at which scales. Identification of knowledge  
28 gaps will allow the key basic science questions to be elaborated in the separate  
29 sections of the Plan, and provide both the rationale and intellectual construct for  
30 contributing to ecological science.  
31
  - 32 • Among the most complex challenges facing EPA is the rate of change: new  
33 environmental problems, new socioeconomic situations, and new threats to ecosystem  
34 services arise. A 10-year plan that is assiduously held to is very likely to miss  
35 opportunities for making the largest impacts, unless it has a review cycle and adaptive  
36 management plan. We recommend that not only the progress, but the vision and  
37 implementation, be reviewed frequently enough to allow nimble responsiveness and  
38 maximal effectiveness.  
39
  - 40 • It is recommended that the intended audience of the Plan and the range of decision  
41 types supported by the Ecological Research Program be more clearly described “up  
42 front” in the document. It would be helpful to include in the Plan a matrix or table of  
43 decision types (i.e., the types of choices being made at various decision-making  
44 levels) vs. decision makers (i.e., governmental, industrial, private organizations, etc.).  
45 The Committee notes that it is particularly important to elaborate issues of scale  
46 (local vs. regional).

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- The Committee recommends that EPA collaborate with other federal agencies and academic scientists to conduct a scientific community assessment of status and trends of ecosystem services in the U.S. (similar to the Intergovernmental Panel on Climate Change [IPCC] assessments). Such an assessment would be an appropriate and very important output from the research that is described in the Plan. This assessment would be a high impact, visible product from EPA that could have a large influence on decision-makers.
- The Committee recommends that EPA include in the Plan an organizational plan for inter-institutional collaboration. The importance of inter-institutional collaboration is an issue that arose repeatedly in the Committee’s discussion of the Plan. The Committee notes that the assessment of status and trends in ecosystem services could provide an opportunity for such collaboration. While we understand the challenges associated with developing a large collaborative research program, we find that if EPA were to lead an effort to undertake the assessment suggested above, the payoff would be large for science and management. The effort would be a visible contribution to a national initiative. One venue for an assessment of status and trends in ecosystem services would be collaboration with the National Center for Ecological Analysis and Synthesis, which could provide data analysis support, as well as support services for a series of workshops.
- The research program described in the Plan has the potential to provide guidance and to stimulate innovation in the Agency’s environmental management actions and policies. To realize that potential, effort is needed to strengthen and articulate the connections between the concepts in the research plan and the regulatory and non-regulatory programs in the Agency.
- The Committee notes that there is a strong connection between the current vision outlined in the Plan and EPA’s long history of engagement in risk assessment. We recommend that this connection be explicitly discussed in the plan. The relationship between ecosystem services valuation and the application of ecological risk assessment should be described in the Plan. The Committee finds that ecosystem services assessment is an activity that will provide decision makers with information to translate ecological risk assessments into management strategies for achieving sustainable future environmental protection.

**4.2 Charge Question 2. Please comment on the adequacy of the goals, objectives, and questions in contributing significantly to meeting the overall purpose of the program.**

In the Plan, EPA has identified five long-term goals to guide its research agenda. These five goals are: 1) by 2014, provide on-line decision support that offers EPA, states, local communities, and resource managers the ability to integrate, visualize, and maximize the use of diverse data, models, and tools at multiple scales to generate and understand the consequences of alternative decision options on the sustainability of

1 ecosystem services and human well-being; 2) by 2013, deliver publicly accessible,  
2 scalable national atlas, inventory system, and models for selected ecosystem services that  
3 can be quantified directly or indirectly; 3) by 2013, provide an assessment of the positive  
4 and negative impacts on ecosystem services resulting from changes in nitrogen levels at  
5 select locations and within select ecosystems; 4) by 2015, provide guidance and decision  
6 support tools to target, prioritize, and evaluate policy and management actions that  
7 protect, enhance, and restore ecosystem goods and services at multiple scales for two  
8 specific ecosystem types, wetlands and coral reefs; and 5) by 2013, complete four site-  
9 specific demonstration projects that illustrate how regional and local managers can  
10 proactively use alternative future scenarios to conserve and enhance ecosystem goods and  
11 services in order to benefit human well-being and secure the integrity and productivity of  
12 ecological systems.

13  
14 In the discussion of each long-term goal in the Plan, EPA has outlined the science  
15 questions and objectives to be addressed. The Committee provides the following  
16 comments on each of the long-term goals and related research questions and objectives:  
17

### 18 ***Long-term Goal 1 – Effective Decision Support***

19  
20 The Committee commends EPA’s Office of Research and Development (ORD) on  
21 expanding its vision for an ecological research agenda to include a component targeted  
22 directly at ensuring that its products are useful for decision making. This goal is not only  
23 appropriate but also essential if the Plan is to be part of a catalyst that helps to address the  
24 concern that ecosystems are being degraded because they are perceived as “free and  
25 limitless,” and their full value is not reflected in individual and policy decisions. In  
26 addition, the Committee agrees with ORD that it is important to recognize and  
27 incorporate into the vision for this long-term goal the overall objectives of outreach and  
28 education, valuation of ecosystem services, and estimation of ecological production  
29 functions. All of these are important objectives that, if met, will enhance the Agency’s  
30 ability to accomplish its mission and contribute to improved decision making.  
31

32 Although the Committee supports Long-term Goal 1 and the overall research  
33 objectives included under this goal, we have several concerns about EPA’s proposed plan  
34 to accomplish the goal. These concerns focus on: 1) how the plan is structured; 2)  
35 specific means to accomplish the goal; and 3) overall feasibility of accomplishing the  
36 goal.  
37

### 38 **Structuring the Plan to accomplish Long-term Goal 1**

39  
40 As reiterated throughout the Plan, some of the information needed to evaluate  
41 tradeoffs regarding ecosystem services in the context of decision making concerns the  
42 value or benefits of changes in service flows. These values reflect the impact of service  
43 flow changes on human health and well-being. In order to influence decisions,  
44 information about these values in turn must be communicated to the public (through  
45 outreach and education) and to decision makers (through the decision support platform).  
46 EPA describes the following four research program elements to accomplish Long-term

1 Goal 1: 1) Human Health and Well-being (HHWB) (i.e., research to help decision makers  
2 understand links between ecosystem services and human health and well-being); 2)  
3 Ecosystem services valuation (ESV) (i.e., research to give decision makers constructs to  
4 describe ecosystem values in a way that supports assessment of tradeoffs); 3) Outreach  
5 and Education (OE) (i.e., outreach to decision makers to ensure that research will meet  
6 their needs and be applied with confidence); and 4) Decision Support Platform (DSP)  
7 (i.e., research to develop and make available tools for decision makers operating in  
8 different circumstances, communities, spatial scales, and levels of complexity and  
9 uncertainty). The Committee finds that acknowledging the important roles of all of these  
10 elements is appropriate to an ecological research program within the ecosystem services  
11 framework, but they do not seem to be logically structured within Long-term Goal 1 and  
12 many aspects of these program elements may be outside the purview of ecological  
13 research per se. The following recommendations are provided to restructure this part of  
14 the Plan:

- 15  
16 • The Committee recommends combining and integrating the HHWB and ESV  
17 elements of the Plan, clearly identifying which aspects of HHWB and ESV are to be  
18 accomplished within the Ecological Research Program, and which are to be  
19 accomplished through cooperation and collaboration with other units within and  
20 outside of EPA. The logic of separating HHWB and ESV elements is not clear. The  
21 whole purpose of ecosystem service valuation is to determine the value of the impacts  
22 of changes in the flow of ecosystem services on human well-being (including changes  
23 in well-being stemming from changes in health outcomes). Thus, these two elements  
24 should logically be combined and integrated. On page 22 of the Plan it is suggested  
25 that they will be “closely coordinated,” but an explicit plan for using the output of the  
26 HHWB health outcomes as an *input* into the ESV is needed. In addition, explicitly  
27 linking the HHWB and ESV research will provide a conceptual basis for thinking  
28 about the linkage of ecological systems and indicators of human well-being in the  
29 context of the ecosystems services framework, which is likely to be a difficult task.  
30 The separate treatment of human health under the current structure may also give it  
31 more prominence in the study of ecosystem services than is warranted, since it is not  
32 clear that this is a major component of the impact of ecosystem services on human  
33 well-being. The Ecological Research Program should explicitly rely upon  
34 cooperation with the various medical, economic and other social sciences (mostly  
35 residing in other EPA units and outside agencies) to help identify, define, and  
36 quantify the values to ecosystem services to human health. The Ecological Research  
37 Program should focus on developing the ecological production functions of the  
38 ecosystems services framework.  
39
- 40 • The Committee recommends combining the DSP and OE elements. If the purpose of  
41 the OE element is to reach out to decision makers to ensure that the DSP meets their  
42 needs (as stated on page 21 of the Plan), then it would seem logical to combine these  
43 two elements into a single coordinated and integrated element which would draw  
44 from the ESV work. In fact, much of what is described as the means by which the  
45 OE objectives will be met (on page 34 of the Plan) appears to link closely to the DSP.  
46 The Committee also notes that many aspects of the DSP and OE sections of the Plan

1 will require cooperation with scientists in other agencies and parts of EPA, rather than  
2 being totally (or even largely) developed by ORD Ecological Research Program staff.  
3 The need for such cooperation is discussed in other sections of this advisory report.  
4

5 **Means to accomplish key research under Long-term Goal 1**  
6

7 The Committee is concerned that the Plan does not clearly describe how EPA will  
8 provide the expertise to accomplish research in three key areas: 1) valuation of ecosystem  
9 services; 2) development of the decision support platform; and 3) outreach and education.  
10

11 Valuation of ecosystem services  
12

13 One of the overarching research questions articulated on pages 8- 9 of the Plan  
14 concerns the impact of “changes in ecosystem services on human well-being and on the  
15 services’ monetary and non-monetary value.” However, the Committee notes that  
16 developing these ecosystem service values is a major research undertaking by itself (EPA  
17 Science Advisory Board, 2008a) and, despite the repeated reference in the Plan to  
18 ecosystem service values, it is not clearly indicated how these values will be determined  
19 and used, for example, in the DSP. The Plan mentions “partnering” with other EPA  
20 offices, organizations, or individuals to determine values. The Committee supports such  
21 partnering, but it is not clear what role these partners would play. The Plan seems to  
22 recognize this as a potential problem (see page 17 of the Plan), but does not articulate a  
23 strategy for addressing the problem. There is reference on page 22 of the Plan to drawing  
24 on the expertise within EPA’s National Center for Environmental Economics (NCEE),  
25 but it is not clear what is intended here. The Committee questions whether NCEE will be  
26 doing original valuation research that is specifically related to the Ecological Research  
27 Program. Information the Committee has received suggests that the NCEE commitment  
28 to this effort is limited. The Committee notes that, in general, NCEE has a strong focus  
29 on supporting regulatory impact analyses and therefore cannot devote resources to the  
30 goals of the Plan commensurate with what is required unless additional resources are  
31 provided. In addition, the recent SAB review of the ORD budget suggests there is little,  
32 if any, funding available for valuation research through external (STAR) grants (U.S.  
33 EPA Science Advisory Board, 2008b). The Committee further notes that, even though  
34 valuation or benefits assessment is listed as one of the Plan’s overarching research goals,  
35 on page 16 (Figure 5) the Plan indicates that valuation work will receive a very small  
36 share (only 2%) of Ecological Research Program resources (U.S. EPA Office of Research  
37 and Development, 2008). Thus, it appears that the Program will not generate much (if  
38 any) original valuation research, either through ORD directly or through its partners in  
39 the Plan. If this is true, a statement to clearly indicate such should be included at the very  
40 beginning of the Plan where the issue of valuation is first introduced. Throughout the  
41 Plan, there is discussion about the key role of value information, but it is not clear what  
42 valuation research will be undertaken. Therefore the Committee recommends that:  
43

- 44 • In the Plan, the discussion of the key role of ecosystem services value information  
45 should be clarified to indicate what original valuation research will, and will not, be  
46 conducted.

1  
2 The Committee finds that without additional resources ORD does not have the  
3 expertise to conduct valuation itself or the capacity to fund this type of research by  
4 others. However, ORD can benefit from and provide valuable input into valuation efforts  
5 conducted (and funded) by others. All ecosystem services valuation exercises, regardless  
6 of the specific valuation method used, require as input predicted changes in the flow of  
7 ecosystem services. EPA's Ecological Research Program can play a critical role in  
8 estimating the ecological production functions that can be used to generate predicted  
9 changes in service flows stemming from alternative decisions or management options  
10 (and the associated changes in stressors). The Committee notes, however, that even this  
11 will require the interdisciplinary interaction of a team comprised of ORD scientists and  
12 social scientists.

13  
14 The identification of ecosystem *services* requires information not just about the  
15 functions, processes, and bio-physical state of ecosystems but also about the (potential or  
16 actual) human uses or the contributions to well-being associated with those systems.  
17 Consideration of non-Western value systems, notably those of native Americans will be  
18 important to ensure that well-being is parameterized in an accurate multidimensional  
19 manner. This suggests that the identification, measurement and mapping of ecosystem  
20 services cannot be based solely on bio-physical information but must also incorporate  
21 information relating to social, economic, cultural or other population characteristics that  
22 affect the extent to which ecosystems contribute to human well-being. For example,  
23 maps and models of the relevant characteristics (and projected future characteristics) of  
24 the humans/societies near (and downstream from) a wetland are required to translate the  
25 particular water captured, filtered and stored into a "service" that is of value to people.  
26 These same human/social characteristics are frequently cited in the Plan as potential  
27 sources of stressors on wetlands, reinforcing the need for measures and models (and  
28 maps) of relevant human/social characteristics.

29  
30 Incorporating this information to identify and measure changes in services does not,  
31 however, mean that the Plan must include an assessment of alternative valuation methods  
32 (as currently articulated in the Plan). While such an assessment is important, given  
33 ORD's expertise, the Committee recommends that:

- 34  
35 • In the Plan, EPA should focus on research that will be conducted to predict changes  
36 in the ecosystems that provide selected ecosystem services rather than on evaluating  
37 alternative valuation methods for those services. This research focus will take  
38 advantage of the expertise available within ORD.

39  
40 The Committee notes that valuation is a complicated area requiring extensive  
41 consideration of a number of issues (EPA Science Advisory Board, 2008a), and there is  
42 the potential for misinterpretation if not done very carefully. For example, the plan  
43 suggests that the Science Advisory Board Committee on Valuing the Protection of  
44 Ecological Systems and Services (CVPESS) has recommended the use of "donor-based"  
45 methods of valuation based on stocks and flows of energy. The Committee notes that this  
46 assertion is incorrect. CVPESS did *not* recommend the use of "donor-based" methods.

1 This subject was debated by the CVPESS, but it is a controversial approach that is  
2 rejected by many, if not most, economists, as well as others on the Committee. This is an  
3 important consideration because “buy-in” from economists, social scientists, and others  
4 involved in the valuation and policy making process is essential to the success of the  
5 Plan. The Committee notes that this is just one example of the issues that can arise in  
6 valuation, but it illustrates why the Committee is concerned about this aspect of the Plan.

7  
8 Decision Support Platform (DSP)  
9

10 The Committee finds that in the Plan, several aspects of the discussion concerning the  
11 DSP are unclear. First, the Plan does not clearly identify the user community for the  
12 DSP. There are numerous references in the Plan to decision makers who are the intended  
13 audience for the DSP. However, it is likely that in many cases the users of the DSP may  
14 be analysts rather than decision makers. These analysts, in turn, provide information to  
15 the decision makers. It is important that the types of decision makers comprising the  
16 audience of the DSP be clearly identified. The Committee questions, for example,  
17 whether the DSP audience includes decision makers in industry. The Committee finds  
18 that EPA will miss a major opportunity if the Plan does not address how industry would  
19 use this information and tool set to factor ecosystem services into their day-to-day project  
20 designs and funding decisions. The Committee notes that clients (stakeholders) who will  
21 use the DSP must be identified early in the process, and their involvement in the decision  
22 process must be continuous. The Panel therefore recommends that:

- 23  
24 • In the Plan, EPA should explicitly identify potential clients who will use the DSP.  
25 This will allow outreach efforts to be targeted more specifically. The Panel notes that  
26 any computer-based environmental decision tool needs to be marketed to show its  
27 utility. Achieving widespread use among a variety of clients will require a variety of  
28 approaches.  
29

30 A second concern about the discussion of the DSP in the Plan is that it does not clearly  
31 describe how the DSP would work. The Committee questions, for example, whether the  
32 DSP is intended to provide support for *actual* decisions (in which case it must include  
33 specific information relevant to the particular decision context), or simply to *teach*  
34 decision makers about the importance of ecosystem services using illustrative case  
35 studies. The Committee notes that it may be a relatively easy task to collect information  
36 about ecosystem services in one place on an internet website for easy access by decision  
37 makers. Similarly, teaching tools can be easily developed and made available to decision  
38 makers. However, it is much more difficult to develop a meaningful interactive decision  
39 support tool for direct use in evaluating specific policy options. The nature and scope of  
40 the decisions relating to the provision of ecosystem services are likely to be varied in  
41 scale (e.g., local, regional, national) and geography (e.g., consideration of sites at  
42 different locations). Therefore, development of a single decision support tool that could  
43 simply be adapted (e.g., through re-parameterization) to specific contexts seems nearly  
44 impossible. If EPA envisions a suite of tools in the DSP, it is not clear how they would  
45 be designed (e.g., by ecosystem type or scale). Again, it might be possible to put various  
46 ecological models (with estimated ecological production functions) into the DSP, but in

1 order to evaluate tradeoffs, information about values is needed. The Committee  
2 questions whether the DSP will contain specific valuation information that can be  
3 combined with estimated ecological production functions for use in evaluating tradeoffs.  
4 The Committee notes that it can be quite dangerous to combine specific valuation  
5 information with separately estimated ecological production functions since this will  
6 inevitably involve the difficult task of transferring ecological values data and functions  
7 (including economic benefits) between different ecological and social contexts. The  
8 validity of such transfers hinges on a number of complex issues relating to the structural  
9 and functional similarities between the original ecological/social system (the study  
10 context) and the target ecological/social system (the policy context). If not done  
11 carefully, such transfers can be problematic, and are likely to be invalid. The Committee  
12 therefore recommends that:

- 13  
14 • In the Plan, EPA should more clearly describe how the DSP would actually work.  
15 This description should indicate whether the DSP is intended to provide support for  
16 *actual* decisions or to *teach* decision makers about the importance of ecosystem  
17 services using illustrative case studies. The Plan should describe the suite of tools  
18 envisioned in the DSP and how these tools would be designed.

19  
20 In the Plan, the DSP is often described as an instrument bringing together and making  
21 available whatever models and measures are developed under any of the other four long-  
22 term goals. The Committee finds that the DSP could more effectively promote  
23 coordination if it were used to encourage convergence among the separately developed  
24 models and measures. In this sense, a less flexible platform that required all  
25 projects/investigators to negotiate in the direction of common mutually acceptable  
26 models and measures might be more advantageous. There is also some indication that  
27 research to be completed under Long-term Goals 1 and 2 (Effective Decision Support and  
28 National Inventory, Mapping and Monitoring) could conflict and compete over models  
29 and measures. As discussed in the Plan, ORD's intention seems to be that the work  
30 under these two goals would be complementary, with the maps and models developed  
31 under Long-term Goal 2 being designed to be easily incorporated as both tools and  
32 contents in the DSP. However, it is not clear in the Plan how the required collaboration  
33 between research projects conducted under Long-term Goals 1 and 2 would be achieved  
34 operationally. Similarly, models and measures to be developed under the other goals are  
35 destined for use in the DSP, but it is not clear that they are constrained in any way to  
36 promote convergence across goals/projects. Therefore, the Committee recommends that:

- 37  
38 • In the Plan, EPA should clearly describe how mapping, monitoring and modeling  
39 research conducted under Long-term Goal 2 (and modeling work proposed under  
40 other long-term goals) would be coordinated with work to develop the DSP. EPA  
41 should describe how collaboration on these research projects would be achieved  
42 operationally.

43  
44 Outreach and Education (OE)

45

1 Long-Term Goal 1 of the Plan contains an OE component. The Committee notes,  
2 however, that OE has not historically been a significant part of ORD's work and,  
3 therefore, additional expertise may be needed in this area. The Plan alludes to the use of  
4 participatory, deliberative processes. This will require expertise in the use of these types  
5 of processes, but there appears to be limited (if any) expertise in this area within ORD.  
6 Aside from direct work on decision-aiding processes of this type, the OE component of  
7 the plan could seek to educate the general public about ecosystem services, under the  
8 assumption that one way to influence decision makers is to generate pressure from  
9 consumers and voters. This suggests the need for a more comprehensive OE plan, which  
10 will require human capital resources to provide necessary education. In particular, the  
11 Committee finds that efforts to "teach the teachers" could be very useful. The Committee  
12 recommends that:

- 13
- 14 • EPA should develop a more comprehensive OE plan addressing human capital  
15 resource needs to provide the education. The committee supports the Agency's plans  
16 to pursue opportunities for partnering with outside groups for these types of activities.  
17 The partnership with National Geographic is a good example of the kinds of activities  
18 needed.
- 19

### 20 **Overall feasibility of accomplishing Long-term Goal 1**

21

22 A major concern of the Committee relates to the overall feasibility of accomplishing  
23 Long-term Goal 1. The plan to accomplish this goal is ambitious, and the Committee  
24 questions whether ORD can realistically achieve the objectives and accomplish the tasks  
25 set forth here. The following factors (some of which have already been discussed)  
26 contribute to this concern:

- 27
- 28 - The design of decision support tools that can adequately address specific decision  
29 contexts will be difficult, given the wide diversity of: 1) needs of specific decision  
30 makers; 2) types of ecosystem services being addressed; 3) relevant geographical  
31 scales; 4) relevant jurisdictions; and 5) specific locations of interest.
- 32
- 33 - Development of the DSP is likely to be very time-consuming and costly.
- 34
- 35 - There is currently insufficient expertise within ORD to conduct the proposed  
36 research. Much of the research requires social and decision science expertise,  
37 which is generally lacking in ORD. Although the plan calls for partnerships with  
38 other units within EPA (e.g., NCEE) or outside, the nature and strength of these  
39 commitments is unclear. For example, the commitment articulated by NCEE is  
40 fairly limited and certainly not sufficient to meet the research objectives regarding  
41 valuation included in the plan. Relying on the good will of partners to meet the  
42 objectives and annual performance goals of a major part of the plan is risky.
- 43
- 44 - Although the ORD identifies decision support as a fundamental driving force for  
45 the Plan, the resources devoted to this part of the Plan constitute a small  
46 percentage of total resources available to the Ecological Research Program.

- 1  
2 - The timing of the work related to this objective is unclear. While it may be useful  
3 to collect currently available information about ecosystem services and their  
4 value(s) in a central on-line location in the early years of the Plan, the main payoff  
5 from the decision support will come much later when new research results and  
6 decision tools are available and incorporated into this platform. Alternatively, the  
7 DSP could be designed and then “tested” using the place-based projects in the  
8 Multi-Year Plan. The Committee finds that in all of these cases, the objective of  
9 having a fully operational decision support platform in place within five years  
10 may be unrealistic.

11  
12 Concerns about the feasibility of this part of the Plan are particularly worrisome  
13 because ORD has suggested that ultimately the success or failure of the Plan hinges on  
14 the success or failure of the decision support platform. The Committee recognizes the  
15 need to ultimately justify the ORD ecological research program based on its ability to  
16 affect decisions. However, we recommend that:

- 17  
18 • Development of the DSP should be a long-term objective and not a short run test of  
19 the program’s effectiveness (based on metrics such as the number of users of the  
20 decision support platform). The committee believes that ORD can contribute to this  
21 long run objective through other parts of the Plan even if it does not produce the type  
22 of fully operational decision support platform envisioned in the plan within the next  
23 five years.

24  
25 ***Long-term Goal 2 – National Inventory, Mapping, and Monitoring***

26  
27 Long-term Goal 2 envisages developing a publicly accessible, scalable national atlas,  
28 an inventory system, and models for selected ecosystem services. The Plan states that  
29 these research products will enable EPA, state and local governments, non-governmental  
30 organizations, and other decision makers to assess the likely effects of management  
31 actions on ecosystem services. The Committee finds that the work to be conducted under  
32 Long-term Goal 2 may be one of the strongest parts of the Ecological Research Program  
33 Multi-year Plan because EPA has extensive experience in developing environmental  
34 inventories, mapping, and monitoring. The maps and resulting models developed under  
35 Long-term Goal 2 should definitely be incorporated into the Decision Support Platform  
36 of Long-term Goal 1. However, the Committee notes that more detailed information is  
37 needed to completely understand how this would happen. We presume that such  
38 information will appear in an implementation plan to be developed by ORD. The  
39 Committee is concerned that the plan not define ecosystem services too narrowly,  
40 overemphasizing basic human health and welfare goals. For example, under a narrow  
41 perspective, the Arctic National Wildlife Refuge would have no value other than its  
42 ability to produce oil. The use of valuation has merit in the management of human-  
43 dominated landscapes, but a major aspect of resource management, namely non human-  
44 dominated systems, should also be considered in research questions and objectives under  
45 Long-term Goal 2. In this regard, the key for the Ecological Research Program is to be  
46 sure that research addresses all ecological components and processes that are important to

1 the provision of any services identified as relevant to EPA mandates and responsibilities.  
2 In addition, it is important that adequate attention is given to identifying all of the  
3 services to which any given component or process contributes, including services not  
4 explicitly targeted within a given policy or decision-making context. With regard to  
5 Long-term Goal 2, the Committee provides the following specific comments and  
6 recommendations concerning: 1) forecasting models, the atlas of ecosystem services, and  
7 modeling expertise; and 2) the need for coordination of federal agency monitoring  
8 activities.

### 9 10 **Forecasting models, the atlas of ecosystem services, and the need for modeling** 11 **expertise**

12  
13 Considerable data have been accumulating from numerous federal monitoring  
14 programs; Olsen et al. (1999) identify at least 15 of these programs. Some of these  
15 monitoring programs are based on probability sampling, others on site characteristics.  
16 Sampling occurs at different spatial and temporal scales, resulting in different lengths of  
17 series. Thus far, the monitoring programs have been used largely to determine status and  
18 trends. The Committee finds that EPA now needs to address questions such as: How and  
19 why are ecosystems and ecosystem services changing?; How are ecosystems being  
20 affected by humans?; and finally How might management decisions reduce negative  
21 consequences, or even result in beneficial gains? The Committee also finds that the idea  
22 of developing a scalable national atlas is a good one; the atlas can be an excellent  
23 communication tool but it should be linked to modeling efforts. The Committee  
24 specifically recommends that:

- 25  
26 • EPA's Ecological Research Program should plan to develop forecasting models from  
27 the information in available databases.
- 28  
29 • The atlas should be linked to models that can predict changes in ecosystem services.  
30 The monitoring data should lead directly into the atlas and the forecasting models; by  
31 doing so EPA will be capable of assessing the consequences of choices. The  
32 demonstration projects are the places to try to forge the connections between the  
33 maps, models, and forecasting tools.
- 34  
35 • The Plan proposes development of an Ecological Research Program "Community of  
36 Practice for Modeling." This is a laudable idea, but the Committee questions who  
37 will participate, and where these modelers will come from. The Committee  
38 recommends that EPA invest in meeting the need for graduate education to produce  
39 the next generation of modelers, and notes that industry has apparently started to do  
40 so.

### 41 42 **Review of monitoring projects by the "federal family"**

43  
44 As previously mentioned, numerous federal agencies are conducting ecosystem  
45 monitoring activities. Given resource constraints, it is important to ensure that these

1 activities are well planned and coordinated. In this regard, the Committee provides a  
2 number of recommendations.

- 3
- 4 • EPA should collaborate with other federal agencies to conduct a review of all federal  
5 agency ecosystem/ecosystem services inventory, mapping, and monitoring type  
6 projects. This review could be conducted through a workshop similar to the type  
7 conducted by the National Center for Ecological Analysis and Synthesis (NCEAS,  
8 2008). This review should bring together all of the various federal agency  
9 components as a “federal family” to optimize coordination and synergy among these  
10 different monitoring programs.
- 11
- 12 • The suitability of various databases for use in developing EPA’s Ecological Research  
13 Program products should be assessed as soon as possible and definitely before 2013.  
14 One of the goals of the workshop recommended above would be to determine  
15 whether the scales of sampling and measurement are small enough. Programs like  
16 EPA’s Environmental Monitoring and Assessment Program (EMAP) were set up for  
17 inference at regional scales that may be too large for what is desired by the EPA’s  
18 proposed Ecological Research Program.
- 19
- 20 • The Committee finds that, subsequent to the workshop mentioned above, a regular,  
21 high visibility assessment of ecosystem services in space and time could be the most  
22 important product to come out of EPA’s Ecological Research Program. The  
23 Committee recommends that EPA conduct such an assessment. It could be patterned  
24 after the Intergovernmental Panel on Climate Change model, which has certainly  
25 garnered international attention. EPA’s Ecological Research Program has the  
26 mapping and landscape ecology expertise to carry out this work.
- 27
- 28 • The Committee recommends that EPA provide some examples in the Plan to illustrate  
29 the link between ecosystem structures/functions and ecosystem services. For  
30 example, water provisioning is an ecosystem service that could be linked to a wide  
31 range of interconnected ecosystem structures and functions.
- 32

### 33 ***Long-term Goal 3- Nitrogen Assessment***

34

35 Long-term Goal 3 of the Plan calls for an assessment of the positive and negative  
36 impacts on ecosystem services resulting from changes in nitrogen levels at select  
37 locations and within select ecosystems. The Committee commends ORD for providing in  
38 the Plan a more than ample background discussion of the importance of reactive nitrogen  
39 (Nr) to terrestrial and aquatic ecosystems. We agree with the assertion in the plan that  
40 this is an important area of ecological research. However, given the relatively modest  
41 effort that can be undertaken with available resources, we have some concern about  
42 investing effort in this area. The following comments and recommendations are provided  
43 to improve this part of the Plan.

- 44
- 45 • The Committee recommends that a more detailed description of the research  
46 proposed under Long-term Goal 3 be provided. The Committee expects that it is

1 EPA’s intention to provide this in the implementation phase of the program. At this  
 2 point, however, the major question posed by the Committee is: What is the  
 3 fundamental question to be addressed by the Nitrogen Assessment? Some Committee  
 4 members found that the nitrogen assessment section of the Plan was well written and  
 5 that the proposed research seemed to be tractable. However, other Committee  
 6 members found that the description of the research was so general that it was difficult  
 7 to evaluate.  
 8

- 9 • The Committee recognizes that EPA intends to initially undertake a modest Nitrogen  
 10 Assessment at specific locations and eventually expand this to a national effort.  
 11 However, there is some sentiment among Committee members that perhaps the Nr  
 12 research could be dropped in favor of focusing more effort in other areas of the  
 13 Ecological Research Program (e.g., outreach and education). The Plan clearly  
 14 describes the importance of Nr to ecosystems. However, the Committee finds that the  
 15 Plan does not clearly or convincingly state why EPA’s Ecological Research Program  
 16 should include a Nitrogen Assessment, particularly at the limited level proposed.  
 17
- 18 • The Committee recognizes the potential value of investigating Nr because it  
 19 represents a cross media approach for evaluating ecosystem services and it also  
 20 impinges on human health. However, there are a number of other agencies (e.g., U.S.  
 21 Department of Agriculture, and National Oceanic and Atmospheric Administration)  
 22 and some programs within EPA (e.g. Office of Air and Radiation) conducting  
 23 scientific studies and research on Nr as related to human health issues. The  
 24 Committee therefore recommends that ORD reduce the chance of duplication of  
 25 effort by partnering with other federal agencies and EPA offices conducting scientific  
 26 studies and research on Nr as related to human health issues. Through such  
 27 partnerships, ORD might eventually contribute to a better understanding of the  
 28 significance of Nr to ecosystem services flows and human health and well-being.  
 29
- 30 • The discussion of Long-term Goal 3 in the Plan should contain a clearer explanation  
 31 of why Nr was chosen for study rather than other chemicals. The Plan clearly states  
 32 that Nr can have both positive and negative effects on ecosystem services and that  
 33 both the positive and negative ends of the spectrum must be examined. We strongly  
 34 agree with that conclusion and note that this departure from the "negative only"  
 35 approach is commendable. However we question the rationale for choosing to study  
 36 only N as opposed to other substances such as mercury whose negative effects on  
 37 services might be easier to assess. Furthermore, we question why ORD has chosen to  
 38 assess N instead of P; both affect plant productivity.  
 39
- 40 • The Plan states that the nitrogen assessment will take advantage of ongoing studies in  
 41 wetlands and coral reefs. The Committee finds that concentrating Nr research on  
 42 wetlands would be profitable, but we note that it would also be profitable to  
 43 concentrate on terrestrial systems (e.g., in the western U.S. where N is often limiting  
 44 productivity). Although coral reefs are important in many parts of the world, they do  
 45 not have a high importance to the majority of U.S. citizens (see below).  
 46

## 1 *Long-term Goal 4 – Ecosystem Assessments*

2  
3 Long-term Goal 4 of the Plan focuses on investigation of the dynamics of ecosystem  
4 service flows in two priority ecosystems, wetlands and coral reefs. The Plan states that  
5 both of these ecosystems deliver a wide range of services (e.g., fish and fiber production,  
6 water supply support, water purification, climate regulation, flood regulation, coastal  
7 protection, recreational opportunities, and tourism). Furthermore, the plan indicates that  
8 these systems are in serious decline (Dahl, 2005; Wilkinson, 2004) and that efforts to  
9 manage and protect them have been inadequate. The Committee finds that the long-term  
10 goal of assessing ecosystem services in wetland ecosystems is entirely appropriate, but  
11 notes that it will be a challenge to address the complex spatial and temporal issues of  
12 ecosystem processes and their linkage to ecosystem services (and ultimately their  
13 valuation). These areas will require significant resources for research extending beyond  
14 those currently identified (i.e., the availability of EPA ORD scientists). In addition, while  
15 we recognize that the purpose of the Plan is to provide a visionary “big picture” of EPA’s  
16 goals and objectives for ecological research, we note the need to address many complex  
17 issues concerning project design and uncertainty associated with the research to be  
18 completed under Long-term Goal 4. ORD has indicated that these critical details (some  
19 of which are described below) will be addressed in follow-up implementation plans. The  
20 Committee provides the following recommendations to further develop and implement  
21 Long-term Goal 4:  
22

- 23 • The follow-up implementation plans that will describe many complex issues  
24 concerning project design and uncertainty associated with research to be completed  
25 under Long-term Goal 4, and other long-term goals, should receive outside peer  
26 review.  
27
- 28 • The initial projects to be undertaken by EPA to accomplish Long-term Goal 4 should  
29 focus on a small set of representative wetland systems and perhaps also include a  
30 national assessment. This would produce useful examples for different user groups.  
31
- 32 • The Committee finds that, although coral reef systems are globally important, they  
33 are a relatively low priority in the U.S. We recommend that ORD undertake projects  
34 in more common human-dominated ecosystems that provide services to more U.S.  
35 citizens.  
36
- 37 • Research efforts under Long-term Goal 4 should be integrated with some of EPA’s  
38 other multi-year programs to more efficiently utilize resources.  
39
- 40 • The Committee recommends that, as research on this exciting area is accomplished,  
41 ORD develop a strong, active, iterative adaptive management process that modifies  
42 the process and coordinates efforts across the many research entities (e.g., EPA ORD  
43 laboratories, universities, National Science Foundation, National Oceanic and  
44 Atmospheric Administration [NOAA], and Department of the Interior). It is critical  
45 that this process and the approaches used receive “buy-in” now from these potential

1 partners to ensure the success of this effort. Given today’s funding climate, joint  
2 partnership is essential.

- 3
- 4 • The Plan should acknowledge that this approach is an extension of the EPA  
5 Ecological Risk Assessment (ERA) framework and relate the process to the risk  
6 assessment framework of Problem Formulation, Exposure and Effects  
7 Characterization, Risk Characterization, and Risk Management. The many critical  
8 issues and recommendations identified in the 2007 U.S. EPA Science Advisory Board  
9 (2007) report on improving ecological risk assessment (EPA Science Advisory  
10 Board, 2007) should be incorporated into the Plan. In this regard, spatial and  
11 temporal issues are particularly important.
- 12
- 13 • The Committee recommends that in the Plan, ORD acknowledge and tackle multi-  
14 stressor diagnosis and subsequent ranking/linkage to ecosystem attributes, and then to  
15 services. Understanding “why” (i.e., causality) ecosystem services are lost in multi-  
16 stressor systems is a key missing piece. This work is critical to the success of the  
17 overall approach articulated in the Plan. If such work is not undertaken, there will be  
18 substantial uncertainty in the model predictions and thus in EPA’s ability to validate  
19 the approach. For example, if databases do not effectively characterize the  
20 spatial/temporal components of “background” or “reference,” then it will not be  
21 possible to link a stressor with an adverse effect (or service loss), nor evaluate the  
22 effectiveness of a Best Management Practice (BMP) in restoring an ecosystem  
23 attribute (and service). It is critically important to establish sound linkages among  
24 biophysical processes. Such work should be regularly reviewed by external experts.  
25 This could be done as part of the implementation plan.
- 26
- 27 • As discussed above, funding this effort will be a challenge. To improve the chances  
28 of success, the Committee recommends that ORD follow a strategy of undertaking  
29 one or two simpler pilot projects initially, where tangible products showing the  
30 process from beginning to end can be produced within a three-year period. This  
31 approach would increase the likelihood of new and continued funding, allowing for  
32 “proof of concept” and additional stakeholder buy-in. Simultaneously, long-term  
33 projects could be proceeding. There will undoubtedly be continual advances in the  
34 tools being created and the ability to value services each year, so work under Long-  
35 term Goal 4 should continue to advance for many years to come.
- 36

### 37 ***Long-term Goal 5 - Place Based Demonstration Projects***

38

39 Long-term Goal 5 of the Plan calls for place-based research to investigate ecosystems  
40 services. ORD has chosen to focus on four different areas for proposed place-based  
41 demonstration projects: Tampa Bay, the Midwest (13 “breadbasket” states); the  
42 Willamette River; and the coastal Carolinas. Figure 22 on page 94 of the Plan provides a  
43 partial map of the United States showing the location of these areas. There was a  
44 diversity of opinion among Committee members regarding the suitability of these four  
45 different areas for place-based demonstration projects. During the Committee’s  
46 deliberations, it became clear that this diversity of opinion was due to a lack of adequate

1 and transparent explanation in the Plan regarding the specific choices. The Committee  
2 recognizes that there are no ‘perfect’ choices, but notes that a high degree of acceptability  
3 can be obtained by well rationalized, transparent choices. We therefore recommend that:  
4

5 • The Plan should contain a transparent explanation of the process used to select sites  
6 for place-based demonstration projects. To this end, we recommend that the  
7 following organizing principles be used (along with others as appropriate, so long as  
8 they are transparent) for selecting and justifying different areas for place-based  
9 demonstration projects. Whether more or less than four such areas will be chosen will  
10 be governed by these principles:

- 11
- 12 - The areas must be widely representative of the major ecological areas in the U.S.  
13 where humans live or on which they rely.
  - 14
  - 15 - Historic, current and projected future changes to ecosystem services in these areas  
16 must be documented/predicted (in this regard we support use of the concept of  
17 “ecosystem services districts and operational management options” discussed on  
18 page 5 of the Plan).
  - 19
  - 20 - It must be possible to generalize/transfer the findings of place-based  
21 investigations to other geographic areas/systems in the U.S. (and also, where  
22 appropriate, outside of the U.S.)
  - 23
  - 24 - The selected areas as a set should provide opportunities for systematic  
25 comparisons and contrasts in important ecosystem services, structures and  
26 functions, as well as opportunities for collaborative studies in concert with the  
27 wetland (and coral reef or alternative ecosystem) and the nitrogen study  
28 components of the Ecological Research Program. For each selected area,  
29 appropriate data must be available on the local ecology, ecosystem services, and  
30 changes in those services.
  - 31
  - 32 - Adequate local resources (EPA or other [partner] staff and facilities) must be  
33 available.
  - 34
  - 35 - Although not an organizing principle, it is also highly recommended that local  
36 decision makers be supportive of these efforts in their area.
  - 37

- 38 • When the choices are made, they should be shown on a map that includes all U.S.  
39 States and Territories, which is not presently the case in Figure 22 on page 94 of the  
40 Plan. This will provide transparency regarding key ecological areas excluded (e.g.,  
41 Alaska is presently excluded but not included on the figure).
- 42
- 43 • In the Plan, some clarification of the text that supports the final choices is needed.  
44 The Plan should indicate that: a) scales differ for a purpose - large and small scales  
45 need to be chosen (both within and between component studies) to attempt to  
46 determine what scale is most tractable/useful, and b) biofuels are not the only focus in

1 the Midwest. With regard to the latter point, we note that the only mention in the  
2 Plan of life-cycle assessment (LCA) is in the Long-term Goal 5 in relation to biofuels.  
3 LCA is a useful means for visualizing and assessing different alternative actions  
4 relative to management alternatives. We therefore provide the following  
5 recommendation concerning LCA:  
6

- 7 • We strongly urge EPA to consider expanding the application of LCA in the Plan  
8 beyond biofuels, at least in the form of demonstration projects that could be used to  
9 show the utility and need for this approach relative to future decision making.  
10
- 11 • The Committee emphasizes the importance of coordination and attention to  
12 interrelationships across the place-based demonstration projects. This is explicitly  
13 mentioned in the Plan: ORD apparently has a designated place-based coordinator, and  
14 there is specific mention in the Plan of relationships to the nitrogen theme and the  
15 wetlands ecosystems project. However, we find that the brief descriptions of the  
16 individual projects do not show how such coordination will be operationally  
17 achieved. The usefulness of the “quintain” approach discussed on page 93 of the Plan  
18 (i.e., a function or condition studied in multiple cases to evaluate similarities and  
19 differences in order to better understand the whole) (Stake, 2006) would be more  
20 evident if a strategy for cross examination of functions and services were explained in  
21 more detail.  
22
- 23 • The Committee strongly recommends that transboundary issues be explicitly  
24 considered in the place-based projects. Due to atmospheric transport, such issues will  
25 apply to all projects, even those geographically isolated from political borders. We  
26 were surprised that transboundary issues were not discussed or considered in the  
27 discussion of Long-term Goal 5, particularly since the proposed mid-Western place-  
28 based demonstration project includes the border with Canada and the Great Lakes,  
29 which are managed by Canada and the U.S. as one entity. Similar transboundary  
30 issues exist elsewhere; e.g., conditions in the coastal waters of British Columbia,  
31 Canada influence management in the Puget Sound/Georgia basin in Washington.  
32

33 **4.3 Charge Question 3. Please comment on the logic model approach and**  
34 **provide any recommendations that should be considered in developing**  
35 **implementation plans.**  
36

37 In the Plan, ORD has provided a logic model that describes how the Ecological  
38 Research Program will be designed, planned, implemented, and managed. The model  
39 also summarizes: 1) how research results will be communicated to users, and 2) the types  
40 of outcomes and specific environmental results that the research program is designed to  
41 achieve. This model is summarized in Figure 4 on page 14 of the Plan. The Committee  
42 finds that the logic model approach articulated by ORD is a reasonable way to represent  
43 the research activities that comprise the Plan. The logic model construct of inputs and  
44 activities focused on particular outputs and, more importantly, outcomes is sensible.  
45 Indeed, the Plan states explicitly that, without appropriate outcomes, research efforts and  
46 the results that will follow are of little utility. A similar approach is shown for EPA

1 research in general in the recent National Research Council (NRC, 2008) report. This  
2 NRC report, *Evaluating Research Efficiency in the U.S. Environmental Protection*  
3 *Agency*, discusses the difficulty of evaluating research programs in terms of results,  
4 which are usually described as outputs and ultimate outcomes. NRC (2008) notes that  
5 between outputs and ultimate outcomes are many kinds of “intermediate outcomes” that  
6 have their own value as results and can therefore be evaluated. The logic models in the  
7 Ecological Research Program Multi-Year Plan and in the NRC report both show the  
8 sequence of research, including inputs, outputs, intermediate outcomes, and ultimate  
9 outcomes. By placing efforts into the structure of this kind of logic model, the Ecological  
10 Research Program can in essence work backward from desired outcomes, and can  
11 improve the potential that research efforts will be appropriately framed. The Committee  
12 does, however, have the following comments and recommendations that ORD should  
13 consider as it refines and implements this logic model.

- 14  
15 • The outputs and outcomes listed in the model are generic; considerable thought and  
16 attention must be put into ensuring that the appropriate specific outcomes are  
17 formulated.  
18
- 19 • The Committee recommends that ORD consider adapting some of the terminology  
20 and structure of the NRC logic model, particularly when research outputs are  
21 formulated. ORD should consider including intermediate outcome boxes in the  
22 model as shown in Figure 4-1 on page 37 of the NRC (2008) report (outcomes from  
23 the research itself, and outcomes from users of the research). In addition, it will be  
24 critical that careful analysis and oversight of these outputs and outcomes occurs  
25 through time, and that feedback from outcomes is used to reevaluate both the  
26 necessary inputs and the activities, thus completing the loop suggested in the Figure 4  
27 of the Plan.  
28
- 29 • The Committee recommends that feedback loops be explicitly incorporated into the  
30 logic model. It is important to ensure that the outputs lead to useful outcomes; if they  
31 do not, then the Ecological Research Program must address and adjust its activities.  
32 Such feedback loops, while implied in the logic model structure, are not explicitly  
33 described. In addition, this mechanism will be an important way for the Ecological  
34 Research Program to get feedback on the quality and utility of the research and tools  
35 being provided.  
36
- 37 • The Committee recommends that the logic model explicitly identify linkages to  
38 partners that are collaborating in research activities. The model shown in Figure 4 of  
39 the Plan appears to be internal to the EPA Ecological Research Program, even though  
40 many partners will be collaborating in the research activities. Thus, it is important  
41 that the transfers to and from other users be collaborative in nature, and not passive.  
42 This is necessary for other offices within EPA, other users of the data from a  
43 management perspective, and the outside research community. These linkages need  
44 to be shown in the model. As noted elsewhere, the Committee is very concerned that  
45 the relatively small investment in outreach and education, only 1% of the total effort  
46 overall, will not provide what will be necessary to ensure these collaborations and

1 transfers. Therefore, the Ecological Research Program will have to find creative  
2 partnerships to ensure that these interactions occur and that they are collaborative.  
3

- 4 • In addition, the “Externalities” identified in Figure 4 of the Plan should not be defined  
5 as such, at least not within the terminology of economics. It is recommended that a  
6 more appropriate term, such as external forcing functions, be used to identify these  
7 important drivers.  
8

9 **4.4 Charge Question 4. Please comment on anticipated challenges to achieving**  
10 **the overall goal of the Ecological Research Program Multi-Year Plan based**  
11 **on the Program as presented.**  
12

13 The Committee has identified a number of challenges and research opportunities that  
14 the Ecological Research Program will face as it strives to achieve program goals. It is  
15 important to clarify that the Committee does not view these challenges necessarily as  
16 shortcomings, but rather inherent issues that will persist and must be explicitly addressed.  
17 The Committee recognizes four broad categories of challenges that are associated with:  
18 1) the nature of the overarching research questions and annual performance goals; 2)  
19 specific methodological or tactical approaches; 3) efforts to extend program outputs to  
20 partners and other user groups in order to support decision-making processes; and 4)  
21 resources, including institutional capabilities. Many of these challenges were clearly  
22 articulated in the Plan. The Committee has also identified a number of cross-cutting  
23 ecological research opportunities to improve and contribute to a variety of EPA  
24 programs. We provide the following comments on these challenges and opportunities.  
25

26 *Challenges associated with the nature of overarching research questions and*  
27 *performance goals*  
28

29 The Committee commends the authors of the Plan for articulating an ambitious and  
30 exciting vision for the Ecological Research Program. The Committee finds that the  
31 vision is appropriately bold and far-reaching, but we find that it would be helpful to focus  
32 the vision on the timeline in the Plan (i.e., articulate the specific pieces that can actually  
33 be accomplished in the proposed timeframe). Several members of the Committee felt  
34 that the specific long-term and annual performance goals were particularly ambitious  
35 given the limited resources and short time span of the Plan. Achieving fewer or narrower  
36 goals is generally preferable to falling short of overly-ambitious aims. The Committee  
37 recommends that the organization of the Plan be altered to more clearly distinguish  
38 between the long-term goals of the Program and the short-term specific objectives that  
39 might actually be accomplished. Separating the vision statements and long-term goals  
40 into a separate section at the beginning of the Plan would make it clear that these are not  
41 intended to be accomplished in full within the time and resources of the current Multi-  
42 Year Plan. Subsequent sections of the document could focus on the short-term goals and  
43 objectives intended to be accomplished within the current Plan. In light of the need to  
44 focus the goals, the Committee notes that reducing possible redundancy and increasing  
45 connection/interaction with previous or current work of other agencies is imperative.  
46 Two other general areas of concern are related to the heavy emphasis on the utilitarian

1 values of ecosystem services, particularly as related to human health, and the  
2 comparatively little attention given to understanding the effects of multiple stressors on  
3 ecosystem services. As noted above, adequate attention should be given to identifying all  
4 of the services to which any given ecosystem component or process contributes,  
5 including services not explicitly targeted within a given policy or decision-making  
6 context. Consideration of the effects of multiple stressors will be important in developing  
7 ecological production functions for targeted ecosystem services.

8  
9 ***Challenges associated with specific methodological or tactical approaches***

10  
11 Given the ambitious nature of the Plan, the Committee finds that there are a number of  
12 methodological challenges EPA scientists are likely to encounter. Although some of  
13 these challenges were explicitly recognized in the Plan, it seems useful to highlight them.  
14 Several methodological challenges relate to the use of data. Clearly, developing metrics  
15 for appropriate ecosystem services and connecting those indicators to human health and  
16 well-being is a subject of tremendous debate and will not be easily resolved. Similarly,  
17 identifying the appropriate spatial and temporal scales of analysis and application is  
18 exceedingly difficult, yet the Program's success ultimately depends on getting this right.  
19 Data management itself will likely pose challenges. These challenges involve not only  
20 data manipulation, storage, metadata documentation, and analysis, but also acquisition  
21 (i.e., dealing with data gaps) and validation of data. Quantifying and articulating  
22 uncertainty is a clear research opportunity related to data collection, analysis and model  
23 development. The Committee also recognizes that certain perceived challenges and  
24 opportunities may derive from the fact that operational/tactical plans and implementation  
25 strategies are still under development.

26  
27 ***Challenges associated with extending program outputs to partners and other user***  
28 ***groups to support decision making***

29  
30 The Committee recognizes that the ultimate success of the Ecological Research  
31 Program lies in the extent to which it can support decision-making and regulatory  
32 processes. Notably, decision-making tools such as risk assessment, life cycle assessment,  
33 and the Natural Resource Damage Assessment and Recovery process (NRDAR) need to  
34 connect seamlessly to the proposed research program. While the Committee finds that  
35 the goals of the Ecological Research Program are relevant to decision makers, we are  
36 concerned that implementation of a successful outreach and education program is likely  
37 to be a serious challenge for a number of reasons. Most notably, we find that fully  
38 engaging the diverse group of stakeholders and users will be difficult due to the diversity  
39 of their needs and their capabilities to participate in the development of and/or use of the  
40 decision support platform. Active engagement seems essential given the reality that few  
41 users are likely to train themselves. Clearly, meeting the needs of users is further  
42 complicated by the conflicting jurisdictional responsibilities of agencies and  
43 organizations. Therefore, the Committee recommends that:

- 44  
45 • Efforts be made immediately to enlist the input and cooperation of potential  
46 users/clients of the Ecological Research Program to better insure that the planned

1 research will address issues of greatest interest to them, and that research outcomes  
2 can be communicated in a way that meets the most important user needs.

- 3
- 4 • Direct links should be established between outcomes of place-based demonstration  
5 project research and policy and regulatory processes. This is necessary in order to  
6 demonstrate the relevance and applicability of the Ecological Research Program to its  
7 partners.

8

9 In addition, the Committee is concerned that only 1% of the total budgetary resources of  
10 the program are allocated to outreach and education. We find that this amount is  
11 insufficient to support effective outreach efforts.

12

13 ***Challenges associated with availability of resources, including institutional capabilities***

14

15 The Committee applauds the authors and contributors to the Plan for seeking to tackle  
16 some of the most important, cross-cutting questions that we face in environmental  
17 protection. Moreover, we see that, simply by virtue of working through and developing  
18 strategies to deal with the inherent challenges, efforts to develop the Plan represent a  
19 tremendous opportunity to advance the way that ecological research is conducted.  
20 The limited availability of resources is the most serious and potentially problematic  
21 challenge to the Ecological Research Program. With the absence of funding in  
22 competitive grant programs, such as STAR, to fund partner efforts, the program will face  
23 challenges in funding the necessary work and providing incentives for partner  
24 involvement. The lack of grant support is particularly problematic for involving  
25 academic partners. As recognized in the Plan, the current Ecological Research Program  
26 staff skill set will not by itself, be sufficient to address the issues and conduct the work  
27 needed to achieve program goals. Reliance on partners for work to accomplish particular  
28 program objectives is risky but, given the available program resources, that would seem  
29 to be unavoidable at this point. In this context, the Committee recommends:

- 30
- 31 • Cooperators and collaborators, both within and outside of EPA be identified as soon  
32 as possible and explicit agreements be drafted that specify what work is to be  
33 accomplished when by each partner.

34

35 **4.5 Charge Question 5. What suggestions does the committee have for**  
36 **measuring annually over the next five years the progress, productivity,**  
37 **efficiency, and effectiveness of the Ecological Research Program?**

38

39 The recent NRC (2008) report on evaluating research efficiency provides  
40 recommendations for the evaluation of research and development programs at EPA. The  
41 Committee notes the following key recommendations provided by the NRC in this  
42 regard: 1) EPA and other agencies should only apply quantitative efficiency metrics to  
43 measure process efficiency of research programs. Process efficiency can be measured in  
44 terms of inputs, outputs, and some intermediate outcomes; it does not require ultimate  
45 outcomes. 2) EPA and other agencies should use expert review panels to evaluate the  
46 investment efficiency (i.e., an indication of whether an agency is doing the right research

1 and doing it well) of research programs. The process should begin by evaluating the  
2 relevance, quality, and performance of the research. 3) The efficiency of research  
3 programs at EPA should be evaluated according to the same overall standards used at  
4 other agencies. In fact, the Plan indicates that EPA does intend to use expert peer review  
5 panels (e.g., the Agency's Board of Scientific Counselors, and the Science Advisory  
6 Board) for future evaluation of the program.

7  
8 The Committee provides the following more specific comments and recommendations  
9 concerning measurement of progress, productivity, efficiency, and effectiveness of the  
10 Ecological Research Program. We suggest that measured progress toward the visionary  
11 goals and objectives in the more detailed implementation plans should focus on the  
12 ecological structures and processes that contribute toward the production of goods and  
13 services, that themselves contribute toward human health and well-being. The following  
14 recommendations are provided in this regard:

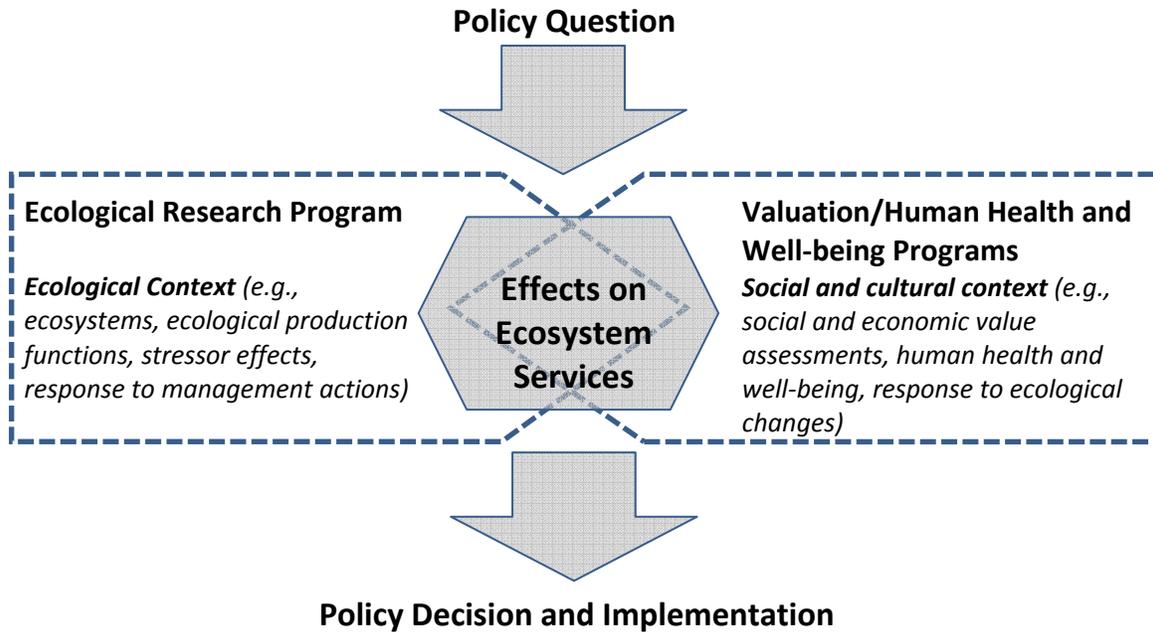
- 15
- 16 • Goals and objectives should be monitored, reevaluated and adjusted as needed to  
17 capitalize on evolving and emerging partnerships and other opportunities to leverage  
18 the limited resources of the Ecological Research Program.
  - 19
  - 20 • The stated goals and research objectives of the Plan should be focused on the  
21 identification and articulation of the ecological processes and structures that  
22 contribute toward ecosystems services that have been identified in collaboration with  
23 ecological, medical, and social scientists in the Agency.
  - 24
  - 25 • Specific research objectives should be operationally defined so that progress and  
26 attainment can be clearly determined and quantified.
  - 27
  - 28 • In the specification of ecological production functions for targeted ecosystem  
29 services, the Ecological Research Program should maintain a broader ecosystems  
30 perspective to assure that the effects of multiple stressors on the multiple services that  
31 arise from these systems are adequately acknowledged and addressed.
  - 32

33 The Committee finds that, given the visionary intentions of the Plan and the lack as  
34 yet of detailed research implementation plans, it is premature to prescribe specific  
35 measures to evaluate annual performance/progress goals for the program. However, as  
36 development of the research plan goes forward, the authors of the Plan should specify  
37 goals and associated research objectives for the individual projects and for the program as  
38 a whole that are within the purview, expertise and control of the Ecological Research  
39 Program. As noted above, specific objectives should be operationally defined in a way  
40 that: 1) allows clear determination of whether they have been achieved and 2) can be  
41 subjected to quantitative measures of the extent of accomplishment. The Committee  
42 further recommends that:

- 43
- 44 • At this formative stage of the new ecosystems services paradigm, the program  
45 assessment should include monitoring, evaluation and adjustment of objectives as  
46 partnerships and collaborations within and outside the Agency evolve. Such an

1 adaptive management approach requires flexibility and vigilance to capitalize on  
2 opportunities that arise as the program continues to develop, and an explicit plan for  
3 coordinating activities and products across the multiple projects and themes of the  
4 Ecological Research Program.

5  
6 The Committee finds that it is appropriate for the Ecological Research Program to set  
7 research goals based on contributions to understanding ecological service flows, and  
8 through those service flows protection of human health and well-being. However, the  
9 program should not claim responsibility (or allow itself to be held responsible) for  
10 achieving the ultimate goals of the entire EPA research and regulatory mission. As  
11 illustrated in Figure 1 below, the identification of relevant ecological services and effects  
12 on these services must be based on a dialog between Ecological Research Program  
13 ecologists and the medical and social scientists, regulators and decision makers  
14 representing EPA programs that are responsible for determining and valuing  
15 environmental and human health and well-being goals of the Agency. The key role for  
16 the Ecological Research Program in this context is to research and articulate the  
17 appropriate ecological endpoints and the intermediate ecological structures and processes  
18 (ecological production functions) that contribute to identified services. Thus, the  
19



20  
21  
22 Figure 1. The role of EPA's Ecological Research Program in an Ecosystem Services  
23 Paradigm

24  
25 evaluation of the success of the Ecological Research Program should be gauged in terms  
26 of progress toward effective specification of relevant ecological endpoints and production  
27 functions, with special attention to the effects of individual and multiple stressors that  
28 come under the purview and regulatory control of the EPA. The Ecological Research  
29 Program has the further responsibility to the Agency and to citizens of the country and

1 the world to investigate and bring attention to ecological processes and structures that  
2 contribute to additional, non-targeted ecological services and potential services.

3  
4  
5 **4.6 Charge Question 6. Does the Committee have any recommendations on how**  
6 **EPA can better enhance its ability to leverage available resources within and**  
7 **outside the Agency?**  
8

9 As stated above, the Committee finds that the success of the Ecological Research  
10 Program is likely to depend in large measure upon its ability to leverage available  
11 resources within and outside of EPA. Based on information received by the Committee,  
12 and our deliberative discussions, we have separated our comments on ways to leverage  
13 resources into three topical areas. These three areas of concern are: 1) practical aspects  
14 of implementation; 2) financial support for implementation; and 3) outreach and  
15 education.

16  
17 *Practical aspects of implementation*  
18

19 Because the Plan lays out a new approach, the Committee finds that there is a need to  
20 avoid the perception that the Plan is being imposed upon the user community by ORD.  
21 Thus, the Committee finds that there is a need to articulate a multi-level approach to the  
22 Plan (i.e., research products will be developed at different levels for various users). In  
23 addition, more input is needed from the end-users (e.g., municipalities, land managers,  
24 industry) to identify the research products that would be most useful.

25  
26 In the Plan, ORD has identified potential partners for the development of new  
27 methods and has indicated that memoranda of understanding will be developed to provide  
28 arrangements for collaborative partnerships. For example, the Plan cites a memorandum  
29 of understanding that has been developed with the Gund Institute for Ecological  
30 Economics to allow the sharing of data from study sites. The Committee provides three  
31 recommendations concerning collaborative partnerships:  
32

- 33 • The Committee recommends that the memoranda of understanding to be developed  
34 with federal partners need to be more than agreements to cooperate. Specifics should  
35 be provided concerning who will do specific work when there is overlap, and how to  
36 share resources. During the Committee’s discussions with EPA it was made clear  
37 that this is indeed the intent, but this needs to be articulated more clearly in the Plan.  
38
- 39 • Because there will be a need for access to expertise that may not be available “in-  
40 house,” the Committee also suggests that ORD utilize Special Government  
41 Employees as part-time consultants or advisors to quickly bring expertise to particular  
42 issues.  
43
- 44 • The success of the Plan is largely dependent on developing an effective outreach and  
45 education program, but the plan to develop an outreach program is not well  
46 developed. The Committee recommends that in the Plan ORD provide a section in

1 the “vision” paragraphs to outline how the Agency will achieve outreach and  
2 education goals. As stated above, this has not historically been a significant part of  
3 ORD’s work; therefore additional expertise may be needed in this area.  
4

5 ***Financial support for implementation***  
6

7 It was made clear during the Committee’s discussions with ORD that there are limited  
8 resources available to achieve the goals of the Plan. Therefore, it is important that ORD  
9 consider reallocation or redistribution of existing resources to take advantage of  
10 opportunities for partnerships with other groups and agencies. We provide six  
11 recommendations in this regard:  
12

- 13 • The Committee finds that ORD’s available people, infrastructure, and data represent  
14 leverage opportunities. We suggest that ORD use these opportunities as leverage to  
15 offer in-kind services and collaborate with other groups/agencies. In this regard,  
16 there are ample partnership opportunities. ORD can partner with other agencies  
17 within the U.S. (e.g., U.S. Fish and Wildlife Service, U.S. Forest Service, National  
18 Park Service). For example, if a terrestrial place-based or ecosystem project is added  
19 to the Ecological Research Program, ORD can take advantage of U.S. Fish and  
20 Wildlife Service resources and expertise in existing projects. In addition, funding  
21 incentives for cross-agency collaborations could enhance these partnerships.  
22
- 23 • ORD should consider active partnerships with other agencies outside the U.S. and  
24 thus gain the ability to address transboundary issues (e.g., watershed or airshed  
25 issues).  
26
- 27 • The Plan proposes partnerships with a number of nongovernmental organizations  
28 (NGOs). Beyond partnering with nongovernmental organizations, the Committee  
29 recommends that ORD consider working with professional societies to sponsor  
30 sessions or symposia in order to present results of work to accomplish the Plan’s  
31 goals and solicit feedback from stakeholders and end-users. For example,  
32 partnerships with the following organizations could be considered: Society of  
33 Environmental Toxicology and Chemistry; North American Benthological Society;  
34 Ecological Society of America; North American Association of Environmental  
35 Educators; Association of Environmental and Resource Economists; and International  
36 Society for Ecological Economics.  
37
- 38 • The Committee also suggests that ORD consider partnerships with private business,  
39 foundations, NGOs, and such organizations as non-profit foundations to raise funds to  
40 conduct research and development activities.  
41
- 42 • We strongly encourage ORD to make the STAR program a priority in efforts to  
43 leverage resources and achieve goals by: enhancing the STAR Graduate Fellowships  
44 program; providing funds for non-targeted, exploratory extramural research to  
45 develop tools and procedures to accomplish the goals of the Plan; and developing a

1 competitive grants program to run summer credit workshops for teachers through  
2 STAR.

- 3
- 4 • The Committee recommends that ORD consider requiring or expecting leverage from  
5 universities in order to obtain ORD funding. Leverage can come in the form of  
6 reduced indirect costs or tuition and fee waivers. ORD could also consider providing  
7 matching funds or supplements to existing graduate and teacher education programs.  
8

### 9 *Outreach and education*

10

11 As stated previously, the success of the Plan is largely dependent on outreach and  
12 education activities. Unless the human capital needed to bring expertise into the  
13 valuation process is developed, and the stakeholders and end-users are provided the  
14 education needed to use the information, the tools and techniques developed will likely  
15 not be used. To accomplish this, the Committee provides the following two  
16 recommendations:

- 17
- 18 • We recommend that ORD partner with professional societies, publishing companies,  
19 media outlets, and NGOs to develop and disseminate education and outreach  
20 materials to professionals, teachers, and the lay public. Some suggested approaches  
21 that could be developed in partnership with other organizations include: workshops,  
22 symposia, and sessions at meetings, WIKI blogs, presentation materials for educators  
23 and public forums, media resources including cable television educational networks,  
24 and 10-15 minute video clips that can be used in classroom settings.  
25
  - 26 • We also recommend that ORD partner with community groups to enhance education  
27 and outreach activities. It will be important to take advantage of local traditional eco-  
28 knowledge to address the issue of “sense of place” to gain acceptance of the valuation  
29 approach by end-users.  
30

## 31 **5. CONCLUSION**

32

33 EPA’s draft *Ecological Research Program Multi-Year Plan FY 2008 – 2014*  
34 articulates a new strategic direction that focuses on quantifying ecosystem services and  
35 their contribution to human health and well-being. As stated above, the Committee  
36 strongly supports this strategic direction and commends the Agency for developing a  
37 research program that has the potential to be transformative for environmental decision  
38 making as well as for ecological science. We find that the research focus on ecosystem  
39 services represents a suitable approach to integration of ecological processes and human  
40 welfare for the purposes of a public environmental management agency. The Ecological  
41 Research Program’s focus on ecosystem services can therefore provide a sound  
42 foundation for environmental decisions and regulation based on the dependence of  
43 humans upon ecological condition and processes. While we support the strategic  
44 direction taken by EPA, we have concerns about the Agency’s draft Plan. The most  
45 serious challenge facing the Ecological Research Program is the limited availability of  
46 resources. We find that the long-term goals of the program are unlikely to be

1 accomplished in the proposed time frame with current resources. Furthermore, the ORD  
2 staff skill set may be insufficient to address the issues and conduct all of the work needed  
3 to achieve long-term program goals. Given these concerns and the fact that studying  
4 ecosystem services is a field in its infancy, the lack of grant support is particularly  
5 worrisome. We strongly encourage EPA to provide additional intramural and extramural  
6 support (e.g., through STAR grants) for the Program. .  
7

8 We have provided a number of recommendations to improve the long-term goals,  
9 research objectives, and implementation strategy in the Plan. Our recommendations  
10 focus on: 1) providing additional information to clarify how various research products  
11 will be developed and used; 2) identifying and engaging as soon as possible clients who  
12 will use the research products and targeting outreach efforts to educate those clients; 3)  
13 working with other federal agencies to avoid duplication of effort and promote  
14 coordination and synergy; 4) retaining the important long-term visionary goals, but  
15 clearly identifying some relatively narrow goals and objectives that can be accomplished  
16 on schedule with limited resources; 5) providing a more transparent explanation of the  
17 process used to select sites for place-based demonstration projects; 6) evaluating program  
18 success on the basis of progress toward specifying relevant ecological endpoints and  
19 production functions, not achieving the ultimate goals of EPA's research and regulatory  
20 mission; and 7) effectively partnering with other federal agencies, NGOs, professional  
21 societies, private businesses, and foundations to leverage available resources.

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23  
24

1 **APPENDIX A. SPECIFIC COMMENTS ON THE ECOLOGICAL RESEARCH**  
2 **PROGRAM MULTI-YEAR PLAN**

3  
4 The following specific comments on various parts of the draft Ecological Research  
5 Program Multi-Year Plan are offered by individual Committee members.

6  
7 **Page ii:**

- 8  
9 - Ecological Research Program personnel do not appear to include many social  
10 scientists. The Plan refers to a valuation team, but the individual named as the lead is  
11 an ecologist, not a social scientist. Similarly, the person named as the human well-  
12 being lead is a biologist. Without more direct involvement from other disciplines,  
13 and more expertise specifically related to valuation, it is not clear that ORD will have  
14 the capacity to develop a meaningful decision support platform that meets Long-term  
15 Goal 1.

16  
17 **Page 1, Introduction:**

- 18  
19 - This part of the Plan should indicate how EPA will use lessons learned from other  
20 programs. The U.S. Forest Service and others have been managing ecological  
21 services for many years with varying amounts of success. It is not clear how this  
22 experience base was or will be used in the creation of the Plan.

23  
24 **Page 3:**

- 25  
26 - The list of “pioneering examples” on this page is a bit hard to fit into the plan for the  
27 future.

28  
29 **Page 4:**

- 30  
31 - Ecosystem services are defined here as “the products of ecological functions or  
32 processes that directly or indirectly contribute to human well-being, or have the  
33 potential to do so in the future.” A concern about this definition is that it emphasizes  
34 the products rather than the processes that are the foundation for those products.

35  
36 **Page 5:**

- 37  
38 - The third bullet on this page indicates that enhancing understanding of ecosystem  
39 impacts that emerge over longer time scales, including threshold responses or tipping  
40 points, is reflected in the Ecological Research Program’s ongoing suite of grants  
41 investigating threshold behavior and regime shifts in aquatic systems. Examples of  
42 these research efforts (and findings) should be provided. This is a critical area and it  
43 is not apparent that the agency has invested much to support it.

44  
45 **Page 6, Table 1:**

- 1 - This table presents priority ecosystem services, but it is not clear why or how this list  
2 was generated from the full set. What was the rationale, for instance, for having  
3 cultural services or nitrification in this table? The logic behind the selections should  
4 be clearly presented. The lists of examples in the right three columns (regulating  
5 services, provisioning services, cultural services) appear to be incomplete.  
6
- 7 - Habitat and biodiversity are not services. Both are very important but neither is a  
8 supporting service as defined in this table. Human well-being is derived from  
9 habitats and from having a biologically diverse condition in that habitat. Trying to use  
10 a structural measure such as acres of habitat as a measure of ecological service will  
11 lead to confusion and possibly double counting of benefits. Clearly there is a need to  
12 define the set of services that flow generally from specific habitat types (e.g. low  
13 marsh, high marsh, freshwater marsh, tidally flushed marsh), but these would not be  
14 separate services. Biodiversity is another structural measure of condition and we all  
15 might agree that more diversity is better. However, if an upper limit to biodiversity is  
16 exceeded the process relationships that under lie ecological communities degrade.  
17
- 18 - The list of ecosystem services in this table should be prioritized. If (or when)  
19 resources become limiting, there should be a structure in place for deciding what is  
20 most important. This would mean making *a priori* value statements, but some of  
21 those ecosystem services are directly related to current human physical well-being,  
22 others to future physical well-being. Some are related to apparent economic status or  
23 current human psychological well-being.  
24

25 **Page 8:**

- 26
- 27 - The proposed approach to measuring achievement of goals (i.e., by considering how  
28 the information is used by decision makers) is asking a great deal from a science that  
29 is not yet developed.  
30
- 31 - A simpler statement of general research questions presented here might be, “how and  
32 why are ecosystem services changing, how are they being impacted by humans, what  
33 are the consequences for human health and welfare, and how might management  
34 decisions reduce negative consequences?” More specific questions could address the  
35 theories and hypotheses to be tested. For example, how are different temporal or  
36 spatial scales to be integrated? One of the leading models for doing this, the  
37 hierarchical patch dynamics paradigm (Wu and Loucks, 1995), or another framework  
38 could be presented as a starting point.  
39

40 **Page 9:**

- 41
- 42 - The mention of multiple stressors here is a positive feature.  
43
- 44 - The top two bullets and paragraph on this page are good but the research questions  
45 will be very difficult to address. Answering these questions will likely take more  
46 resources and time than envisioned. We know that ecological responses to identical

1 stressors can differ widely across regions, landscape, and social context. Much more  
2 work in a variety of contexts will need to be done in order to sufficiently answer the  
3 broad questions of 1) what are the effects of multiple stressors on ecosystem services  
4 at multiple scales over time and 2) what is the impact of changes in these services on  
5 human well-being and on the services' monetary and non-monetary value.  
6

- 7 - It is surprising here that two “priority ecosystems” leapt to the fore so quickly. Does  
8 this mean that the rest of the long-term goals are not national in scope? What is the  
9 rationale for selecting priority ecosystem types and priority geographic regions?  
10 There is no mention of investigating multiple stressors.  
11
- 12 - In the general approach provided here, how does “landscape characterization” fit with  
13 ecosystem services discussed in the rest of the Plan?  
14
- 15 - The usefulness of “maps” as described here and on page 43, paragraph 2) is critical,  
16 but the examples given are complex issues that cannot be crudely modeled. Good  
17 data and an understanding of interlinking processes are needed. This requires  
18 substantial research.  
19
- 20 - With regard to research outputs, the focus seems to be on carbon and nitrogen. How  
21 can one model these two biologically driven cycles without knowing the impacts of  
22 other key stressors (e.g., habitat, metals, organics, temperature, and hydraulics)? Will  
23 these impacts be defined?  
24
- 25 - Output #2 “stressors” should have a clearly corresponding counterpart that reflects  
26 not just things that degrade services (stressors) but also our ability to restore, reclaim,  
27 enhance services. We want to be able to predict not just losses, but our ability to  
28 achieve *gains*. Later in the document it is clear that gains are being considered, but it  
29 does not come through in this section.  
30

31 **Page 10:**

- 32
- 33 - The first two bullets on this page do not seem to be different from one another.  
34
- 35 - The last paragraph showing incremental changes in services due to a management  
36 action or the effect of an environmental stressor is good but it will require years of  
37 study of pre and post monitoring of best management practices – or an in-depth  
38 understanding of interlinking ecosystem processes which are modeled. The time  
39 frame required to accomplish this is uncertain.  
40

41 **Page 11:**

- 42
- 43 - It is necessary to establish ecological “baselines” in order to measure both losses and  
44 gains. “Baselines” should be given more emphasis in the Plan. Very little progress  
45 can be demonstrated until the Ecological Research Program can make a case for the  
46 baselines it is using.

- 1  
2 - The tables on pages 11 and 12 refer to several specific examples of “services.”  
3 These services include nutrient removal, temperature regulation, habitat, and food and  
4 goods. These services are also those described in the Millennium Ecosystem  
5 Assessment. However, there is a conceptual inconsistency with these services that  
6 acts as a barrier to clarity. “Nutrient removal” and “temperature regulation” are  
7 *processes*. Habitat and food and goods are *outputs of processes*. How do you  
8 measure a process? By measuring the inputs to and outputs of that process. A more  
9 consistent focus on the desirable (and undesirable) *outcomes* would be preferable as  
10 the focus of measurement.

11  
12 **Page 12, Figure 3:**

- 13  
14 - This figure represents a potentially misleading and easily abused approach. Applying  
15 monetary values to each of these services can be very divisive and open to  
16 “interpretation”. How much social value is applied to rice farming for example  
17 compared to fishing? This graph shows we should never farm food since the loss of  
18 natural services will always exceed the food production.

19  
20 **Page 13:**

- 21  
22 - It would be useful to see where inputs from other agencies and partners enter the  
23 logic model on this page. What or who will drive the cooperation among the 7  
24 research laboratories? How will partners be enlisted into the program? How will  
25 research be funded?  
26  
27 - Timing of the long-term goal outputs (pages 13 and 15 and figure 5) makes it appear  
28 that the place-based demonstration projects would be running in parallel with the  
29 mapping and model development and be completed prior to the decision support  
30 tools. This seems out of order. One would expect the place-based projects to be an  
31 opportunity to test the tools, models, and maps.

32  
33 **Page 14, Figure 4:**

- 34  
35 - The logic model presented here appears to be a useful way to characterize the  
36 relationships among the planning and implementation components of the proposed  
37 research activities within the Ecological Research Program. The model is less useful  
38 as a way to clearly place the Program activities in the larger environmental policy,  
39 planning and management context. The “Externalities” component in the model  
40 identifies a number of potential constraints coming into the Program, but it does not  
41 provide sufficient representation of environmental and social “inputs” (triggers, goals,  
42 etc) such as environmental changes (from local floods to global climate change) and  
43 social changes (population and demographic shifts, land development, etc). Nor does  
44 the model show where Program research outputs go, such as to support EPA policy  
45 making to protect relevant ecosystems functions and structures, to improve and  
46 sustain the levels of ecosystems services that are enjoyed by citizens, and providing

1 scientific information to help educate publics about ecosystems services to secure  
2 support for the protection of important ecosystems.

- 3
- 4 - Outputs like peer-reviewed publications that are intermediate between doing the  
5 research and observing outcomes are also important because there is still widespread  
6 scientific skepticism that the concept of ecosystem services can be made operational.  
7 Publications in journals such as Science, Nature, and Ecological Applications will  
8 lead to more widespread acceptance of the concept among skeptical scientists. It is  
9 legitimate for the Plan to focus on the research enterprise, but some acknowledgment  
10 (in text and/or in the logic model figure) of where the Program fits in the larger  
11 context would be a useful addition. Figure 4 makes it appear that the Ecological  
12 Research Program is internal to EPA and it also appears that the Program is isolated  
13 from the EPA Program Offices, Regions, and other ORD research programs.  
14 Relationships between the Ecological Research Program and other research plans  
15 should be acknowledged. Interactions with global change would include  
16 collaboration on issues of carbon sequestration; interactions with the Office of Water  
17 could relate to development of nutrient criteria as well as wetland and mitigation  
18 evaluation procedures. Establishing a linkage with the Human Health Research  
19 Program seems particularly important. Another potential health link would be with  
20 the Centers for Disease Control and Prevention.
  - 21
  - 22 - The logic model does not include reference to the quality of the research. Users will  
23 not adopt implementation of items developed in the first three steps unless they are  
24 part of adequate quality for making decisions. The model also needs feedback loops  
25 in case the models, maps or tools do not work. In addition, the cost of tools does not  
26 seem to be part of the process for evaluating how good the tools are. The tools should  
27 be cost effective relative to the resources being protected.
  - 28
  - 29 - In the logic model, why are the management options research outputs? Typically,  
30 one would specify some possible options or policies under consideration and the  
31 research would evaluate the impacts.
  - 32
  - 33 - The objective is not to ensure human well-being by conserving and enhancing  
34 ecosystem services. What if there are tradeoffs (as there inevitably will be), either  
35 between different ecosystem services and/or between ecosystem services and other  
36 things that contribute to human well-being? Is the long-term environmental outcome  
37 goal separate from a goal of enhancing human well-being?

38  
39 **Page 15:**

- 40
- 41 - The five goals that are proposed here are individually important, but it is less clear  
42 whether they are collectively sufficient or the most important goals for EPA's  
43 ecological research efforts. The Plan points out that the Ecological Research Program  
44 is one of several research programs within and outside of EPA and that the stated  
45 goals are intended complement those of the other programs. However, the brief  
46 description in the Plan does not convincingly show how the five goals and the noted

1 efforts to cooperate with the other programs combine to cover the most important  
2 research needs of the Agency. The EPA should make a more comprehensive study of  
3 the interrelationships among the research programs cited (and others) and work  
4 vigorously to secure effective interrelationships and coordination among them.

- 5
- 6 - Similarities between the decision support tool mentioned here and EPA's CADDIS  
7 system (U.S. EPA, 2008) should be mentioned.
- 8
- 9 - Uncertainty should be addressed in Long-term Goal 2 –National Mapping, Inventory,  
10 and Modeling.
- 11

12 **Page 16, Figure 5:**

- 13
- 14 - The figure illustrating the planning and implementation framework is confusing.  
15 Coordination and integration among the five goals of the proposed program are  
16 within the control of the Program. Such coordination is rightly a stated intention of  
17 the Program and the organization of the goals and projects implies an effective  
18 structure for achieving that end. However, the Plan does not adequately describe how  
19 the coordination implied by the intersecting cells in Figure 5 will be operationally  
20 achieved. There should be budget to support activities such as bringing project and  
21 theme leads (the bottom row and last column of the matrix) together periodically to  
22 assure that useful coordination is planned and implemented, that schedules are set and  
23 upheld (or revised) so that progress on the separate themes and projects allows for  
24 timely and mutually beneficial sharing and integration of data, methods, models and  
25 other information that is developed. In the Plan, more emphasis should be placed on  
26 how coordination among the goals/themes/projects will be operationally achieved. It  
27 might be useful in this regard to define coordination activities as a sixth goal of the  
28 Ecological Research Program. In addition, the resources allocations for the years  
29 2008 – 2014 should be identified. It would seem that some projects will need more  
30 resources at the start and others will need more towards the end. Furthermore, it is  
31 difficult to evaluate the Program if the laboratories and leads are not identified.
- 32

33 **Page 17:**

- 34
- 35 - The rationale for allocation of the resource percentages to each long-term goal should  
36 be provided here.
- 37

38 **Page 18:**

- 39
- 40 - In Table 2 it is not apparent how the “overarching issues” of sustainability and global  
41 change relate to the “high priority topics” of endocrine disruptors, Hg, and  
42 nanotechnology. It is a concern that these high priority topics have a human health  
43 focus. There needs to be a focus on natural stressors (e.g., habitat, temperature, flow,  
44 meteorological events) that are linked directly to human activities and climate change  
45 and are front and center for stressors and local to global impacts.
- 46

- 1 - The challenge presented here for EPA laboratories is great. They are likely to be  
2 entrenched in institutional momentum and tradition which will be difficult to change.  
3 In the second paragraph on this page it is stated that the Ecological Research Program  
4 has a close working relationship with the Global Change and Water Quality  
5 Programs. This relationship should be documented.  
6

7 **Page 19:**

- 8  
9 - In the third paragraph on this page it is stated that the Ecological Research Program is  
10 developing new methods to enhance, maintain, or restore the full range of water-  
11 related ecosystem services. This should be documented.  
12

13 **Page 20:**

- 14  
15 - The purpose of including Table 3 is not clear. The table requires some additional  
16 discussion. The Ecological Research Program workforce is indicated as internal,  
17 which contradicts what has been stated elsewhere, namely that there will be  
18 considerable reliance on outside collaborators.  
19

20 **Page 21:**

- 21  
22 - It is stated here that accomplishing Long-term Goal 1 will be one of the biggest  
23 challenges and that EPA has the least ability and internal expertise to deal with this.  
24 EPA should look externally and enlist the help of the academic community in  
25 addition to expanding internal resources.  
26  
27 - When creating a large multi-model system to be used in a decision making context as  
28 described in Section 1.0, some systematic across the board validation would appear to  
29 be prudent.  
30

31 **Page 22, Section 1.1.1:**

- 32  
33 - The projects identified here include “associations between the condition of stream  
34 habitat and sport fishing revenue.” That kind of study has been done before; what has  
35 not been included in those kinds of analyses are other forms of recreation and  
36 spiritual renewal that are also dependent on condition of stream habitat.  
37

38 **Page 23:**

- 39  
40 - The discussion of decision tools is a nice “capstone” for the Plan but, in many cases,  
41 the science questions are a bit artificial, and could be better stated as scientific  
42 objectives.  
43  
44 - It seems unusual to use the terms “homes protected from flooding” and “recreational  
45 user days” to describe “population and human health issues.” Also, terms like “urban  
46 greenspace and indicators of mental function” should be avoided. Doesn’t this mean

1 that urban greenspace can be valuable for a variety of reasons? “Mental function”  
2 sounds either too vague or too peculiar.

3

4 **Page 24:**

5

6 - In developing a classification system of ecosystem services (Section 1.2.1), some  
7 recognition of regulatory structure should be acknowledged if this approach is to be  
8 useful to managers.

9

10 - In Section 1.1.2 recommend considering the increasing incidence of asthma and its  
11 relationship with air pollution. This seems to be a high priority as compared to  
12 nitrogen.

13

14 **Page 25, Section 1.1.3:**

15

16 - Collaboration with some National Science Foundation research programs (e.g., Long-  
17 term Ecological Research Program, Human and Natural Systems – formerly  
18 Biocomplexity) with social science expertise would help in Section 1.1.3.

19

20 - In the first bullet on this page, proposed work to conduct a spatiotemporal analysis of  
21 disease with sale of medical supplies/pharmaceuticals requires further justification.

22

23 - The Ecological Research Program should ensure that at least one of the demonstration  
24 projects described here and elsewhere focus on an ecosystem service that can be  
25 taken “all the way to the end product.” That is, define an ecosystem service that can  
26 indeed be characterized, quantified, valued and its relationship to human health and  
27 well-being made clear. For example, the Plan suggests endpoints such as “reduced  
28 flood insurance payments, recreational expenditures, and reduced costs of mosquito  
29 control measures per wetlands area as potential endpoints.” Page 25 of the Plan  
30 mentions “estimates of morbidity and mortality from air pollution levels under  
31 alternative scenarios of urban design.” This should be feasible.

32

33 **Page 26:**

34

35 - The section lacks identification of specific efforts to include and/or to coordinate with  
36 relevant social science on human health and well-being. All long-term goals adhere  
37 to the ecosystem services framework and have at least one “valuation” objective, but  
38 it is not clear where the required measures of health and well-being will be obtained.  
39 The service targets of the Ecological Research Program can generally safely be  
40 assumed to be associated with human health and well-being (or at least they are all  
41 things that people generally care about), but there is little or no indication of any  
42 explicit effort to quantify and confirm specific associations within or across the  
43 particular themes/projects. For example, research is proposed to identify the  
44 ecological processes and structures in wetlands that affect the quantity, quality,  
45 spatial distribution (and timing) of fresh water. But there is no reference to how the  
46 models and maps of this (potential) service will be related to (e.g., overlaid with)

1 relevant measures and/or projected characteristics of human/social “consumers”  
2 (demanders) of this service or where measures of such social characteristics will be  
3 obtained. Among possible sources of relevant social value information are the many  
4 national surveys conducted regularly by the U.S. government (U.S. EPA Science  
5 Advisory Board, 2008a) and focused surveys conducted by other regional, state, and  
6 local agencies.

- 7
- 8 - The annual performance goals listed in Table 4, beginning with 2010 as a target data  
9 for development and testing of the preliminary human health and well-being  
10 indicators tied to ecosystem services, seem to be very ambitious. Development in this  
11 area will have to occur before results can be communicated to the client base  
12 described in Table 7.
  - 13
  - 14 - One example of valuation of certain ecosystem services from the Willamette River  
15 Basin is the Willamette Ecosystem Marketplace ([www.willamettepartnership.org](http://www.willamettepartnership.org)).  
16 The Marketplace conceives of a multi-credit bank for the Willamette Basin.  
17 Associated with this, the Willamette Partnership is a water quality trading program to  
18 cool the Willamette River. The Partnership integrates elements of ecosystem services  
19 into a “mitigation bank site” where credits can be bought and sold. The existence of  
20 the Partnership and the Marketplace means that environmental consequences are  
21 viewed as part of the economic system, rather than external to it.
  - 22
  - 23 - The way valuation is described here raises the concern that exploitation and alteration  
24 of natural and wild lands could increase.

25  
26 **Page 27:**

- 27
- 28 - The plan includes the development of an Ecosystem Services Classification System  
29 comparable to that used by the Census Bureau for industrial goods. However, it is  
30 not clear that this type of standardization will be feasible, given the place-specific  
31 nature of ecosystem services. Nevertheless, some recognition of regulatory structure  
32 should be acknowledged if this approach is to be useful to managers.

33  
34 **Page 28, Figure 7:**

- 35
- 36 - The very philosophical Long-term Goal 1 described here may be quite elusive. Will  
37 the Program really address the question of what economic valuation methods are most  
38 “efficacious” for valuing ecosystem services (as shown on Figure 7, page 28)? The  
39 current staff within ORD does not appear to have the needed expertise for answering  
40 this science question, and there is no meaningful discussion of any external funding  
41 for this component of the research.

42  
43 **Pages 28-29:**

- 44
- 45 - While the development of ecological production functions is an important objective,  
46 the description of this component of the Plan suggests some confusion about the

1 concept of production functions. For example, economic production functions  
2 provide information about *technological* possibilities for substitutability, they do not  
3 provide any information about scarcity or the *availability* of complementary services.  
4 Likewise, production functions are not used for describing human well-being.  
5

6 **Page 31:**  
7

- 8 - The Plan makes reference to the use of information from the market for carbon offsets  
9 as a source of valuation information, but prices from tradable permit markets do not  
10 provide value information (except under *very* limited conditions).  
11

12 **Page 32, Section 1.3.1:**  
13

- 14 - Regarding outreach and education, it should be noted that client groups that will be  
15 receptive to using the ecosystem services approach include local watershed groups  
16 and the national nongovernmental organizations they work with (e.g., American  
17 Rivers, River Network, Waterkeepers). Another potentially interested client would  
18 be developers of conservation subdivisions. Assessing ecosystem services arising  
19 from those developments could be coupled with analyses of home prices, etc.  
20

21 **Page 33:**  
22

- 23 - The use of NGOs to quickly enhance outreach and education activities is novel,  
24 innovative and should be encouraged. This is how NGOs make a living, so why not  
25 take advantage?  
26  
27 - Regarding the text on pages 33 and 35 (Sections 1.3.1 and 2.0), client groups that will  
28 be receptive to using an ecosystem services approach include local watershed groups  
29 and the national NGOs they work with (e.g., American Rivers, River Network,  
30 Waterkeepers). Another potential interested client would be developers of  
31 conservation subdivisions. Assessing ecosystem services arising from those  
32 developments could be couples with analyses of house prices, etc.  
33

34 **Page 35:**  
35

- 36 - A more comprehensive education and outreach plan is needed here.  
37

38 **Page 43, Section 2.1:**  
39

- 40 - EPA has a good deal of experience in monitoring (e.g., Olsen et al., 1999). What is  
41 proposed under Long-term Goal 2 is at a scale and effort far greater than any of the  
42 current monitoring programs. Agency program scientists will need to devote a great  
43 deal of thought to deciding what variables will be monitored, and at what spatial and  
44 temporal scales. The temporal scales do not have to be the same, even within a single  
45 monitoring program. As an example, the Oregon Plan for Salmon and Watersheds  
46 (run by the Oregon Department of Fish and Wildlife) has various sets of sampling

1 sites (called panels) sampled at different frequencies: every year, every three years,  
2 every nine years, and every twenty-seven years (the multiples of three were chosen to  
3 coincide with salmon return periods). Yet, at any given point in time, information  
4 from all the sites, even though the sampling frequencies are different, can be  
5 combined in a statistically valid manner (based on statistical modeling results). Thus,  
6 information from different temporal and spatial scales of monitoring may be  
7 combined, as long as temporal/spatial correlation or other models have been  
8 developed to tie the pieces of information together.

9  
10 **Page 44:**

- 11
- 12 - On this page and also in Figure 13 on page 96 it is difficult to visualize concrete  
13 results from some of the general statements (e.g., “quantifying ecosystem services”).  
14 More detail would be helpful.
  - 15
  - 16 - A concern here is that the definition of ecosystem services to be monitored explicitly  
17 excludes ecological processes and functions as services. By excluding processes and  
18 functions one is only monitoring current state and not the underlying processes that  
19 generate that state. It apparently excludes rate measures, which would not appear to  
20 make sense if one is trying to measure provision of a service. An additional concern  
21 is that defining ecosystem services as those that are directly used by humans does not  
22 represent the value of natural systems and communities for their own sake (i.e.,  
23 existence value).
  - 24

25 **Page 45:**

- 26
- 27 - Table 9, identifying core ecosystem services, is incomplete. Will climate change and  
28 nonpoint source runoff be considered? More information should be provided to  
29 indicate how this table was developed. What were the criteria for selection of  
30 services? On the next page, it is stated that biodiversity is directly measurable. This  
31 is possible with diversity indices, but that is feasible only with certain taxonomic  
32 groups. Which components will be chosen? In streams, for example, diversity of  
33 algae, macroinvertebrates, and fish respond differently to stressors.
  - 34
  - 35 - The atlas idea (Fig. 11) is an excellent communications tool; people are very  
36 comfortable looking at maps. The Willamette Futures Project has used an atlas  
37 successfully to display different scenarios for land cover change and changes in  
38 certain ecosystem services as part of its public product. Figure 11 also mentions  
39 “responsive, low variability indicators for estimating ecosystem services”. EPA  
40 experienced a fair amount of difficulty in developing appropriate ecological  
41 indicators for EMAP, so this is probably a tall order for at least some of the  
42 indicators. (How does one derive a meaningful, low variability indicator out of  
43 responses that often exhibit high variability?) Because different ecosystem services  
44 will require development of different indicators, this will indeed complicate the  
45 framework for a monitoring design (e.g., require sampling at different spatial and  
46 temporal scales)

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- The last paragraph on the page leaves the reader hanging because there is no answer to the obvious question of how the Program addresses the data gaps identified by Carpenter et al. (2006).

**Page 46:**

- The long-term goal monitoring component in Figure 11 (also described in the second paragraph on page 48 and the first paragraph on page 49) will require much future research.

**Page 47:**

- The first 4 bullets on this page all are based on best professional judgment and thus need some outside critical review in the process to ensure quality science.
- This and other parts of the Plan would be strengthened by adding examples showing how relationships between direct measures of ecosystem structure and function have been quantifiably linked to ecosystem services. What services have been demonstrated to be measurable and mapable? This proof of concept is a crucial piece that is missing from the Plan.

**Page 49:**

- The science questions identified on this page (as well as on pages 50, 86, 87, and 111) are very complex. Given the state of the science, it is unlikely that these questions can be completely addressed within a period of several years.
- Regarding the issue of “census vs. sample” addressed on this page, given the place-specific nature of ecosystem services, it is inevitable that many resources will need to be sampled. Ecosystem attributes such as land cover, desertification, and wetlands (mentioned as data gaps in the 2006 Millennium Ecosystem Assessment) are examples of candidates for censusing, along with any ecosystem services derived from land cover measures that can be derived from satellite imagery. Where a census is not possible, only a probability sample can yield statistically valid estimates of uncertainty. Probability sampling occurs in many, but not all, of the various national monitoring programs described in Olsen et al. (1999). It must be added that probability sampling does not rule out having sites such as Long Term Ecological Research Program (LTER) sites, which provide extremely useful information on biological and ecological processes for scientists. It would indeed be useful (as the Ecological Research Program proposes) to take the current national monitoring programs that are based on probability sampling (starting with the EPA Office of Water’s national aquatic survey indicators) and see how responses presently recorded could be used to develop indicators of ecosystem services for a national inventory.

**Page 52:**

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- The annual performance goals presented in Table 10 are ambitious and may be unrealistic given that there is little current infrastructure set up to monitor services. If resources are limited, what will be diverted to address these goals?

**Page 53, Figure 12:**

- Some of the research questions listed here are management questions. Where is it clearly expressed that the Program will establish cause-effect relationships that can reliably predict effects to ecological resources to support decision making? The Plan should clearly indicate how parts of the Program support the development of establishing cause and effect and how these relationships are used at various levels of the environmental management process.

**Page 56:**

- The community of practice for ecosystem services modeling is not adequately described. Who will participate? How inclusive will it be?

**Page 57:**

- The modeling described here is a very large challenge. The annual performance goals presented here for modeling are unrealistic given the general approach. Where will the modelers come from? An education plan is needed to support this goal. An investment in graduate education is needed to move forward on this goal.

**Page 61:**

- Why does the first bullet on this page focus on fecal coliform impairment? EPA has established that *E. coli* is a more useful indicator.

**Page 62:**

- Haven't landscape metrics as indicators of Great Lakes coastal wetland quality (first bullet on the page) already been developed?
- More detailed information should be provided in paragraph two on this page to indicate how EPA will collaborate with the U.S. Geological Survey and National Oceanic and Atmospheric Administration. These collaborations have been problematic in the past.
- The Plan mentions research teams exploring mapping techniques for different services. Reference to or examples of some products from these teams would provide greater confidence in the feasibility of what is being proposed.

**Page 64:**

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- The annual performance goals presented here for mapping are tractable. EPA has the expertise to accomplish them. However, it will be a challenge to obtain the data needed for the maps.

**Page 67:**

- It is good that the N example on this page illustrates both positive and negative effects. It is surprising that there is no mention of hormesis.

**Page 69:**

- The U.S. Army Corps of Engineers Institute for Water Resources would appear to be a natural partner in the nitrogen and ecosystem assessments.

**Page 70:**

- A concern here is that a net benefits approach would yield management decisions such as allowing fertilization of oligotrophic systems to produce stronger recreational or commercial fisheries.
- The outcomes section of the goal provided in Figure 15 states that economists will convert ecosystem response functions to monetary values where possible. Are these in-house economists? If not, is there funding for this research?

**Page 72:**

- It is difficult to tell how the ecosystem assessments will be performed. There are numerous references in this section of the Plan to generating value or benefit estimates for wetlands and coral reefs (as well as for specific demonstration projects) but no indication of who will do this research. In addition, it is not clear whether data from the place-based assessments in Long-term Goal 5 will be used for the ecosystem assessments. If so, will data from other studies also be incorporated? This would seem to be necessary, particularly for the coral reef assessment.
- Answering the question posed in the first bullet on this page (What are the current spatial extent and condition of ecosystems?) will require very long-term research. Answering the other questions on this page will also be difficult and will require several years to address at a minimum.

**Page 74:**

- Much research on wetlands and coral reefs has already occurred at the local scale. For wetlands, modeling strategies have been developed for the Willamette Futures Project and the Tampa Bay watershed. Further research should be able to use these modeling strategies to map different wetland scenarios at scales larger than simply the

1 local level. For coral reefs, it appears that first “landscape characterization” will  
2 occur at the level of the eastern Caribbean. Though it is not a trivial effort to build a  
3 model linking coral reefs to human health and well-being, just communicating  
4 information on projected declines associated with urban development may prove  
5 useful. As previously noted in this advisory report, the decision to conduct research  
6 on coral reefs is not well justified.

7  
8 **Page 75:**

- 9  
10 - The SAB report on ecological risk assessment (U.S.EPA Science Advisory Board,  
11 2007) addresses multi-scale research needs.

12  
13 **Page 76:**

- 14  
15 - The importance of wetlands on hydrological connectivity should be mentioned in the  
16 first paragraph on this page.

17  
18 **Page 77:**

- 19  
20 - It is surprising that storm surge protection was not included as an ecosystem service  
21 in “Figure 16. Does that mean that salt marshes are not included in the assessment?  
22

23 **Page 82:**

- 24  
25 - The first bullet on this page indicates that the proposed research will determine the  
26 best methods (monetary and non-monetary) to value wetland services at multiple  
27 scales. It will be difficult to determine the best methods to value wetlands if the  
28 extent of the importance of wetlands is not known.  
29

30 **Page 84 – 85:**

- 31  
32 - It will be important to make sure that models mentioned for valuing, assessing, and  
33 forecasting ecosystem services can show predictive relationships. Adequate data will  
34 be needed to do this. In this regard, some of the models/frameworks in EPA’s  
35 CADDIS system are not effective.  
36

37 **Page 92:**

- 38  
39 - This section has not clearly indicated how selection of places will “make the concept  
40 of ecosystem services districts an operational management option.” The concept of  
41 ecosystem services districts is not mentioned. How did that concept shape the way  
42 the places were selected?  
43

44 **Page 93:**

45

- 1 - The research questions outlined here are good and they relate to testable hypotheses.  
2 One concern is that the research is focused only on temperate and tropical areas. The  
3 U.S. also includes arctic regions, and those regions are experience considerable  
4 changes as a result of global climate change.  
5

6 **Page 95:**  
7

- 8 - It should be clearly indicated here that, with the exception of humans and endangered  
9 species, the focus is not on effects to individual organisms, but rather on impacts to  
10 populations or communities of organisms. Thus, although biodiversity is important, it  
11 is not necessarily the key issue (cf. Ridder, 2008).  
12

13 **Page 99:**  
14

- 15 - The choice of the Willamette here makes considerable sense because much work has  
16 already been done on ecosystem services in this region. In producing the impressive  
17 work visualizing future scenarios for the Willamette Basin, work with landscape  
18 architects proved particularly valuable. Collaboration with this group should be  
19 explored.  
20

21 **Page 105:**  
22

- 23 - The Midwestern landscapes and coastal Carolina components are less developed,  
24 which is somewhat of a concern, particularly for the Midwestern landscape since it is  
25 so much larger and potentially more complex than any of the other place-based  
26 activities. The problems being faced by coastal Carolinas are no different than are  
27 being faced by Georgia. Why was this project cut off at the Carolinas? In many  
28 respects state protections on coastal development are much stricter in the Carolinas  
29 than in Georgia, which provides considerable opportunities for useful comparisons.  
30

31 **Page 110, Section 6.0:**  
32

- 33 - There should probably be several layers of annual review of progress. Each ORD  
34 laboratory could meet at least twice during the year and review progress of internal  
35 research initiatives. An annual meeting of the ORD laboratories and partners to  
36 report research findings in symposia or workshops could promote stronger  
37 interactions and information exchange.  
38

39 **Page 111:**  
40

- 41 - Concerning interaction with organizations, a proven way for EPA and the Ecological  
42 Research Program to take advantage of all the ecological and other scientific  
43 expertise in the marketplace is to put out requests for proposals for investigator  
44 initiated research. The EPA Environmental Monitoring and Assessment Program  
45 made good progress with the help of EPA STAR and other grants. EPA should  
46 continue with this model of making research progress.

- 1  
2 - It is stated here that the Program has been developed with “less-than-usual input from  
3 stakeholders within the Agency.” This is unfortunate because the Program has set as  
4 a goal decision maker acceptance of ecosystem services as a valid basis on which to  
5 make environmental decisions. Succeeding in this task requires input from decision  
6 makers as the program is being developed.  
7

8 **Page 117:**  
9

- 10 - It is not possible to comment on performance measures since they have not yet been  
11 developed. However, as previously noted, to the extent that some of the annual  
12 performance goals are very ambitious, the Program runs a risk of low performance  
13 ratings.  
14

15 **Page C-1:**  
16

- 17 - Important outcomes from the previous multi-year plan are listed here for 2009 and  
18 beyond. What happens to these outcomes with the new direction of the Program?  
19

20 **Other specific comments:**  
21

- 22 - A key issue will be delivering information to decision makers at the political level  
23 and ensuring that this information is heard and appropriately acted upon. To this end  
24 there is a need to develop short, effective briefing notes (similar to press releases) that  
25 can be delivered to Congress.  
26
- 27 - It is appropriate that EPA establish appropriate linkages with at least its neighbors,  
28 Canada (via Environment Canada) and Mexico. Further, there are similarities with  
29 the European Union Water Framework Directive and other similar measures that  
30 strongly suggest linkages also be established with the European Union.  
31
- 32 - The new strategic direction is good in that it is less fragmented and more holistic. It  
33 recognizes the reality that human beings need to take responsibility for changes they  
34 are making to the environment and specifically determine what changes should occur  
35 and what should not (cf. Chapman, 2007).  
36
- 37 - The Plan lacks a clear discussion of what will be done with monitoring data. There is  
38 a need to identify specific questions to be answered and the specifications of how the  
39 data are to be collected. In this regard power calculations are needed. This should be  
40 part of the more detailed implementation plan.  
41
- 42 - Time and space remain among the most difficult features of a system to analyze  
43 because of the lack of independence of each factor. Bayesian tools can be used for  
44 dealing with spatial relationships. It is not clear that the Plan sets the stage for the  
45 decadal long sampling programs that will be necessary for the Program.  
46

This draft SAB committee report has been prepared for final review and approval of the chartered SAB. This draft report does not represent EPA policy.

- 1 - The specific strategy to build conceptual models that are clearly causal should be  
2 included in implementation plans. At this point it is not clear how these models will  
3 be built, tested, and applied. Oreskes et al. (1994) should be consulted for useful  
4 information on this subject.  
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## ATTACHMENT G

### Compilation of SAB Comments on the EPEC Eco-Research MYP (7-28-2008)

#### 1. **Dr. Deb Swackhamer (Lead Reviewer)** **Quality Review: Advisory on EPA Ecological Research Program Multi-Year Plan**

The review of the Ecological Research Program's MYP does a clear job of lauding the aspirational goals of the Program while thoroughly describing the challenges for meeting these goals. The Program was reviewed by SAB Ecological Processes and Effects Committee (EPEC), which provided a rich array of specialties and perspectives. The report is generally well-organized and well-written, with a few exceptions noted below.

- a) Adequacy of addressing charge questions: The Committee was presented with 6 charge questions, and did a very thorough and thoughtful of responding to them.
- b) Draft report is clear and logical: In general, the report is extremely well-written, very clear, and very well organized. The recommendations are easily found due to the use of bullets, and they are clearly articulated as recommendations. The report is very clear about when the Committee was unanimous, or when there was a diversity of opinion. The Committee is commended for referring to specific pages in the MYP to map their discussion back to the Plan (eg p 19 line 39, p 20 line 41).
- c) Conclusions and recommendations are supported by information in the body of the report: In the main body of the report, the conclusions and recommendations were well supported by the discussion and other information. However, there were several sections of the Executive Summary and the Letter to the Administrator that were not clear without referring to the main report. I had some trouble clearly mapping the bulleted recommendations from the Letter to the Executive Summary and main body of the Report; they seem too vague and therefore ineffective as stand-alone recommendations. In the Executive Summary, the first two bullets on page ix are difficult to understand, particularly the reference to outreach and education in both. On page viii, line 5, the "certain areas" should be articulated as they are later in the report.

The discussion of Long Term Goal 3 on page x of the Executive Summary lacks some consistency with the full text discussion of this LTG. The Committee expressed concerns over the choice of nitrogen as a focus rather than another element, for example. The Executive Summary implies that the Committee endorsed the focus of LTG 3, when in fact that does not appear to be the case.

I did not find Figure 1 (page 26) useful.

Specific comments:

- P viii, line 5: the word “logic” can be confused with the use of this word later in “logic model”, and might be changed to “rationale”.
- P viii, line 7: STAR should be spelled out and then the acronym used for the rest of the document.
- P viii, lines 22-3: the phrase in ( ) is awkward.
- P xii, line 19: ORD should be spelled out and then the acronym carried forward.
- P 5, lines 19-20: NCEAS is referred to here but should be cited; it is in the references, and is cited elsewhere.
- P 16, line 38: P should be spelled out.
- P 24, line 26: comma needed after “not”
- P 30, line 6: remove extra period.
- Page 32, lines 17-18: need a space between these two references
- Page A-10: lines 14 -19 and lines 27-32 are nearly the same

**2. Dr. Mike McFarland (Lead Reviewer)**

The SAB Ecological Processes and Effects Committee (Committee) is commended for providing a clear and unambiguous report summarizing their scientific review of the Office of Research and Development’s (ORD) Ecological Research Program Multi-Year Plan (Plan). The letter to the administrator is well balanced and highlights the salient findings of the Committee’s scientific assessment. Similarly, the Executive Summary provides a detailed synopsis of the Committee’s full responses to each of the Agency charge questions with each response followed by concise descriptions of specific recommendations. Given the quality of the Committee’s responses to Agency charge questions, I fully support approval of the report pending any modifications/revisions agreed to by the SAB.

Although the Committee, in principle, supports that the strategic direction of the Agency’s Ecological Research Program Multi-Year Plan as well as its conceptual framework, it has a number of serious reservations regarding the Plan’s ability, as currently described, to generate the information necessary for reaching scientifically defensible decisions. The Committee acknowledges that many of the Plan’s technical limitations are associated with its proposed implementation program as well as the acute lack of funding and absence of vital in-house Agency expertise. The following section provides specific responses to the quality review charge questions followed by supplemental observations presented for consideration by the Committee.

**Were the original charge questions to the SAB Panel adequately addressed in the draft report?**

The Committee is applauded for providing clear, concise and detailed responses to each of the Agency charge questions. In each of the Committee's responses, a bulleted list of specific recommendations was provided for Agency consideration. It is particularly gratifying to note the Committee's strong support for the need to align ORD's ecological research program with the Agency's ecological risk assessment goals.

**Is the report clear and logical?**

On the whole, the report is clear and logical. However, there is one statement that is repeated both in the Executive Summary (page xii lines 23-24) and in the body of the report (page 9 lines 17-19) that is confusing. The Committee suggests that ORD "consider a non-Western value system most notably that of Native Americans to ensure that well-being is parameterized in an accurate multidimensional manner".

Although I believe that I understand the intent of the Committee's statement, I am not entirely convinced that it is appropriate. At best, the statement is fraught with confusion particularly to a reader unfamiliar with Native American culture and, at worst, the statement could be misinterpreted as patronizing (or at least judgmental). In my opinion, the degree to which Western value systems and Native American value systems diverge on the importance of ecosystem services is not sufficiently defined in the body of the report to merit inclusion of this statement.

**Where the conclusions drawn and/or recommendations made supported by information in the body of the draft report?**

The conclusions/recommendations articulated by the Committee are fully consistent with information found in the body of the report. The Committee has highlighted the need to address a number of overarching program limitations specifically the lack of sufficient program funding as well as the absence of requisite expertise in ORD to fully execute the Plan. The Committee is applauded for its support of ORD's decision to pursue financial leveraging opportunities both within and outside the Agency for funding vital ecological research as well as its acknowledgement that a sustainable ecological research program requires investment in the training of future scientists through an extramural grants program.

**SUPPLEMENTAL INFORMATION**

- a) Page 4 (line 34). Should the sentence that begins with "A 10-year plan ..." be rewritten to state "A 5-year plan ..." since multiyear plans have a five (5) year time horizon?
- b) Page 9 (line 11). Should the word "physical" be placed in between ORD and scientists to distinguish physical scientists from social scientists?

- c) Page 12 (lines 14 – 18). What is the current or potential role of the Agency’s Office of Information with respect to outreach and education (OE)?
- d) Page 12 (lines 41-42) There are a number of other federal agencies that maintain and have jurisdiction over large tracks of land (terrestrial ecosystems) including the US Dept. of the Interior (Bureau of Land Management), US Dept. of Agriculture (US Forest Service) and US Dept. of Defense (test and training ranges). Each of these agencies (as well as others) is required to conduct ecological assessments (as mandated under the National Environmental Policy Act or NEPA) of the property under their management. These federal agencies also support well funded ecological research programs whose activities may be leveraged by the ORD.
- e) Page 24 (lines 10 – 11). The statement that begins “We find that this amount (1%) is insufficient to support effective outreach efforts...” should be revised to reflect the fact that this statement is an opinion and not the result of an actual cost analysis.
- f) Page 27 (lines 39-42). The Committee should consider adding Interagency Personnel Agreements (or IPAs) to this list. IPAs allows government employees (local, state or federal) with specific skill sets to be detailed to ORD (or other EPA offices) to meet program needs.

**3. Dr. Catherine Kling (Lead Reviewer)**

Comments on the SAB Advisory on the EPA Ecological Research Program Multi-Year Plan

This report is very clearly written and entirely responsive to the charge questions. The report is logical and the conclusions drawn are supported by the information in the body of the report. The message that EPA is entirely on the right track with its new focus on ecosystem services comes through loud and clear; this is an important and clear message that the committee has done a great job at delivering.

A general comment: one of the tensions in considering a research program like the one presented here is to cut the right balance between undertaking the research that answers the right questions for a particular decision that must be addressed (which suggests waiting until those questions are clear and then formulating a specific research project) vs. having a set of ecosystem values sitting on the shelf waiting for use when a decision need arises. In the latter case, the values that will be “on the shelf” will no doubt not quite fit the research question. And, it is these values that are most likely to be misinterpreted or misused. In the former case, the analysis needed will often be too slow to be of use in making the decision. (Related to this point is the need to avoid valuing ecosystem services just for the sake of doing so; indeed, many decisions related to ecosystems will not need formal valuation to support good decision making. In other cases, explicit valuation will be a very

key input to a decision process.) The Ecological Research Program at EPA somehow needs to do their best to balance these two competing needs (easy to say, hard to do).

- a) On page 5, the committee provides a fantastic suggestion: that EPA should collaborate with other federal agencies and scientists to conduct an assessment of status and trends of ecosystem services in the U.S. (they draw an analogy to the IPCC). This strikes me as a very valuable enterprise for which EPA should obviously be the lead. Further, this could be a significant component of the effort to intelligently leverage EPA (and other agencies and NGOs) resources in this important area. Two suggestions: 1) make this recommendation more prominent by adding it to the Executive Summary and possibly the letter to the Administrator and 2) to mention this idea again in the report in reference to the section and discussions related to leveraging of EPA resources on ecosystems research.
- b) The entire issue of how best for EPA to develop and support decision support platforms has been a continuing struggle in the ecosystems research area. I wonder if it might be useful for EPA to examine in depth one or more DSPs that have been developed and implemented by other agencies (or by EPA in another area?) to learn what approaches have been effective both in terms of model and data and in terms of the delivery of the DSPs to the end users. Are there DSPs related to superfund sites? There is a large multi-state, multi-agency effort to restore the Chesapeake Bay, are there DSPs that have been developed in that effort? Have they been effective? What can be learned from them (positive or negative)?
- c) Thank you for noting that “biofuels” are not the only environmental issue in the 13 state region of the Midwest (page 19)
- d) There is discussion r.e. Charge Question 5 on the new NRC report on evaluating research efficiency at EPA. While I assume that the NRC report deals with the “PART” process that has been such a thorn in the past, I was not clear whether the recommendations provided by the SAB review on page 25 were based on the NRC report and/or whether they would be consistent with being successful in whatever PART-like process will evaluate the ecological research program in the future. While I think the comments provided in the SAB review are very sensible, I just want to be sure that SAB is not suggesting things that will later be problematic (e.g., is the point that it is “premature to prescribe specific measures to evaluate annual performance/progress goals for the program” (lines 34-35, page 25) going to be a problem for EPA later?)

- e) Very minor point: there is an occasional monster paragraph in the report that makes reading the manuscript a bit more daunting than necessary. See pages 8 and 13 for examples.

This was an extremely thoughtful and thorough report.

#### 4. **Dr. Baruch Fischhoff**

My reading of the draft report and review raises the following concerns:

The Decision Support Platform is likely to be a waste of money, diverting limited resources from ecological research to expensive computer exercises that bring little value to anyone but their developers, unless the following issues are addressed:

- (a) Members of an explicitly identified user community must be involved in all stages of its development, so that the DSP has some specific uses and not just an ill-defined set of conceivable uses.
- (b) The DSP is subjected to rigorous empirical evaluation of its usability, with individuals drawn from that identified user population, performing tasks like those for which the DSP is intended. These evaluations must meet the highest standards of human-computer interaction research and, as mentioned, begin with the earliest stages of system development – so that usability is essential to the design, not an afterthought tacked on at the end.

The draft review raises very serious concerns in this regard (p. 9ff). To my mind, it is not skeptical enough. As the authors note (quoting Goosen et al., 2007, on p. 41), the general problem of creating useful DSP's has not been solved. It takes a leap of faith that a few additional suggestions will do the trick, and justify this investment. I am not convinced that the program's stated goals would not be better served by investing its resources in sound research, with enough set aside to ensure that they are communicated effectively to decision makers (a belief that may underlie the draft review's concern about the minimal education and outreach budget). One can support decisions without decision support systems.

The commitment to assessing the value of ecosystem services is commendable. However,

- (a) As the draft review notes, the lack of resources makes the realization of this commitment infeasible. Not only is the NCEE underfunded as is, but the SAB has heard a proposal to eliminate it. This report could be very useful if it led to strengthening the NCEE, not so useful if it added an additional demand to a threatened common pool resource.
- (b) The report appears to be open to non-economic methods of valuation (as will be summarized in the SAB C-VPES report that it cites on p. 31. I would like to see that openness made more explicitly. Monetization can serve some purposes (e.g., in regulatory proceedings). However, there are other contexts (e.g., community planning, restoration, communication, education) where it can be a distraction. Moreover, as the report notes

(Section 1.2.3), there are situations in which it is hardly viable. Requiring monetization implicitly devalues those resources that economics does not yet know how to handle.

I am skeptical of any Outreach and Education activities without explicit empirical evaluation. I see unconscionable amounts of resources wasted on what seem like useless (even counterproductive) websites, PSAs, etc. People naturally exaggerate how well they understand their audience and how well they have communicated. There is no substitute for evidence – which must be collected to social science standards (i.e., not just web hits or TV views). Partnering solves nothing unless the partners have sound practices.

It seems strange that a report on ecosystem health would have only one reference to invasive species. It is also my sense that the activities proposed here move at too slow a pace to facilitate EPA's response to invasives. Rather, these activities may just serve the forensic purpose of documenting the damage that invasives have done (perhaps in terms). If so, then, with its limited budgets, EPA may be choosing comprehensiveness over effectiveness. The report may envision some (unspecified) others picking up the action. However, I didn't see the explicit plan and resources to make that happen. (The draft review discusses these issues in more general terms in its answer to Charge Question 3, and elsewhere.)

Generalizing this last point, I had the feeling that there was relatively little ecology in the report, given the program's mission, outside the two case studies (and, to a lesser extent, the wetlands and coral reef sections). Rather, the plan seems to emphasize data management and highly selected chemical threats. That makes me wonder whether the Agency's scientific resources in ecology have been depleted and the report is written to take advantage of the capabilities that it has left, rather than pushing for strengthening of its resources in ecology. Continuing my first two worries, I wonder whether the systems being proposed (DSP, valuation, etc.) will be able to accommodate the broad range of ecological knowledge, or just variables that appear across places and scales (just as I fear that they will not be able to accommodate the broad range of human concerns).

Overall, my inclination would be to build out from case studies, ensuring that they are addressed adequately, with an eye to developing general methods – rather than assuming that a general method exists, investing a lot in its creation, and then hoping that it can be applied. Decision makers (broadly defined) might be best served by having someone else's, perhaps very different, problem solved well, so that they can see what a full solution looks like.

##### **5. Dr. Rebecca Parkin**

The charge for an SAB quality review asks whether:

- a) the original charge questions to the SAB EPEC are adequately addressed in the draft report;
- b) the draft report is clear and logical; and

c) the conclusions drawn, and/or recommendations made, are supported by information in the body of the report.

My responses to the above questions are:

- a) Nearly all of the charge questions were addressed adequately. The responses to Questions 1 and 3-5 are adequate. The responses to Charge Question 2 are more difficult to assess because the organizational structure of the report does not go down to the level of the elements within the bulleted questions. While the goals were clearly addressed for Long-Term Goals (LTG) 1 and 4, they were less obviously considered for LTGs 2, 3, and 5. The objectives for LTGs 1, 2, and 4 and the research questions for LTGs 1 and 2 were explicitly discussed. Elements within each of the bulleted questions seem to have been missed in part for each of the LTGs.
- b) Other than the comment in a), the draft report was clearly written. Throughout it was written in a logical manner.
- c) The conclusions stated in the letter to the Administrator, Executive Summary (ES) and report were supported by evidence presented in the report. Many points made repeatedly in the report (e.g., limited resources, lack of internal expertise, need to develop partnerships) were stated in the letter and/or ES. However, there are points of urgency or emphasis in the report which were not noted in the letter and/or ES. These discontinuities may be readily addressed in a variety of ways (e.g., rephrasing, ensuring consistency in capturing major points in the ES and the most urgent and important points in the letter). Examples of mismatches between the report and the letter and/or ES include the following:

- Pages 10, 17, 18: The need to obtain “buy-in” from stakeholders and partners is repeatedly noted and stated as “essential” in the report, but this need is not stated either in the letter or ES.
- On various pages (e.g., pp. 12, 21 and 29) outreach and education (O&E) are noted as elements of the plan, but functions for which ORD has little expertise. It is curious to this reviewer that, if this issue merits repeated mentions, there is no mention of O&E in the letter and only a brief listing of this issue in the ES. Further, the importance of ensuring an empirical basis for O&E has often been stressed by the SAB, but is not mentioned in the report (p. 29). This reviewer sees this omission as a key, missed opportunity for reinforcing this important point.
- Defining ecosystem services too narrowly, and thereby overemphasizing human health and welfare goals, is raised as an important issue (p. 13, line 38 through p. 14, line 4), but it is not noted in the letter or ES. Without bringing this concern forward to at least the ES, it appears to this reviewer that the committee does not see this issue as important as the text implies.
- The committee notes that understanding why ecosystem services are lost is a “key missing piece,” which is crucial to the overall

success of the plan (p. 18). However, this point, which is emphasized in the report, is not mentioned in the letter or ES.

- Selecting sites which are widely representative and offer the opportunities for generalization to other areas is noted as important (page 19), but is not stated in the ES or letter.
- Another issue which is addressed repeatedly in the report (e.g., pp. 15, 19, 20 and 23) is the importance of ensuring that the scale of measurements is appropriate for the decision problem and that that scale can be adequately characterized using available data. This issue is not stated in the ES or letter.
- Is “as soon as possible” the correct meaning on p. 15, line 13? If so, shouldn’t this issue be noted at least in the ES?
- The question raised asking why ORD has chosen to focus on N instead of P (p. 16) seems important enough to merit mention in the ES.
- The use of life cycle analysis is “strongly urged” by the committee (p. 20), but only in the report.
- On pages 23, 24 and 30, the point is made that ORD should enlist the support and input of potential partners “immediately” and “as soon as possible.” This need for early action, if it is what the committee as a whole intends, is not expressed in the letter or ES.
- A “tremendous opportunity” to advance ecological research is noted on p. 24 only. If it is so significant, this reviewer would expect to see it at least in the ES as well.

Additional comments to consider:

- Two acronyms are used before they are defined (e.g., ORD and STAR).
- Some acronyms are defined but are not used again in the report after being defined (e.g., NRDAR, LTER and ERA).
- Some portions of the report (e.g., page 7) become tedious to read due to heavy use of acronyms.
- P. 1, line 24: This reviewer recommends deleting “understand” as it is not measurable, but “respond” is if it is assessed in terms of specific types of response.
- Combining types of information and functions are described as “quite dangerous” (p. 11) in the report, but are not highlighted elsewhere. This reviewer wondered whether this description fits the committee’s actual intent or whether rewording would be more appropriate.
- Wherever 1% is pointed out as insufficient for O&E (e.g., pp. 21 and 24), a means to determine what would be a sufficient percentage should be indicated.
- This reviewer questions the appropriateness of calling upon ORD to work with organizations to “raise funds” (p. 28).

- This reviewer does not agree with the first bullet on page 29, suggesting that ORD leverage universities by getting them to accept reduced indirect costs. In this era of reduced federal funding, many universities are not able to offer such options. Federal agencies are usually some of the few places where universities CAN get full indirects. Most other funders (e.g., foundations and not-for-profits) do not allow full indirect cost recovery.

**6. Dr. Agnes Kane:**

I concur with the Committee's review of this draft plan. This review was thorough and thoughtful and provides clear guidelines for revision. As a physician, I support the committee's first suggestion to place greater emphasis on the relationship between ecosystem services and human health and well-being. This should be considered at multiple levels: individuals (especially susceptible individuals), local communities, and the entire population. Specific case studies or examples should be developed to illustrate potential or demonstrated human health impacts at each of these levels.

Outreach and education is an important issue that applies to all Agency environmental programs. Other community and education outreach programs have been developed by external funding mechanisms (e.g., SBRP Grants and NIEHS Center Grants). EPA should consider utilizing the resources and expertise that have already been developed by these funding mechanisms.

**7. Dr. Jana Milford:**

My review of the draft report raises the following concerns.

a). It is not clear to me that the first charge question has been adequately addressed. This charge question asks specifically if the proposed strategic direction will offer "meaningful contributions to the ecological sciences" and provide "research that will be useful to decision makers at EPA and other levels of governance." The question of how the Agency's proposed focus on ecosystem services will contribute to/fit in with the broader field of ecological sciences seems an especially appropriate subject for SAB comments, yet it is barely addressed in the report. In particular, I expected the panel to discuss the opportunity costs of the proposed focus (and the apparent shift away from EPA ORD's prior focus on ecological risk assessment). Does the strategic direction still accommodate necessary research in monitoring ecosystem status? Does the utilitarian focus of "ecosystem services" risk losing important potential research contributions to improved understanding of ecosystem functions/responses that are unrelated to recognized "services" to human health and well-being? Similarly, is there a risk that over-emphasis on ecosystem services that are too narrowly defined will prove to be a disservice to decision makers in the long run? The panel might consider these questions and nevertheless conclude they enthusiastically support the new direction, but I wish the broader questions could be addressed.

b) The very first recommendation on p. viii of the Executive Summary suggests that resources are inadequate to accomplish the goals of the research program and urges EPA to provide STAR grant support for ecosystem services. This may be a rather off-putting start to the Committee's report, since it could be perceived as self serving. The Committee might reconsider the placement of that recommendation, and also consider whether there are other ways to fill the needed research/capacity gaps (e.g., new hires at ORD with increased in-house research, contracting out work to consulting companies, etc.).

c) On p. xi and p. 16, the Committee advises ORD to eliminate its proposed research focus on coral reef ecosystems under Long-term Goal 4, because coral reefs "are a relatively low priority in the U.S." This statement is not supported by any evidence, and moreover seems rather narrow-minded. EPA has historically had and arguably should continue to have an important role in research and policy development related to "globally important" environmental problems. But perhaps instead of making value judgments about whether coral reef ecosystems are an important U.S. priority, the Committee might ask ORD for a better explanation of how studying the dynamics of ecosystem service flows in coral reefs will advance ecological sciences and ultimately help inform decision making.

d) On p. xi and p. 20, the Committee needs to explain more clearly why consideration of "transboundary" issues is important. I don't see how the fact that an ecosystem extends across political jurisdictions (e.g., the U.S. and Canada) would come into play in assessing the production function of ecosystem services it provides.

e) The recommendation on p. xiii and p. 12 that ORD develop a grants program for teacher education is not adequately justified. No one would disagree that teacher training is valuable, but is this an appropriate use of ORD time and resources? Likewise, the Committee needs to better explain/justify its recommendations that ORD should focus its limited resources on public education/outreach efforts.

f) The recommendation on p. 5 that EPA work with other agencies to produce an IPCC-style assessment of status and trends of ecosystem services requires clarification. The IPCC assessment cycle represents an enormous international activity. Is that really what the Committee had in mind?

g) The recommendation on p. 14 that EPA "develop forecasting models from the information in available databases" isn't clear. What does the Committee have in mind here?

h) The list of "principles" for judging the locations of "place-based demonstration projects" on p. 19 seems likely to over-constrain the problem for

ORD. Perhaps these could be more clearly presented as principles for the Agency to consider, without suggesting that they must all be met.

**8. Dr. Rogene Henderson:**

I am not an ecologist, so I limited my review to a detailed reading of the transmittal letter and of the executive summary and a more skimming review of the rest of the document.

I found this advisory to be clearly written and well organized. Each of the charge questions was carefully addressed. The report was clear and logical and the recommendations appeared to be well-supported by the text of the report. I especially agreed with the recommendation (page 7) to combine and integrate the HHWB and ESV elements of the Plan. The effect of the ecosystems services on human well-being is a link that must be made.

**9. Dr. David Dzombak:**

*(a) Are the original charge questions to the SAB committee adequately addressed in the draft report?*

The SAB Ecological Processes and Effects Committee (EPEC) review has addressed all of the charge questions. Each of the charge questions appears to be addressed in sufficient depth, and specific recommendations have been developed for each of the charge questions and sub-questions.

*(b) Is the draft report clear and logical?*

The organization of the draft report and its executive summary by the SAB EPEC follows the charge questions directly and is easy to follow.

There are some aspects of the review that I would encourage the committee to reconsider. There are some specific instances where the recommendations of the committee are not consistent. More importantly, the committee did not recommend dropping any of the proposed activities to achieve focus and perhaps more impact.

(i) The committee report makes clear that the comprehensive, broad-scope plan set forth by ORD is commendable in many respects, but also highly ambitious and unlikely to be achievable within existing budgetary and personnel constraints. After reading the detailed committee support for this position, it seems to me that many aspects of the comprehensive plan have no chance of being achieved. Financial and human resources available to the Agency appear to be far below what would be needed to implement the plan. I get the sense that if ORD embarks upon implementation of the current plan and attempts to advance on all fronts, progress on each front will be very slow. I would ask that the committee consider making recommendations of activities that should be omitted in order to focus available resources on high priority issues and make an impact. More

recommendations such as the one made by the committee to concentrate on terrestrial systems rather than coral reefs (pages 16,17) would be helpful.

(ii) On page 4, in the next to last bullet, the committee discusses the speed with which new ecological challenges are developing, and recommends that ORD put into place an adaptive structure that can address high priority, rapidly changing problems. If this is indeed the view of the committee, then other recommendations urging ORD to focus its resources better would seem to be in order.

(iii) On page 11 (bottom) and page 12 (top), the committee comments on the proposed outreach and education activities, noting that “OE has not historically been a significant part of ORD’s work and, therefore, additional expertise may be needed in this area.” The committee goes on to call for a more comprehensive OE plan. This recommendation, for ORD to build significant new capacity and use scarce funds on non-research activity, seems hard to justify given the scope of the research needed and the concern about having funds to do it.

(iv) On page 28, the committee recommends that ORD “make the STAR program a priority in efforts to leverage resources and achieve goals by: enhancing the STAR Graduate Fellowships program; providing funds for non-targeted, exploratory extramural research ...; and developing a competitive grants program to run summer credit workshops for teachers...” This recommendation for non-targeted investment seems inconsistent with the concerns expressed about inadequate resources to implement the core aspects of the program. It seems inconsistent to comment about an overly ambitious plan and then recommend such non-targeted investments. I suggest that more recommendations for narrowing focus and targeting resources are needed, rather than recommendations of the sort offered here.

*(c) Are the conclusions drawn, and/or recommendations made, supported by the information in the body of the draft SAB report?*

The conclusions drawn and recommendations made are supported by the information in the body of the draft report. My only recommendation in regard to this question is that the inconsistencies noted under (b) should be addressed.

**10. Dr. Valerie Thomas:**

Letter to administrator, p. i, lines 25-26: “the SAB strongly supports this strategic direction and commends the Agency for developing a research program that has the potential to be transformative for environmental decision-making as well as for environmental science.” Where are these claims, “potential to be transformative for environmental decision-making as well as for environmental science” supported? The statement is repeated in the Executive Summary, p. vii, lines 35-36. There should be at least one paragraph somewhere that describes how this research will be transformative for environmental science. Throughout the

document, the doubt cast on the feasibility of the plan, and the lack of funding for fundamental research, casts doubt on the transformative potential of the research plan. If there is transformative potential, that needs to be explained and highlighted.

What does EPA need to do to achieve the transformation?

Letter p. i, lines 33-35. “we have a number of concerns about the draft Plan... related to the tension between stating an important and ambitious vision and producing a practical implementation.” Overall the meaning of the letter is not clear. It reads as if the SAB supports the plan, but thinks, as usual, that there should be more money for research. But from the details of the body of the report, the Panel really seems to be saying, perhaps, that it strongly supports the “direction” but not the Plan, because the Plan seems unlikely to accomplish its stated goals. If that is what the Panel is trying to say, the Letter should be revised to make this clear.

Executive Summary, p. viii.

lines 2-3: “goals are unlikely to be accomplished”  
lines 15-16: “goals cannot be accomplished without basic ecological research”  
These statements don’t line up with the Committee’s support for the research plan.

Executive Summary p. ix:

Line 5: “the Committee supports long-term Goal 1”

Lines 38-39: “the Committee is concerned about the overall feasibility of accomplishing Long-term Goal 1.”

These two statements don’t add up with the support of the Committee for the Plan. Why does the committee support the Goal if it can’t be achieved?

pp. 3-4. The report says that \$68M will be dedicated to the program, and the Committee recommends use of STAR program funds as well as more internal funds. It would be helpful if the Committee could say how much funding would be enough, and the relative balance of external and internal funding.

p. 7, lines 16-46 – the suggestion to combine HHWB and ESV seems useful, as does the suggestion to combine DSP and OE.

pp. 10 line 30 – p. 11 line 42. This entire section calls into question the validity of the plan for developing the DSPs (Decision Support Platforms). The Committee recommends, on p. 11 line 14, that “EPA should more clearly describe how the DSP would actually work.” The benefit of this recommendation is unclear: the Committee seems to be saying that the idea of the DSP has not been thought through, and that making one at all will face significant obstacles. So asking EPA to describe how it would work seems to be a rhetorical question – by describing

how it would work it would become clearer that it would not work. Rather than this pedagogical recommendation, it seems that the Committee should clearly say that the DSP does not seem to be feasible and should be cut from the plan or significantly revised.

p. 16, lines 9-16: The Committee recommends dropping the study of reactive nitrogen. I think that in the SAB review of the sustainability research plan, we recommended that EPA take on one or two high profile important case studies, to demonstrate the actual value of the research on a major problem. This proposed focus on reactive nitrogen seems to be in that spirit. So I wonder if SAB is giving EPA conflicting advice in reviews of different but related research programs. On the other hand, Long-term goals 4 and 5 also address specific case studies; how all of these fit together, and which ones are scientifically stronger, or more important for EPA's mission, is not very clear.

#### **11. Dr. James Galloway and Dr. Thomas Theis**

In general we feel that the committee has done a good job with its review, however we believe that the negative tone of the review of Goal #3 is not appropriate. Specifically, we are getting a mixed message from this review; it appears that the advisory committee is split on the importance of Goal 3. Unfortunately, the disagreement comes across as apparently recommending that EPA not pursue an integrated nitrogen assessment. In our view this is unwise. The issues of nitrogen are of such current importance now, and will only grow in the future, that what the committee should do is to advise EPA on how to make the proposed program better in both the short term and the long term.

In addition to this general comment, we have the following specific responses to the bulleted items in the committee's review.

- a) The report is in at least one important way forward-thinking in its endorsement of the ecosystem services approach to evaluating environmental quality, but seems misinformed on the importance of Nr to the production (positive and negative) of goods and services produced by ecosystems.
- b) The suggestion to substitute Hg for Nr effects research would move the MYP in a very different direction. Hg impairs ecosystem functions by virtue of its toxicity. Nr has both positive and negative impacts, and presents policy makers with a useful example of the need to incorporate tradeoffs into policy.
- c) Hg already has a MYP. If EPEC wished to endorse studies involving Hg then they should be sure to note this, and encourage EPA to work cooperatively.

- d) The sentiment of some committee members to use the funds for other areas in the Ecological Research Program (e.g., outreach and education) is puzzling. This would not only delay the establishment of a needed national program, but would send a strong signal that such a program is not needed.
- e) We agree with the advisory committee that ORD should partner not only with other EPA entities (i.e., OAR) but also other agencies. From our understanding, these partnerships have always been planned.
- f) Apparently some members of the advisory committee felt that the research description was too general to be evaluated, while others felt the proposed research was tractable. In the spirit of a constructive Advisory, it would be useful for the former group to be more specific of what they are looking for.

**Proposed Disposition of Quality Review Comments the Draft SAB Report, *SAB Advisory on the EPA Ecological Research Program Multi-Year Plan***

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**Dr. David Dzombak**

Comment: The SAB Ecological Processes and Effects Committee (EPEC) review has addressed all of the charge questions. Each of the charge questions appears to be addressed in sufficient depth, and specific recommendations have been developed for each of the charge questions and sub-questions.

*Suggested response: No change necessary.*

Comment: The organization of the draft report and its executive summary by the SAB EPEC follows the charge questions directly and is easy to follow.

*Suggested response: No change necessary.*

Comment: There are some aspects of the review that I would encourage the committee to reconsider. There are some specific instances where the recommendations of the committee are not consistent. More importantly, the committee did not recommend dropping any of the proposed activities to achieve focus and perhaps more impact.

(i) The committee report makes clear that the comprehensive, broad-scope plan set forth by ORD is commendable in many respects, but also highly ambitious and unlikely to be achievable within existing budgetary and personnel constraints. After reading the detailed committee support for this position, it seems to me that many aspects of the comprehensive plan have no chance of being achieved. Financial and human resources available to the Agency appear to be far below what would be needed to implement the plan. I get the sense that if ORD embarks upon implementation of the current plan and attempts to advance on all fronts, progress on each front will be very slow. I would ask that the committee consider making recommendations of activities that should be omitted in order to focus available resources on high priority issues and make an impact. More recommendations such as the one made by the committee to concentrate on terrestrial systems rather than coral reefs (pages 16, 17) would be helpful.

*Suggested response: The Multi-Year Plan is intended to describe EPA's goals and objectives in undertaking a comprehensive ecological research program. In our review of the goals, objectives, and research questions articulated in the Multi-Year Plan we have commented on the scope of proposed research and recommended improvements and additions. However, we would need additional budget information (including potential for cross-program and multi-agency partnerships to accomplish work) in order to recommend elimination of various research components. These are difficult decisions that really must be made in the context of EPA's overall research budget, and as such are beyond the scope of this review. However, the Committee agrees with the comment that*

*the current resources available to support the ecological research program appear to be well below what is needed. The Committee has stated in the letter to the Administrator and in the body of the report that we are extremely concerned that the budget is too small to support the ambitious program. We have noted that the objective of completing much of the proposed research within the time frame of the multi-year plan is unrealistic. In the report we have noted concerns about the feasibility of developing the proposed decision support platform, have recommended that the program focus on research to measure and predict changes in ecosystem services rather than alternative valuation methods, and in one case (coral reef research) have suggested that research in other human dominated systems might be more useful. In the discussion of ecosystem assessments on page 18 we have recommended that ORD follow a strategy of undertaking simpler pilot projects initially, where tangible products showing the process from beginning to end can be produced within a three-year period.*

(ii) On page 4, in the next to last bullet, the committee discusses the speed with which new ecological challenges are developing, and recommends that ORD put into place an adaptive structure that can address high priority, rapidly changing problems. If this is indeed the view of the committee, then other recommendations urging ORD to focus its resources better would seem to be in order.

*Suggested response: Please see previous response. Because the Committee did not review EPA's research budget, specific recommendations concerning the allocation of resources are beyond the scope of this review. However, we have noted numerous concerns about resources and suggested ways that EPA might leverage available resources.*

(iii) On page 11 (bottom) and page 12 (top), the committee comments on the proposed outreach and education activities, noting that "OE has not historically been a significant part of ORD's work and, therefore, additional expertise may be needed in this area." The committee goes on to call for a more comprehensive OE plan. This recommendation, for ORD to build significant new capacity and use scarce funds on non-research activity, seems hard to justify given the scope of the research needed and the concern about having funds to do it.

*Suggested response: We wish to keep this recommendation in the report and think that EPA should make additional resources available for outreach and education. The Committee found that the success of the Ecological Research Program will depend in large part upon outreach and education efforts. This is because (as stated on page 1 of the report) the overall goal of the Program is to "change the ways in which policy and management choices affect the type, quality, and magnitude of goods and services that are received from ecosystems." To accomplish this, buy-in from economists, social scientists, and others involved in valuation and the policy-making process is essential. Therefore, outreach and education efforts will be needed. Outreach efforts will also be needed to build partnerships critical to the success of the Program.*

(iv) On page 28, the committee recommends that ORD “make the STAR program a priority in efforts to leverage resources and achieve goals by: enhancing the STAR Graduate Fellowships program; providing funds for non-targeted, exploratory extramural research ...; and developing a competitive grants program to run summer credit workshops for teachers...” This recommendation for non-targeted investment seems inconsistent with the concerns expressed about inadequate resources to implement the core aspects of the program. It seems inconsistent to comment about an overly ambitious plan and then recommend such non-targeted investments. I suggest that more recommendations for narrowing focus and targeting resources are needed, rather than recommendations of the sort offered here.

*Suggested response: The sentence will be revised to remove the words “non-targeted” and emphasize support for ecological research projects. The Committee felt that it was important to provide STAR funds for projects that could support the Program. The revised bullet on page 28 would be as follows: “We strongly encourage ORD to make the STAR program a priority in efforts to leverage resource and achieve goals of the Ecological Research program by: enhancing the STAR Graduate Fellowships Program to support ecological research, providing funds for exploratory extramural research to develop tools and procedures to accomplish the goals of the Plan, and developing a competitive grants program to run summer credit workshops for teachers through STAR that would support the goals of the Plan.”*

Comment: The conclusions drawn and recommendations made are supported by the information in the body of the draft report. My only recommendation in regard to this question is that the inconsistencies noted should be addressed.

*Suggested response: no change necessary.*

### **Dr. Baruch Fischhoff**

My reading of the draft report and review raises the following concerns:

Comment: The Decision Support Platform is likely to be a waste of money, diverting limited resources from ecological research to expensive computer exercises that bring little value to anyone but their developers, unless the following issues are addressed:

*Suggested response: The second sentence on page 10, line 20 will be revised as follows. “In addition, it is important to note that the DSP could divert limited resources from ecological research to expensive computer exercises and be of limited value unless members of an explicitly identified user community are involved in all stages of its development so that the DSP has specific uses. As further discussed below, The DSP should also be subjected to rigorous empirical evaluation of its usability.”*

- (a) Members of an explicitly identified user community must be involved in all stages of its development, so that the DSP has some specific uses and not just an ill-defined set of conceivable uses.

*Suggested response: The report states (on page 10 line 24) that EPA should explicitly identify potential clients who will use the DSP. The sentence will be revised as follows: "In the Plan, EPA should explicitly identify potential clients who will use the DSP. Members of the explicitly identified user community must be involved in all stages of its development, so that the DSP has some specific uses and not just an ill-defined set of conceivable uses."*

- (b) The DSP is subjected to rigorous empirical evaluation of its usability, with individuals drawn from that identified user population, performing tasks like those for which the DSP is intended. These evaluations must meet the highest standards of human-computer interaction research and, as mentioned, begin with the earliest stages of system development – so that usability is essential to the design, not an afterthought tacked on at the end.

*Suggested response: The following text will be added to the bullet on page 11, line 18. "Furthermore, the DSP should be subjected to rigorous empirical evaluation of its usability, with individuals drawn from that identified user population, performing tasks like those for which the DSP is intended. These evaluations must meet the highest standards of human-computer interaction research and, as mentioned, begin with the earliest stages of system development so that usability is essential to the design, not an afterthought tacked on at the end."*

Comment: The draft review raises very serious concerns in this regard (p. 9ff). To my mind, it is not skeptical enough. As the authors note (quoting Goosen et al., 2007, on p. 41), the general problem of creating useful DSP's has not been solved. It takes a leap of faith that a few additional suggestions will do the trick, and justify this investment. I am not convinced that the program's stated goals would not be better served by investing its resources in sound research, with enough set aside to ensure that they are communicated effectively to decision makers (a belief that may underlie the draft review's concern about the minimal education and outreach budget). One can support decisions without decision support systems.

*Suggested response: See suggested changes above. The report raises concerns about the feasibility of accomplishing Long-term Goal 1, indicating on page 12, line 24 that the Committee questions whether ORD can realistically achieve the objectives and accomplish the tasks set forth. The Committee has also stated that it is not clear how the DSP would be designed and developed (page 10, line 44) and recommends that more information be provided (page 11, line 14). In addition, the committee also recommends that the program focus on research measuring and evaluating changes in ecosystem services (page ix, line 26; page 9, line 36).*

Comment: The commitment to assessing the value of ecosystem services is commendable. However,

- (a) As the draft review notes, the lack of resources makes the realization of this commitment infeasible. Not only is the NCEE underfunded as is, but the SAB has heard a proposal to eliminate it. This report could be very useful if it led to strengthening the NCEE, not so useful if it added an additional demand to a threatened common pool resource.

*Suggested response: No change necessary.*

- (b) The report appears to be open to non-economic methods of valuation (as will be summarized in the SAB C-VPES report that it cites on p. 31. I would like to see that openness made more explicitly. Monetization can serve some purposes (e.g., in regulatory proceedings). However, there are other contexts (e.g., community planning, restoration, communication, education) where it can be a distraction. Moreover, as the report notes (Section 1.2.3), there are situations in which it is hardly viable. Requiring monetization implicitly devalues those resources that economics does not yet know how to handle.

*Suggested response: The following sentence will be inserted on page 8, line 15. "It is important to note that although monetization can serve some purposes (e.g., regulatory proceedings), there are some situations where monetization is not possible. Unless EPA accepts the use of non-economic valuation approaches, resources that cannot be monetized will implicitly be devalued."*

Comment: I am skeptical of any Outreach and Education activities without explicit empirical evaluation. I see unconscionable amounts of resources wasted on what seem like useless (even counterproductive) websites, PSAs, etc. People naturally exaggerate how well they understand their audience and how well they have communicated. There is no substitute for evidence – which must be collected to social science standards (i.e., not just web hits or TV views). Partnering solves nothing unless the partners have sound practices.

*Suggested response: The following sentence will be inserted on page 12, line 18. "It is important that all outreach activities be evaluated to determine their effectiveness. The data used for such evaluations should be collected according to social science standards (i.e., not just using "web hit" or television view data)."*

Comment: It seems strange that a report on ecosystem health would have only one reference to invasive species. It is also my sense that the activities proposed here move at too slow a pace to facilitate EPA's response to invasives. Rather, these activities may just serve the forensic purpose of documenting the damage that invasives have done (perhaps in terms). If so, then, with its limited budgets, EPA may be choosing comprehensiveness over effectiveness. The report may envision some (unspecified) others picking up the action. However, I didn't see the explicit plan and resources to make that happen. (The draft review discusses these issues in more general terms in its answer to Charge Question 3, and elsewhere.)

*Suggested response: The following sentence will be inserted on page 4, line 38. "For example, EPA's research activities must advance at a rapid pace to respond to the threats posed by invasive species. An adaptive management plan is needed to show how EPA and its partners can effectively address this problem."*

Comment: Generalizing this last point, I had the feeling that there was relatively little ecology in the report, given the program's mission, outside the two case studies (and, to a lesser extent, the wetlands and coral reef sections). Rather, the plan seems to emphasize data management and highly selected chemical threats. That makes me wonder whether the Agency's scientific resources in ecology have been depleted and the report is written to take advantage of the capabilities that it has left, rather than pushing for strengthening of its resources in ecology. Continuing my first two worries, I wonder whether the systems being proposed (DSP, valuation, etc.) will be able to accommodate the broad range of ecological knowledge, or just variables that appear across places and scales (just as I fear that they will not be able to accommodate the broad range of human concerns).

*Suggested response: The Committee's report states on page 4, line 23 that the Program goals cannot be accomplished without answering basic science questions. To emphasize the need for ecology in the Multi-year Plan, the sentence on this line will be revised as follows: "The Program goals cannot be accomplished without ecological research to answer basic science questions. It is recommended that knowledge gaps be identified in the Plan, and that EPA plan and appropriately fund the basic ecological research needed to fill these gaps."*

Comment: Overall, my inclination would be to build out from case studies, ensuring that they are addressed adequately, with an eye to developing general methods – rather than assuming that a general method exists, investing a lot in its creation, and then hoping that it can be applied. Decision makers (broadly defined) might be best served by having someone else's, perhaps very different, problem solved well, so that they can see what a full solution looks like.

*Suggested response: No change necessary. The report states that the timing of developing the decision support platform and place-based projects is unclear. However it is suggested on page 13, line 7 that the place-based projects could be used to test the decision support platform.*

### **Drs. James Galloway and Tom Theis**

In general we feel that the committee has done a good job with its review, however we believe that the negative tone of the review of Goal #3 is not appropriate. Specifically, we are getting a mixed message from this review; it appears that the advisory committee is split on the importance of Goal 3. Unfortunately, the disagreement comes across as apparently recommending that EPA not pursue an integrated nitrogen assessment. In our view this is unwise. The issues of nitrogen are of such current importance now, and will only grow in the future, that what the committee should do is to advise EPA on how to make the proposed program better in both the short term and the long term.

In addition to this general comment, we have the following specific responses to the bulleted items in the committee's review.

1. The report is in at least one important way forward-thinking in its endorsement of the ecosystem services approach to evaluating environmental quality, but seems misinformed on the importance of Nr to the production (positive and negative) of goods and services produced by ecosystems.

*Suggested response: See response to comment 3.*

2. The suggestion to substitute Hg for Nr effects research would move the MYP in a very different direction. Hg impairs ecosystem functions by virtue of its toxicity. Nr has both positive and negative impacts, and presents policy makers with a useful example of the need to incorporate tradeoffs into policy.

*Suggested response: see the response to the following comment.*

3. Hg already has a MYP. If EPEC wished to endorse studies involving Hg then they should be sure to note this, and encourage EPA to work cooperatively.

*Suggested response: p. 15, lines 41-42 will be revised as follows: "However, given the relatively modest available resources, we have some concern about what can be accomplished in this area, and how EPA's contribution will complement what is being done in other agencies." The bullet on page 16, line 30 will be revised as follows: "The discussion of Long-term Goal 3 in the Plan should contain a clearer explanation of why Nr was chosen for study. The Plan clearly states that Nr can have both positive and negative effects on ecosystem services and that both positive and negative ends of the spectrum must be examined. We strongly agree with that conclusion and note that this departure from the "negative only" approach is commendable. However we recommend that EPA more fully discuss the rationale for choosing to study N." (this change removes specific reference to mercury and phosphorus)*

4. The sentiment of some committee members to use the funds for other areas in the Ecological Research Program (e.g., outreach and education) is puzzling. This would not only delay the establishment of a needed national program, but would send a strong signal that such a program is not needed.

*Suggested response: The following sentences will be removed from the report: 1) "However, given the relatively modest effort that can be undertaken with available resources, we have some concern about investing in this area (page 15, line 41)" and 2) "However, there is some sentiment among Committee members that perhaps the Nr research could be dropped in favor of focusing more effort in other areas of the Ecological research Program (e.g., outreach and education)." (page 16, line 11).*

5. We agree with the advisory committee that ORD should partner not only with other EPA entities (i.e., OAR) but also other agencies. From our understanding, these partnerships have always been planned.

*Suggested response: No change needed.*

6. Apparently some members of the advisory committee felt that the research description was too general to be evaluated, while others felt the proposed research was tractable. In the spirit of a constructive Advisory, it would be useful for the former group to be more specific of what they are looking for.

*Suggested response: The last bullet on page 15 will be rewritten as follows: "The Committee recommends that a more detailed description of the research proposed under Long-term Goal 3 be provided. The Committee expects that it is EPA's intention to provide this in the implementation phase of the program. At this point, however some Committee members find that the fundamental question to be addressed by the Nitrogen Assessment is not clearly presented. We suggest that this fundamental question might be, "How can Nr be more effectively managed so as to lower its environmental, health and economic costs?"*

#### **Dr. Rogene Henderson**

Comment: I found this advisory to be clearly written and well organized. Each of the charge questions was carefully addressed. The report was clear and logical and the recommendations appeared to be well-supported by the text of the report. I especially agreed with the recommendation (page 7) to combine and integrate the HHWB and ESV elements of the Plan. The effect of the ecosystems services on human well-being is a link that must be made.

*Suggested response: No change necessary.*

#### **Dr. Agnes Kane**

I concur with the Committee's review of this draft plan. This review was thorough and thoughtful and provides clear guidelines for revision. As a physician, I support the committee's first suggestion to place greater emphasis on the relationship between ecosystem services and human health and well-being. This should be considered at multiple levels: individuals (especially susceptible individuals), local communities, and the entire population. Specific case studies or examples should be developed to illustrate potential or demonstrated human health impacts at each of these levels.

*Suggested response: The following text will be inserted on page 7, line 33. "The relationship between ecosystem services and human health and well-being should be considered at multiple levels: individuals (especially susceptible individuals), local communities, and the entire population. Specific case studies or examples should be*

*developed to illustrate potential or demonstrated human health impacts at each of these levels.”*

Outreach and education is an important issue that applies to all Agency environmental programs. Other community and education outreach programs have been developed by external funding mechanisms (e.g., SBRP Grants and NIEHS Center Grants). EPA should consider utilizing the resources and expertise that have already been developed by these funding mechanisms.

*Suggested response: The following sentence will be inserted on page 12, line 18. “In addition, community and education outreach programs have been developed by external funding mechanisms (e.g., Superfund Basic Research Program grants and National Institute of Environmental Health Sciences center grants). EPA should consider utilizing the resources and expertise that have already been developed.”*

**Dr. Catherine Kling**

Comments on the SAB Advisory on the EPA Ecological Research Program Multi-Year Plan

Comment: This report is very clearly written and entirely responsive to the charge questions. The report is logical and the conclusions drawn are supported by the information in the body of the report. The message that EPA is entirely on the right track with its new focus on ecosystem services comes through loud and clear; this is an important and clear message that the committee has done a great job at delivering.

*Suggested response: no change necessary*

Comment: A general comment: one of the tensions in considering a research program like the one presented here is to cut the right balance between undertaking the research that answers the right questions for a particular decision that must be addressed (which suggests waiting until those questions are clear and then formulating a specific research project) vs. having a set of ecosystem values sitting on the shelf waiting for use when a decision need arises. In the latter case, the values that will be “on the shelf” will no doubt not quite fit the research question. And, it is these values that are most likely to be misinterpreted or misused. In the former case, the analysis needed will often be too slow to be of use in making the decision. (Related to this point is the need to avoid valuing ecosystem services just for the sake of doing so; indeed, many decisions related to ecosystems will not need formal valuation to support good decision making. In other cases, explicit valuation will be a very key input to a decision process.) The Ecological Research Program at EPA somehow needs to do their best to balance these two competing needs (easy to say, hard to do).

*Suggested response: The following new bullet will be inserted before the last one on page 4. “In the Plan, it is important for EPA to balance the need for research to*

*answer questions for a particular decision (which suggests waiting until those questions are clear and then formulating specific research projects) vs. research to develop a set of ecosystem service values for a range of decisions. In the latter case, the available values may not quite fit questions to be answered, and the values can be misinterpreted or misused. In the former case, the analysis needed may not be completed rapidly enough to be of use in making the decision. The Committee notes that EPA should not value ecosystem services simply for the sake of doing so. Indeed, many decisions related to ecosystems will not need formal valuation to support good decision making. In other cases, explicit valuation will be a very key input to a decision process.”*

1. Comment: On page 5, the committee provides a fantastic suggestion: that EPA should collaborate with other federal agencies and scientists to conduct an assessment of status and trends of ecosystem services in the U.S. (they draw an analogy to the IPCC). This strikes me as a very valuable enterprise for which EPA should obviously be the lead. Further, this could be a significant component of the effort to intelligently leverage EPA (and other agencies and NGOs) resources in this important area. Two suggestions: 1) make this recommendation more prominent by adding it to the Executive Summary and possible the letter to the Administrator and 2) to mention this idea again in the report in reference to the section and discussions related to leveraging of EPA resources on ecosystems research.

*Suggested response: The third bullet on page x of the executive summary will be revised as follows: “The Committee recommends that EPA collaborate with other federal agencies and academic scientists to conduct a review of all federal agency ecosystem and ecosystem services inventory, mapping, and monitoring type projects. This review should be undertaken in order to determine how such projects can provide data to meet the objectives of the Ecological Research program. The review could be conducted through a workshop, with the aim of coordinating all of the federal agency components to provide synergy and avoid duplication of effort. Subsequent to the workshop EPA should collaborate with other federal agencies and academic scientists to conduct a scientific community assessment of status and trends of ecosystem services in the U.S. (similar to the Intergovernmental Panel on Climate Change [IPCC] assessments). Such an assessment would be an appropriate and very important output from the research that is described in the Plan. It would be a high impact, visible product from EPA that could have a large influence on decision makers.”*

*Suggested response: The last sentence on page 28, line 20 will be revised as follows: “In addition, funding incentives for cross-agency collaborations, such as the scientific community assessment of status and trends of ecosystem services in the U.S. (discussed previously) could enhance these partnerships.”*

*Suggested response: Insert the following on line 33 page ii “(in this regard, the SAB recommends collaborating with other federal agencies and academic scientists to*

*conduct a scientific community assessment of status and trends in ecosystem services in the U.S.)”*

2. Comment: The entire issue of how best for EPA to develop and support decision support platforms has been a continuing struggle in the ecosystems research area. I wonder if it might be useful for EPA to examine in depth one or more DSPs that have been developed and implemented by other agencies (or by EPA in another area?) to learn what approaches have been effective both in terms of model and data and in terms of the delivery of the DSPs to the end users. Are there DSPs related to superfund sites? There is a large multi-state, multi-agency effort to restore the Chesapeake Bay, are there DSPs that have been developed in that effort? Have they been effective? What can be learned from them (positive or negative)?

*Suggested response: The following sentence will be inserted after the first sentence on page 11, line 1: “The Committee suggests that it could be useful for EPA to examine in depth, one or more DSPs that have been developed and implemented by EPA or other agencies to learn what approaches have been effective.”*

3. Comment: Thank you for noting that “biofuels” are not the only environmental issue in the 13 state region of the Midwest (page 19)

*Suggested response: no change necessary.*

4. Comment: There is discussion r.e. Charge Question 5 on the new NRC report on evaluating research efficiency at EPA. While I assume that the NRC report deals with the “PART” process that has been such a thorn in the past, I was not clear whether the recommendations provided by the SAB review on page 25 were based on the NRC report and/or whether they would be consistent with being successful in whatever PART-like process will evaluate the ecological research program in the future. While I think the comments provided in the SAB review are very sensible, I just want to be sure that SAB is not suggesting things that will later be problematic (e.g., is the point that it is “premature to prescribe specific measures to evaluate annual performance/progress goals for the program” (lines 34-35, page 25) going to be a problem for EPA later?)

*Suggested response: The following text will be inserted on page 25, line 10. “In some of our comments we have referred to specific and quantitative measures of program accomplishment. We therefore preface these comments by noting the NRC recommendations that quantitative efficiency metrics should only be used to measure the process efficiency of research programs, and that process efficiency should be evaluated only after the relevance, quality, and effectiveness of a research program have been evaluated.”*

5. Comment: Very minor point: there is an occasional monster paragraph in the report that makes reading the manuscript a bit more daunting than necessary. See pages 8 and 13 for examples.

*Suggested response: The paragraphs on pages 8 and 13 will be reviewed and edited.*

Comment: This was an extremely thoughtful and thorough report.

*Suggested response: No change necessary.*

### **Dr. Michael McFarland**

Comment: The SAB Ecological Processes and Effects Committee (Committee) is commended for providing a clear and unambiguous report summarizing their scientific review of the Office of Research and Development's (ORD) Ecological Research Program Multi-Year Plan (Plan). The letter to the administrator is well balanced and highlights the salient findings of the Committee's scientific assessment. Similarly, the Executive Summary provides a detailed synopsis of the Committee's full responses to each of the Agency charge questions with each response followed by concise descriptions of specific recommendations. Given the quality of the Committee's responses to Agency charge questions, I fully support approval of the report pending any modifications/revisions agreed to by the SAB.

*Suggested response: No change necessary.*

Comment: Although the Committee, in principle, supports that the strategic direction of the Agency's Ecological Research Program Multi-Year Plan as well as its conceptual framework, it has a number of serious reservations regarding the Plan's ability, as currently described, to generate the information necessary for reaching scientifically defensible decisions. The Committee acknowledges that many of the Plan's technical limitations are associated with its proposed implementation program as well as the acute lack of funding and absence of vital in-house Agency expertise. The following section provides specific responses to the quality review charge questions followed by supplemental observations presented for consideration by the Committee.

*Suggested response: No change necessary.*

Comment: The Committee is applauded for providing clear, concise and detailed responses to each of the Agency charge questions. In each of the Committee's responses, a bulleted list of specific recommendations was provided for Agency consideration. It is particularly gratifying to note the Committee's strong support for the need to align ORD's ecological research program with the Agency's ecological risk assessment goals.

*Suggested response: No change necessary.*

Comment: On the whole, the report is clear and logical. However, there is one statement that is repeated both in the Executive Summary (page xii lines 23-24) and in the body of the report (page 9 lines 17-19) that is confusing. The Committee suggests that ORD “consider a non-Western value system most notably that of Native Americans to ensure that well-being is parameterized in an accurate multidimensional manner”.

Although I believe that I understand the intent of the Committee's statement, I am not entirely convinced that it is appropriate. At best, the statement is fraught with confusion particularly to a reader unfamiliar with Native American culture and, at worst, the statement could be misinterpreted as patronizing (or at least judgmental). In my opinion, the degree to which Western value systems and Native American value systems diverge on the importance of ecosystem services is not sufficiently defined in the body of the report to merit inclusion of this statement.

*Suggested response: The sentences on page 9 line 17 will be revised as follows: “It will be important to consider a range of cultural value systems to ensure that...”*

*The sentence on page xii line 23 will be revised as follows: “This should include consideration of a range of cultural value systems.”*

### **Where the conclusions drawn and/or recommendations made supported by information in the body of the draft report?**

Comment: The conclusions/recommendations articulated by the Committee are fully consistent with information found in the body of the report. The Committee has highlighted the need to address a number of overarching program limitations specifically the lack of sufficient program funding as well as the absence of requisite expertise in ORD to fully execute the Plan. The Committee is applauded for its support of ORD's decision to pursue financial leveraging opportunities both within and outside the Agency for funding vital ecological research as well as its acknowledgement that a sustainable ecological research program requires investment in the training of future scientists through an extramural grants program.

### **SUPPLEMENTAL INFORMATION**

1. Page 4 (line 34). Should the sentence that begins with “A 10-year plan ...” be rewritten to state “A 5-year plan ...” since multiyear plans have a five (5) year time horizon?

*Suggested response: This change will be inserted.*

2. Page 9 (line 11). Should the word “physical” be placed in between ORD and scientists to distinguish physical scientists from social scientists?

*Suggested response: The sentence will be revised as follows. "The Committee notes, however, that even this will require interaction of a team comprised of ORD scientists from biological, physical and social science disciplines."*

3. Page 12 (lines 14 – 18). What is the current or potential role of the Agency's Office of Information with respect to outreach and education (OE)?

*Suggested response: the following sentence will be inserted on page 12, line 3. "ORD should coordinate outreach activities with other EPA Offices, such as the Office of Environmental Information, to take advantage of available expertise."*

4. Page 12 (lines 41-42) There are a number of other federal agencies that maintain and have jurisdiction over large tracts of land (terrestrial ecosystems) including the US Dept. of the Interior (Bureau of Land Management), US Dept. of Agriculture (US Forest Service) and US Dept. of Defense (test and training ranges). Each of these agencies (as well as others) is required to conduct ecological assessments (as mandated under the National Environmental Policy Act or NEPA) of the property under their management. These federal agencies also support well funded ecological research programs whose activities may be leveraged by the ORD.

*Suggested response: The following will be inserted on page 12, line 42. "However, the Committee notes that EPA should draw upon available expertise in the U.S. Department of the Interior (Bureau of Land Management), U.S. Department of Agriculture (U.S. Forest Service), and U.S. Department of Defense (test and training ranges). These agencies are required to conduct ecological assessments of property under their jurisdiction and they support well funded ecological research programs whose activities may be leveraged by ORD."*

5. Page 24 (lines 10 – 11). The statement that begins "We find that this amount (1%) is insufficient to support effective outreach efforts..." should be revised to reflect the fact that this statement is an opinion and not the result of an actual cost analysis.

*Suggested response: This sentence will be revised as follows. "It is the opinion of the Committee that this amount is insufficient to support effective outreach efforts."*

6. Page 27 (lines 39-42). The Committee should consider adding Interagency Personnel Agreements (or IPAs) to this list. IPAs allows government employees (local, state or federal) with specific skill sets to be detailed to ORD (or other EPA offices) to meet program needs.

*Suggested response: The following sentence will be inserted on page 27, line 42. "In addition, EPA should consider negotiating Intergovernmental Personnel Agreements to*

*enable government employees (local, state, or federal) with specific skill sets to be detailed ORD or other EPA offices to meet program needs.”*

**Dr. Jana Milford**

My review of the draft report raises the following concerns.

Comment: 1. It is not clear to me that the first charge question has been adequately addressed. This charge question asks specifically if the proposed strategic direction will offer “meaningful contributions to the ecological sciences” and provide “research that will be useful to decision makers at EPA and other levels of governance.” The question of how the Agency’s proposed focus on ecosystem services will contribute to/fit in with the broader field of ecological sciences seems an especially appropriate subject for SAB comments, yet it is barely addressed in the report. In particular, I expected the panel to discuss the opportunity costs of the proposed focus (and the apparent shift away from EPA ORD’s prior focus on ecological risk assessment). Does the strategic direction still accommodate necessary research in monitoring ecosystem status? Does the utilitarian focus of “ecosystem services” risk losing important potential research contributions to improved understanding of ecosystem functions/responses that are unrelated to recognized “services” to human health and well-being? Similarly, is there a risk that over-emphasis on ecosystem services that are too narrowly defined will prove to be a disservice to decision makers in the long run? The panel might consider these questions and nevertheless conclude they enthusiastically support the new direction, but I wish the broader questions could be addressed.

*Suggested response: The following text will be inserted after the first sentence on page 1, line 30: “EPA’s Ecological Research Program Multi-Year Plan contains a relatively detailed discussion of the importance of quantifying ecosystem services and their contribution to human health and well-being in order to advance ecological science and improve decision making. In addition, the SAB Committee on Valuing the Protection of Ecological Systems and Services has identified benefits associated with strengthening the EPA’s approaches for valuing the protection of ecological systems and services (U.S. EPA Science Advisory Board, 2008a).” A detailed discussion of why and how valuation of ecosystem services is important to decision makers is somewhat beyond the scope of this report. These topics are addressed in considerable detail in the Ecological Research Program Multi-year Plan itself and in the report of the SAB Committee on Valuing the Protection of Ecological Systems and Services. As stated in the Committee’s report, we support the new strategic direction and we have focused our comments on how the proposed research plan could be improved. If additional discussion of the benefits of this new strategic focus, is needed the report could include some additional information that has already been presented in the Multi-Year Plan or the CVPESS report.*

*In its review of the components of the Multi-year Plan (e.g., ecosystem assessments and place based demonstration projects), the Committee has commented on the appropriateness of each component of the program and how it could be improved.*

*Providing detailed comments on opportunity costs associated with a shift in strategic direction is somewhat beyond the scope of this review. This would require a review of detailed information on specific components of the ORD research program that are being eliminated or changed. Such information was not available to the Committee for this review, and it is not clear that EPA has made all of these decisions yet. The Agency is in the process of developing implementation plans for the research program and has asked EPEC for continuing advice. We may have an opportunity to address opportunity costs in reviewing EPA's implementation plans.*

*The following bullet will be inserted on page viii: "This Multi-Year Plan represents a considerable change in the research direction for EPA's Ecological Research Program. Previous research in the Ecological Research Program has made significant contributions to the science of ecological monitoring and assessment. As this program is moved into other parts of the Agency, it is essential that EPA's strength and leadership in monitoring and assessment be maintained."*

*The following text will be added on page 15, line 11 "The Committee notes that significant advances in monitoring have been realized through work conducted by ORD's Environmental Monitoring and Assessment Program. This work should be continued as the responsibility for that monitoring is assumed by other programs in the Agency."*

2. Comment: The very first recommendation on p. viii of the Executive Summary suggests that resources are inadequate to accomplish the goals of the research program and urges EPA to provide STAR grant support for ecosystem services. This may be a rather off-putting start to the Committee's report, since it could be perceived as self serving. The Committee might reconsider the placement of that recommendation, and also consider whether there are other ways to fill the needed research/capacity gaps (e.g., new hires at ORD with increased in-house research, contracting out work to consulting companies, etc.).

*Suggested response: It is the strongly held opinion of the Committee that because assessment of ecosystem services is a new area of research, additional extramural support should be provided through the STAR program, and therefore this point was listed at the beginning of the executive summary.*

3. Comment: On p. xi and p. 16, the Committee advises ORD to eliminate its proposed research focus on coral reef ecosystems under Long-term Goal 4, because coral reefs "are a relatively low priority in the U.S." This statement is not supported by any evidence, and moreover seems rather narrow-minded. EPA has historically had and arguably should continue to have an important role in research and policy development related to "globally important" environmental problems. But perhaps instead of making value judgments about whether coral reef ecosystems are an important U.S. priority, the Committee might ask ORD for a better explanation of how studying the dynamics of ecosystem service flows in coral reefs will advance ecological sciences and ultimately help inform decision making.

*Suggested response: The third bullet on page xi and the third bullet on page 17 will be rewritten as follows: "Although coral reef ecosystems are globally important, the Committee finds that other more common "human dominated" ecosystems may provide services to more U.S. citizens, and greater opportunities for coordination and collaboration with other studies within the ecological research program. We therefore recommend that in the Plan EPA provide a better explanation of how studying the dynamics of ecosystem service flows in coral reefs will advance ecological sciences and ultimately help inform decision making."*

4. Comment: On p. xi and p. 20, the Committee needs to explain more clearly why consideration of "transboundary" issues is important. I don't see how the fact that an ecosystem extends across political jurisdictions (e.g., the U.S. and Canada) would come into play in assessing the production function of ecosystem services it provides.

*Suggested response: The Committee thought that important transboundary issues (such as atmospheric transport) were ignored in the discussion of place-based project research. The committee argues that transboundary issues should be considered in developing ecological production functions to investigate ecosystem service flows.*

5. Comment: The recommendation on p. xiii and p. 12 that ORD develop a grants program for teacher education is not adequately justified. No one would disagree that teacher training is valuable, but is this an appropriate use of ORD time and resources? Likewise, the Committee needs to better explain/justify its recommendations that ORD should focus its limited resources on public education/outreach efforts.

*Suggested response: The Committee found that the success of the Ecological Research Program will depend in large part upon outreach and education efforts. This is because (as stated on page 1 of the report) the overall goal of the Program is to "change the ways in which policy and management choices affect the type, quality, and magnitude of goods and services that are received from ecosystems." To accomplish this, buy-in from economists, social scientists, and others involved in valuation and policy making process is essential. Therefore, outreach and education efforts will be needed. Outreach efforts will also be needed to build partnerships critical to the success of the Program.*

*The Committee thought that providing funds for a competitive grants program to run summer credit workshops for teachers through STAR would be a valuable outreach activity to build support for and understanding of the importance of ecosystem services. This recommendation can, however, be removed from the report if the Board strongly disagrees with it.*

6. Comment: The recommendation on p. 5 that EPA work with other agencies to produce an IPCC-style assessment of status and trends of ecosystem services requires clarification. The IPCC assessment cycle represents an enormous international activity. Is that really what the Committee had in mind?

*Suggested response: As stated in the report, the Committee is recommending that EPA collaborate with federal agencies and academic scientist to conduct an assessment of status and trends of ecosystem services in the U.S. This is not viewed as an international activity. Additional details would have to be provided as plans for such an assessment are developed. The IPCC was provided simply as an example assessment drawing from a wide range of scientific expertise.*

7. Comment: The recommendation on p. 14 that EPA “develop forecasting models from the information in available databases” isn’t clear. What does the Committee have in mind here?

*Suggested response: The bullet on page 14, line 26 will be rewritten as follows: “EPA’s Ecological Research Program should plan to use information in available databases to develop ecological production functions and models that can be used to forecast the effects of various stressors on ecosystem service flows.”*

8. The list of “principles” for judging the locations of “place-based demonstration projects” on p. 19 seems likely to over-constrain the problem for ORD. Perhaps these could be more clearly presented as principles for the Agency to consider, without suggesting that they must all be met.

*Suggested response: The sentence on page 19, line 6 will be rewritten as follows: “To this end, we recommend that EPA consider using the following organizing principles ...”*

### **Dr. Rebecca Parkin**

- a) Comment: Nearly all of the charge questions were addressed adequately. The responses to Questions 1 and 3-5 are adequate. The responses to Charge Question 2 are more difficult to assess because the organizational structure of the report does not go down to the level of the elements within the bulleted questions. While the goals were clearly addressed for Long-Term Goals (LTG) 1 and 4, they were less obviously considered for LTGs 2, 3, and 5. The objectives for LTGs 1, 2, and 4 and the research questions for LTGs 1 and 2 were explicitly discussed. Elements within each of the bulleted questions seem to have been missed in part for each of the LTGs.

*Suggested response: We wish to clarify that in its report, the Committee did not explicitly comment on every goal, objective, and question in the Multi-year Plan. However, we did focus on areas where we believed improvement was needed and/or recommendations should be provided. In some cases these were broad areas addressed by more than one objective or question. The following sentence will therefore be inserted on line 16, page 6. “The Committee has not explicitly commented on every goal, objective, and question in the Multi-year Plan. We have focused our comments on areas where we found that improvement was needed and/or recommendations should be provided.”*

- b) Other than the comment in a), the draft report was clearly written. Throughout it was written in a logical manner.

*Suggested response: No change necessary.*

- c) The conclusions stated in the letter to the Administrator, Executive Summary (ES) and report were supported by evidence presented in the report. Many points made repeatedly in the report (e.g., limited resources, lack of internal expertise, need to develop partnerships) were stated in the letter and/or ES. However, there are points of urgency or emphasis in the report which were not noted in the letter and/or ES. These discontinuities may be readily addressed in a variety of ways (e.g., rephrasing, ensuring consistency in capturing major points in the ES and the most urgent and important points in the letter). Examples of mismatches between the report and the letter and/or ES include the following:

- Pages 10, 17, 18: The need to obtain “buy-in” from stakeholders and partners is repeatedly noted and stated as “essential” in the report, but this need is not stated either in the letter or ES.

*Suggested response: This point will be included in the first bullet on page ix.*

- On various pages (e.g., pp. 12, 21 and 29) outreach and education (O&E) are noted as elements of the plan, but functions for which ORD has little expertise. It is curious to this reviewer that, if this issue merits repeated mentions, there is no mention of O&E in the letter and only a brief listing of this issue in the ES. Further, the importance of ensuring an empirical basis for O&E has often been stressed by the SAB, but is not mentioned in the report (p. 29). This reviewer sees this omission as a key, missed opportunity for reinforcing this important point.

*Suggested response: See change concerning empirical basis for O&E in response to comments from Dr. Fischhoff. The following will also be added to the fourth bullet in the letter on page ii: “(the SAB notes that outreach and education has not historically been a part of ORD’s work and therefore additional expertise may be needed in this area)”*

- Defining ecosystem services too narrowly, and thereby overemphasizing human health and welfare goals, is raised as an important issue (p. 13, line 38 through p. 14, line 4), but it is not noted in the letter or ES. Without bringing this concern forward to at least the ES, it appears to this reviewer that the committee does not see this issue as important as the text implies.

*Suggested response: The following will be added as a new bullet on page x, line 22: “Ecosystem services should not be defined so narrowly that they overemphasize human*

*health and welfare goals and fail to appropriately value non human dominated-landscapes.”*

- The committee notes that understanding why ecosystem services are lost is a “key missing piece,” which is crucial to the overall success of the plan (p. 18). However, this point, which is emphasized in the report, is not mentioned in the letter or ES.

*Suggested response. The following sentence will be inserted after the first sentence on page xi, line 2: “We note that a key missing piece in the Plan is research to develop an understanding of the linkage between multiple stressors and ecosystem attributes and service.”*

- Selecting sites which are widely representative and offer the opportunities for generalization to other areas is noted as important (page 19), but is not stated in the ES or letter.

*Suggested response: This is one of the recommended principles for selection of place-based sites. On page xi, line 27 of the executive summary it is stated that the Committee has suggested principles that could guide selection of the place-based sites.*

- Another issue which is addressed repeatedly in the report (e.g., pp. 15, 19, 20 and 23) is the importance of ensuring that the scale of measurements is appropriate for the decision problem and that that scale can be adequately characterized using available data. This issue is not stated in the ES or letter.

*Suggested response: The following sentence will be inserted on page x, line 8. “In this regard, the Committee notes that the scale of data provided must be appropriate to support decision making. Thus the suitability of various databases for use in developing Program products supporting decision making should be assessed as soon as possible, and definitely before 2013.”*

- Is “as soon as possible” the correct meaning on p. 15, line 13? If so, shouldn't this issue be noted at least in the ES?

*Suggested response: See previous response.*

- The question raised asking why ORD has chosen to focus on N instead of P (p. 16) seems important enough to merit mention in the ES.

*Suggested response: See response to Drs. Galloway and Theis.*

- The use of life cycle analysis is “strongly urged” by the committee (p. 20), but only in the report.

*Suggested response: the following sentence will be inserted on page xi line 31. "In addition, the application of life cycle analysis in demonstration projects should be expanded to show the utility of this approach in future decision making."*

- On pages 23, 24 and 30, the point is made that ORD should enlist the support and input of potential partners "immediately" and "as soon as possible." This need for early action, if it is what the committee as a whole intends, is not expressed in the letter or ES.

*Suggested response: The following sentence will be inserted on page xii, line 29 after the first sentence. "In addition, immediate efforts are needed to enlist the input and cooperation of potential users and clients of the Ecological Research Program to ensure that planned research will address issues of greatest interest to them."*

- A "tremendous opportunity" to advance ecological research is noted on p. 24 only. If it is so significant, this reviewer would expect to see it at least in the ES as well.

*Suggested response: The following sentence will be inserted on page xii, line 14. "However, developing strategies to deal with these inherent challenges provides an opportunity to advance the way that ecological research is conducted."*

Additional comments to consider:

- Two acronyms are used before they are defined (e.g., ORD and STAR).

*Suggested response: These acronyms will be defined.*

- Some acronyms are defined but are not used again in the report after being defined (e.g., NRDAR, LTER and ERA).

*Suggested response: These acronyms will be removed.*

- Some portions of the report (e.g., page 7) become tedious to read due to heavy use of acronyms.

*Suggested response: We recognize that the use of acronyms on this page makes reading the report somewhat tedious. However, we wish to keep them in the report because they are used throughout the Multi-year Plan.*

- P. 1, line 24: This reviewer recommends deleting "understand" as it is not measurable, but "respond" is if it is assessed in terms of specific types of response.

*Suggested response: We will include this phrase in quotes because it is taken directly from EPA's Multi-Year Plan.*

- Combining types of information and functions are described as “quite dangerous” (p. 11) in the report, but are not highlighted elsewhere. This reviewer wondered whether this description fits the committee's actual intent or whether rewording would be more appropriate.

*Suggested response: We will replace the word “dangerous” with “challenging”*

- Wherever 1% is pointed out as insufficient for O&E (e.g., pp. 21 and 24), a means to determine what would be a sufficient percentage should be indicated.

*Suggested response: An analysis of the resources needed for outreach and education is beyond the scope of this report. On page 12, line 14, the committee recommends development of a comprehensive OE plan.*

*The sentence on page 21 line 46 will be revised as follows: “... is not likely to provide what will be necessary...”*

*The sentence on page 24 line 10 will be revised as follows “... is likely to be insufficient to support...”*

- This reviewer questions the appropriateness of calling upon ORD to work with organizations to “raise funds” (p. 28).

*Suggested response: The words “to raise funds” will be deleted from this sentence.*

- This reviewer does not agree with the first bullet on page 29, suggesting that ORD leverage universities by getting them to accept reduced indirect costs. In this era of reduced federal funding, many universities are not able to offer such options. Federal agencies are usually some of the few places where universities CAN get full indirects. Most other funders (e.g., foundations and not-for-profits) do not allow full indirect cost recovery.

*Suggested response: The Committee felt that this was an appropriate recommendation. It can be removed if the Board strongly disagrees.*

### **Dr. Valerie Thomas**

Letter to administrator, p. i, lines 25-26: “the SAB strongly supports this strategic direction and commends the Agency for developing a research program that has the potential to be transformative for environmental decision-making as well as for environmental science.” Where are these claims, “potential to be transformative for

environmental decision-making as well as for environmental science” supported? The statement is repeated in the Executive Summary, p. vii, lines 35-36. There should be at least one paragraph somewhere that describes how this research will be transformative for environmental science. Throughout the document, the doubt cast on the feasibility of the plan, and the lack of funding for fundamental research, casts doubt on the transformative potential of the research plan. If there is transformative potential, that needs to be explained and highlighted. What does EPA need to do to achieve the transformation?

*Suggested response: The following text will be inserted after the first sentence on page 1, line 30: “EPA’s Ecological Research Program Multi-Year Plan contains a relatively detailed discussion of the importance of quantifying ecosystem services and their contribution to human health and well-being in order to advance ecological science and improve decision making. In addition, the SAB Committee on Valuing the Protection of Ecological Systems and Services has identified benefits associated with strengthening the EPA’s approaches for valuing the protection of ecological systems and services (U.S. EPA Science Advisory Board, 2008a).” As indicated in the response to Dr. Milford, a detailed discussion of why and how a new focus on valuation of ecosystem services is transformative (in the sense that it is important to decision makers) is somewhat beyond the scope of this report. These topics are addressed in considerable detail in the Ecological Research Program Multi-year Plan itself and in the report of the SAB Committee on Valuing the Protection of Ecological Systems and Services. As stated in the Committee’s report we support the new strategic direction and we have focused our comments on how the proposed research plan could be improved to better support the advancement of ecological science and decision making. If additional discussion of the benefits of this new strategic focus, is needed the report could include some additional information that has already been presented in the Multi-Year Plan or the CVPESS report.*

Letter p. i, lines 33-35. “we have a number of concerns about the draft Plan... related to the tension between stating an important and ambitious vision and producing a practical implementation.” Overall the meaning of the letter is not clear. It reads as if the SAB supports the plan, but thinks, as usual, that there should be more money for research. But from the details of the body of the report, the Panel really seems to be saying, perhaps, that it strongly supports the “direction” but not the Plan, because the Plan seems unlikely to accomplish its stated goals. If that is what the Panel is trying to say, the Letter should be revised to make this clear.

*Suggested response: The Committee is stating that it supports the strategic direction, but it has concerns about the Plan because: 1) the resource allocation for the program is too small to accomplish the ambitious goals and 2) more detailed information and improvements are needed in the Multi-year plan. We think these points were included in the letter but please let us know if additional clarification is needed.*

Executive Summary, p. viii.lines 2-3: "goals are unlikely to be accomplished" lines 15-16: "goals cannot be accomplished without basic ecological research" These statements don't line up with the Committee's support for the research plan.

*Suggested response: The Committee supports the strategic direction of the Plan, but on lines 2-3 is pointing out the need for additional resources, and on lines 15-16 is pointing out that the Plan should contain a more detailed discussion of knowledge gaps. This sentence will be clarified by adding the following: "In particular, empirical data are needed to test hypotheses regarding why changes in ecosystem services are occurring, and at which scales."*

Executive Summary p. ix:

Line 5: "the Committee supports long-term Goal 1"

Lines 38-39: "the Committee is concerned about the overall feasibility of accomplishing Long-term Goal 1." These two statements don't add up with the support of the Committee for the Plan. Why does the committee support the Goal if it can't be achieved?

*Suggested response: The Committee's report supports the development of a Decision Support Platform but expresses concern about the challenges facing the Agency and recommends improvements in the Plan. In addition, the Committee report states that more information is needed to fully understand how the DSP would be developed and used.*

pp. 3-4. The report says that \$68M will be dedicated to the program, and the Committee recommends use of STAR program funds as well as more internal funds. It would be helpful if the Committee could say how much funding would be enough, and the relative balance of external and internal funding.

*Suggested response: Developing a budget for the program is beyond the scope of this report. The Committee notes that extramural funds will not be available to support this program and the available in-house expertise will not be sufficient. More detailed information on the research to be completed would be needed to develop a program budget and to suggest the relative balance of external and internal funding.*

p. 7, lines 16-46 – the suggestion to combine HHWB and ESV seems useful, as does the suggestion to combine DSP and OE.

*Suggested response: No change needed.*

pp. 10 line 30 – p. 11 line 42. This entire section calls into question the validity of the plan for developing the DSPs (Decision Support Platforms). The Committee recommends, on p. 11 line 14, that "EPA should more clearly describe how the DSP would actually work." The benefit of this recommendation is unclear: the Committee seems to be saying that the idea of the DSP has not been thought through, and that making one at all will face significant obstacles. So asking EPA to describe how it would

work seems to be a rhetorical question – by describing how it would work it would become clearer that it would not work. Rather than this pedagogical recommendation, it seems that the Committee should clearly say that the DSP does not seem to be feasible and should be cut from the plan or significantly revised.

*Suggested response: The Committee is stating that the Plan does not contain enough information to provide a complete understanding of how the DSP would be developed or work. The Committee has offered recommendations for further development of the Plan but is not recommending elimination of the DSP.*

p. 16, lines 9-16: The Committee recommends dropping the study of reactive nitrogen. I think that in the SAB review of the sustainability research plan, we recommended that EPA take on one or two high profile important case studies, to demonstrate the actual value of the research on a major problem. This proposed focus on reactive nitrogen seems to be in that spirit. So I wonder if SAB is giving EPA conflicting advice in reviews of different but related research programs. On the other hand, Long-term goals 4 and 5 also address specific case studies; how all of these fit together, and which ones are scientifically stronger, or more important for EPA's mission, is not very clear.

*Suggested response: See response to Drs. Galloway and Theis.*

### **Drs. Otto Doering and Willilam Moomaw (Members of the Committee)**

We have been “missing members” in the EPEC review process, and are commenting now on a specific portion of the 7/03/08 Deliberative Draft.

In reading through the draft, we have some observations on the comments concerning Long Term Goal 3 – Nitrogen Assessment. As you know we are also members of the SAB Integrated Nitrogen Committee. We recognize that the long-term plan may not have made an effective case for developing an integrated reactive nitrogen (Nr) research and management program as you note in your report. We would like to clarify some points. As noted, Nr management is imbedded in both the Clean Air and Clean Water acts, yet experience demonstrates that this media specific approach has proven inadequate to address the wide range of problems that arise from the accelerating release of Nr into the environment. Persistent violations of the ozone and small particulate standards, continuing acid rain deposition, the inability to restore Chesapeake Bay and increasing hypoxic zones in the Gulf of Mexico and off of our coasts implicate nitrogen as a complex pollutant that requires new modes of management. Other environmental issues that are influenced by unregulated Nr include fisheries decline, forestry and agricultural yield reductions from ozone and acid rain and biodiversity loss. Airborne forms of Nr have important direct implications for human mortality and morbidity, while water borne releases compromise drinking water quality. The overall damage costs are very substantial.

Instead of considering single impacts of Nr by chemical form and medium, it appears that a systems dynamics perspective, the nitrogen cascade, is a more effective way to analyze

the role of nitrogen, and identify intervention points for reducing multiple risks in an integrated fashion.

We are concerned that the Deliberative Draft Report recommends that EPA give nitrogen assessment a lower priority for several reasons including (in order):

- “What is the major question to be addressed by Nitrogen Assessment?” We see the major question as being “How can we more effectively manage Nr so as to lower its environmental, health and economic costs?”

*Suggested response: See response to Drs. Galloway and Theis above.*

- The draft report argues that the plan does not convincingly state why EPA's Ecological Research Program should include Nitrogen Assessment. It seems to us that the current high level of health and ecosystem damage because of our current management strategy and policies more than justifies addressing Nr. Advocating dropping of Nr in favor of other priorities does not seem to be justified given the seriousness and urgency of addressing current and future releases of Nr with mandates for biofuels and commitments for expanded electric power production and transportation. Increased food production alone will greatly increase Nr and further degrade essential ecosystem services unless management is improved through better understanding of Nr.

*Suggested Response: The suggestion that Nr research could be dropped will be removed.*

- We strongly agree that EPA should work with other agencies including the Department of Agriculture (non-point sources), Department of Energy and Department of Transportation as well as NOAA. It is also noteworthy that NSF and several foundations are increasing funding for Nr research. As noted, Nr needs to be seen in a multimedia context with major implications for human health as well as environmental quality. EPA is in the best position to coordinate this effort to better understand Nr and develop improved technologies and practices for Nr management and control.

*Suggested response: This recommendation will be inserted on page 16.*

- The selection of Nr over other chemicals is justified because of its ubiquitous nature, and the scale of its impacts on multiple ecosystems and human health. Nitrogen is most often the limiting nutrient in eutrophication (rather than phosphorous), and hence most responsible for algae blooms and other impacts. Nitrogen is deliberately spread across the environment as fertilizer in massive amounts (12 million tons /year) in addition to being inadvertently released from livestock production, fossil fuel combustion, waste water treatment and industrial processes.

*Suggested response: The following text will be inserted on page 15, line 40: The decision to study Nr instead of other chemicals is justified because of its ubiquitous nature, and the scale of its impacts on multiple ecosystems and human health.*

*Nitrogen is often the limiting nutrient in eutrophication, and hence responsible for algae blooms and other impacts. Nitrogen is deliberately spread across the environment as fertilizer in massive amounts (12 million tons /year) in addition to being inadvertently released from livestock production, fossil fuel combustion, waste water treatment and industrial processes.*

- The implications of Nr for wetlands have two-way implications. Not only does Nr eutrophy wetlands, but also engineered wetlands can play an important role in mitigating Nr for agricultural runoff, livestock and human waste management in a cost effective manner with ecosystem benefits.

In short, reactive nitrogen is responsible for a growing set of environmental and human health issues. Arguing that this issue is too large for the modest financial resources that are currently available seems to us to be reversing the argument and accepting a defeatist attitude. The urgency and scale of reactive nitrogen argues for getting started with the resources at hand to develop risk reduction strategies, and continue to work to increase financial and human resources over time. Innovative approaches are being introduced in Europe where the problem of Nr grew well beyond the problems we face in the United States. We can piggyback on their research and policy developments, and shape their insights to our specific needs.

*Response: See response to comments of Drs. Galloway and Theis.*

We hope that the negative tone of the Deliberative Draft can be muted, while remaining true to concerns expressed by some members, and a more positive tone, consistent with the coming recommendations of the SAB Integrated Nitrogen Committee, can be substituted instead.

*Response: We hope the changes that have been made mute the negative tone.*

We apologize for not being more available during the deliberations, but hope that this intervention will be noted and will strengthen your report.

**ATT I --- SAB Draft Report dated February 6, 2008 for Board Review - Do not Cite or Quote**

This draft is a work in progress, does not reflect consensus advice or recommendations, has not been reviewed or approved by the chartered SAB, and does not represent EPA policy. Prepared from Dft 6 (Feb 6) that was discussed at the Feb 28-29 008 SAB meeting  
July 8, 2008



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

OFFICE OF THE ADMINISTRATOR  
SCIENCE ADVISORY BOARD

[Date]

EPA-SAB-08-xxx

The Honorable Stephen L. Johnson  
Administrator  
U.S. Environmental Protection Agency  
1200 Pennsylvania Avenue, N.W.  
Washington, D.C. 20460

Subject: Strategic Research Directions of the US EPA 2008: A Science Advisory  
Board Advisory Report

Dear Administrator Johnson:

The U.S. EPA Science Advisory Board (SAB) initiated a series of interactions with U.S. EPA Office of Research and Development (ORD) senior management and National Program Directors (NPD) to discuss the strategic directions for EPA's research programs during October, 2007. The discussions were motivated by a desire to move beyond the SAB's annual review of a single year's research program budget and to think more strategically about the Agency's overall research program in relation to EPA's own stated needs and also the SAB's own perspective on those needs. Specifically, the Agency asked the SAB to consider where EPA research should be in 2012 and beyond and what factors EPA should consider in order to reach that point.

To assist the SAB in its review, ORD prepared an overview of ORD's strategic research directions for each of its research areas and provided brief documents that summarized the strategic directions and current focus for each specific area. Additionally, EPA staff and SAB members discussed these strategic research descriptions in break-out sessions during the October 2007 SAB meeting. Though quite valuable, these sessions did not provide sufficient depth of information to allow the SAB to formulate a full understanding of each research area and to comment in detail on all the research program areas. Thus, the reflections in this document are a first response by the SAB to EPA's strategic research vision as articulated in that October meeting. In the future, the Board will continue to conduct follow-up discussions with ORD, and possibly other EPA scientists, on EPA's strategic research program directions. From time to time the SAB, at the request of EPA, may provide additional advice.

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July 8, 2008

1           The Agency’s research and development program provides the scientific foundation for  
2 EPA’s actions in support its mission to protect human health and the environment. Included in  
3 these activities are: i) conduct of research and development to identify, understand, and solve  
4 current and future environmental problems; ii) provision of technical support to EPA’s Programs  
5 and Regions; iii) collaboration with EPA’s scientific partners in academia, other agencies, state  
6 and tribal governments, private sector organizations, and nations; and exercising leadership in  
7 addressing emerging environmental issues and advancing the science and technology of risk  
8 assessment and risk management.  
9

10           ORD’s research program structure contains sixteen (16) specific research areas. These  
11 program areas address EPA’s science and technology needs in topics such as: human health; air  
12 and global change; economics and sustainability; environmental technology; ecosystems; water;  
13 and homeland security. These programs are listed and summarized in the Enclosure to this letter.  
14

15           In this report, the Board focuses on fundamental and overarching issues. The SAB  
16 believes that EPA has made progress in identifying the strategic needs within its 16 focused  
17 research areas. Similarly the National Academy of Sciences has remarked on the importance to  
18 research efficiency of good planning and implementation, and concluded that “...EPA and its  
19 ORD have a sound strategic planning architecture that provides a multi-year basis for the annual  
20 assessment of progress and milestones for evaluating research programs, including their  
21 efficiency” (NAS, 2008). The SAB is pleased by the EPA’s efforts to engage in a dialogue on  
22 strategic research planning. This willingness to engage the Board and others openly about  
23 research directions and strategies is laudable as EPA comes to grips with the need for major new  
24 science understandings to meet current environmental protection issues, as well as the emerging  
25 issues that will be a part of its mission in the future.  
26

27           The Agency’s current sixteen focal areas are important. However, if it is to be prepared to  
28 address future needs, EPA’s research program will have to adopt a more integrated view, one  
29 that recognizes the inherent complexities and interconnections among human and ecological  
30 systems, gives greater consideration to feedbacks, and focuses on the relevant scales of each  
31 issue. In this context, it is clear that if the Agency is to truly protect the environment, it must  
32 undertake a larger program of research that goes beyond its immediate regulatory needs and  
33 address the broad array of environmental problems facing the nation.  
34

35           Of course, focused research in support of current regulatory programs is needed. However,  
36 it appears to the SAB that a balanced program that has been recommended by the SAB and the  
37 National Academy of Sciences in a number of past reports (NAS, 2000; SAB, 2006; SAB 2007)  
38 is being lost as a result of constant pressures to address the near-term data needs of the Agency’s  
39 operating programs in the face of ever more serious resource constraints.  
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41           Several changes are needed to address pressing environmental problems that do not fall  
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1 Agency's research plans in fragmentary ways, even though they are often interrelated. In its  
2 research programs, we believe that EPA should:

- 3  
4 1) *Broaden the interpretation of "land preservation" to take a greater leadership role in*  
5 *future land-use decision making and in managing the consequences of bio-fuels, sprawl,*  
6 *green-field development, and the pressures of unconstrained coastal development.* This  
7 program has historically focused on cleanup activities associated with contaminated sites  
8 and releases. In addition, issues associated with the Resource Conservation Challenge  
9 have been a part of the program. Though latitude for change in this program may be  
10 limited by funding strictures, EPA should consider broadening the program to enable it to  
11 focus on issues that are key to the success of EPA's new Sustainability programs,  
12 including research to understand the environmental consequences of incentive structures  
13 associated with land use decisions.  
14
- 15 2) *Expand the focus on the environmental consequences of new technologies to include a*  
16 *broader consideration of the life-cycle of new products and their globalization.*  
17 Understanding changes in where and how products are manufactured and in the types of  
18 products manufactured are important to understanding risks. Shifting locations of  
19 production within the U.S., outside the U.S., can present unique risks to the U.S.  
20 population (e.g., changed water and energy usage and availability, contaminated  
21 products, long-range transport of pollutants, and movement of living organisms to  
22 new locations of the world, to name a few). EPA must conduct research to better  
23 understand these issues and how they influence human health and the environment, as  
24 well as conduct research on the efficacy of alternative regulatory mechanisms for  
25 protecting human health and the environment in the face of these changes.  
26
- 27 3) *Expand the analysis of water infrastructures, supply, demand and quality in light of*  
28 *changing socio-economic pressures and climate.* Increased water demand from  
29 expanding populations in water-short areas is leading agencies to consider agreements for  
30 large-scale transfers of water from one region to another. EPA needs to conduct research  
31 that will improve our understanding of ecosystem and service impacts associated with  
32 such transfers to be prepared to make informed decisions on water management issues in  
33 the future.  
34
- 35 4) *Reinvigorate and modernize research on sensitive human and ecological populations.*  
36 EPA should continue to give primary emphasis to sensitive populations – this information  
37 will also provide critical data to protect the general populations. In this sense, sensitive  
38 populations refer to humans as well as to plant and animal populations. These studies  
39 will also help identify effective interventions when needed. Studies should also address  
40 the critical need for information on chemical mixtures that are reflective of actual  
41 situations in the world.  
42



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**NOTICE**

1  
2  
3 This report has been written as part of the activities of the EPA Science Advisory Board (SAB),  
4 a public advisory group providing extramural scientific information and advice to the  
5 Administrator and other officials of the Environmental Protection Agency. The SAB is  
6 structured to provide balanced, expert assessment of scientific matters related to problems facing  
7 the Agency. This report has not been reviewed for approval by the Agency and, hence, the  
8 contents of this report do not necessarily represent the views and policies of the Environmental  
9 Protection Agency, nor of other agencies in the Executive Branch of the Federal government, nor  
10 does mention of trade names of commercial products constitute a recommendation for use.  
11 Reports of the SAB are posted on the EPA website at <http://www.epa.gov/sab>.

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**ENCLOSURE**

**ADVICE ON EPA'S STRATEGIC VISION FOR ENVIRONMENTAL RESEARCH –  
US EPA SCIENCE ADVISORY BOARD**

**1. Introduction**

The U.S. EPA Science Advisory Board (SAB); senior managers of the U.S. EPA Office of Research and Development (ORD), and the ORD National Program Directors (NPD), began an evaluation and dialog on the strategic directions for EPA's sixteen (16) research programs during October, 2007. This dialog has continued over several meetings since that time, and the parties intend that these discussions continue indefinitely over time. This interaction between the SAB and EPA is motivated by a desire to move beyond thinking about EPA's strategic vision for research in a way that is broader than the view that can be obtained through the lens of each year's annual review of the EPA research program budget. Both the SAB and EPA want to engage and to think more strategically about the Agency's overall research program relatibr to EPA's own stated needs and also the SAB's own perspective on those needs.

In initiating this interaction, the EPA Assistant Administrator for Research and Development) asked the SAB to consider the strategic directions for EPA's 16 specific research areas and to provide its thoughts on the following:

- a) Where EPA research should be in the next five years, i.e., 2012 and beyond in terms of:
  - i. Research areas that will need continued emphasis;
  - ii. Research areas that might need increased emphasis; and
  - iii. Research areas that might be given decreased emphasis over the next several years.
- b) What scientific factors EPA should consider to get to this point?
  - i. Changes in "environmental science" itself;
  - ii. Ways in which the workforce, and the skills available through the workforce, might be adjusted to further evolve and improve the research program (i.e., strategic workforce planning); and
  - iii. Opportunities for efficiency
    - ◆ Are there areas with opportunities for greater coordination and synergy within ORD, across EPA, and across other organizations both inside and outside of government;
    - ◆ Are there other research "themes" that could strengthen EPA's research strategy (e.g., cross-cutting advice on sprawl, disasters, climate change); and
    - ◆ How might we improve the SAB – EPA dialogue on strategic science planning for the future?

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1  
2 Section 1 of this “Enclosure” is this Introduction. Section 2 identifies and summarizes the  
3 key components of EPA’s 16 research areas. In Section 3 the SAB responds to the Agency’s  
4 charge to the SAB for these interactions. Specifically, Section 3.1 offers general SAB comments  
5 on a number of overarching issues that emerged during its October 2007 discussions with EPA  
6 on its strategic research directions. In Section 3.2 the SAB comments on the human scientific  
7 resource needs of EPA, focusing on the problems of sustaining and renewing EPA's excellent  
8 and highly motivated scientific research staff. In Section 3.3 the SAB comments on strategies  
9 that ORD might consider in enhancing its research effectiveness and efficiency. In Section 3.4  
10 of this advisory the SAB offers some suggestions for additional dialogue between the SAB and  
11 EPA on its Strategic Research Discussions. Finally, in Section 3.5 the SAB offers more specific  
12 comments on the current research program directions described in EPA’s 16 strategic research  
13 area descriptions (SAB, 2007a). However, as noted above, these are preliminary comments  
14 because the depth with which the SAB was able to learn about each strategic research area was at  
15 best modest.

16  
17  
18 **2. US EPA Research Program**

19  
20 The EPA Office of Research and Development’s (ORD) began a new strategic planning  
21 effort during 2006 that involved ORD’s National Program Directors (NPD), the ORD Executive  
22 Council (OEC) and the ORD Science Council (SC). The research areas are intended to provide  
23 the scientific foundation to support EPA’s mission by: i) conducting research and development  
24 to identify, understand, and solve current and future environmental problems; ii) providing  
25 responsive technical support to EPA’s Programs and Regions; iii) collaborating with EPA’s  
26 scientific partners in academia, other agencies, state and tribal governments, private sector  
27 organizations, and nations; and iv) exercising leadership in addressing emerging environmental  
28 issues and advancing the science and technology of risk assessment and risk management.

29  
30 ORD has structured its research program around sixteen (16) specific research areas.  
31 These program areas are summarized in a set of strategic documents that formed the information  
32 base for the SAB – EPA discussions during its October 2007 meeting. ORD’s sixteen specific  
33 research programs are listed in Table 1.

34

<b>Grouping</b>	<b>Research Area</b>
a) Technology	i) Land Preservation and Restoration ii) Nanotechnology iii) GEOSS / Advanced Monitoring Initiative
b) Economics and Sustainability	i) Economics and Decision Sciences ii) Technology for Sustainability
c) Ecosystems, Water and Security	i) Ecosystems Protection ii) Water Quality iii) Drinking Water iv) Homeland Security

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d) Air and Global Change	i) Clean Air ii) Global Change
e) Human Health	i) Human Health ii) Computational Toxicology iii) Endocrine Disruptors iv) Human Health Risk Assessment v) Safe Pesticides and Products

1  
2           The SAB challenged ORD during the SAB-EPA interaction on the FY 2008 research  
3 budget to discuss examples of cross-cutting research (e.g., in cross cutting areas such as sprawl,  
4 climate change, sensitive populations, etc.). Though a cross-cutting view of these themes is not  
5 directly addressed in the descriptions listed above, ORD does think of the individual linkages  
6 across research areas and they jointly plan some parts of this research across a variety of specific  
7 areas. In addition, EPA views the individual programs as being either **Program-Targeted**  
8 **Research** (e.g., Clean Air, Drinking Water, Water Quality, Land Preservation, Safe Pesticides  
9 and Products, Homeland Security, Global Change, and GEOSS/AMI) or **Cross-Program**  
10 **Research** (e.g., Human Health, Computational Toxicology, Human Health Risk Assessment,  
11 Endocrine Disrupting Chemicals, Ecosystems, Economics and Decision Sciences, Science and  
12 Technology for Sustainability, and Nanotechnology).

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1 **3. Response to the Charge**

2 **3.1 General Comments: Moving to a more proactive and system-oriented research portfolio**

3 In this report, the Board focuses on fundamental and overarching issues. The SAB  
4 believes that EPA has made progress in identifying the strategic needs within its 16 focused  
5 research areas. Similarly the National Academy of Sciences Committee on Evaluating the  
6 Efficiency of Research and Development at the U.S. Environmental Protection Agency has  
7 noted, “The key to research efficiency is good planning and implementation. EPA and its ORD  
8 have a sound strategic planning architecture that provides a multi-year basis for the annual  
9 assessment of progress and milestones for evaluating research programs, including their  
10 efficiency” (NAS, 2008)<sup>1</sup>. The SAB is pleased by the EPA's efforts to engage in a dialogue on  
11 strategic research planning. This willingness to engage the Board and others openly about  
12 research directions and strategies is laudable as EPA comes to grips with the need for major new  
13 science understandings to meet current environmental protection issues, as well as the emerging  
14 issues that will be a part of its mission in the future.  
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16 The Agency's current sixteen focal areas are important. However, if it is to be prepared to  
17 address future needs, EPA’s research program will have to adopt a more integrated view, one  
18 that recognizes the inherent complexities and interconnections among human and ecological  
19 systems, gives greater consideration to feedbacks, and focuses on the relevant scales of each  
20 issue. In this context, it is clear that if the Agency is to truly protect the environment, it must  
21 undertake a larger program of research that goes beyond its immediate regulatory needs and  
22 address the broad array of environmental problems facing the nation.  
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24 Of course, focused research in support of current regulatory programs is needed. However,  
25 it appears to the SAB that a balanced program that has been recommended by the SAB and the  
26 National Academy of Sciences in a number of past reports (NAS, 2000; SAB, 2006; SAB 2007)  
27 is being lost as a result of constant pressures to address the near-term data needs of the Agency’s  
28 operating programs in the face of ever more serious resource constraints.  
29

30 Several changes are needed to address pressing environmental problems that do not fall  
31 neatly within existing regulatory mandates. Today these needs are only addressed within the  
32 Agency's research plans in fragmentary ways. In its research programs, we believe that EPA  
33 should:

---

<sup>1</sup> NAS also provided a framework for evaluating the efficiency of EPA research. NAS identifies two types of research efficiency. **Investment Efficiency** addresses three questions: are the right investments being made, is the research being performed at a high level of quality, and are timely and effective adjustments being made in the multi-year course of the work to reflect new scientific information. NAS states that these questions are best evaluated by use of expert judgment not quantitative measures. **Process Efficiency** involves quantitative measures of inputs and outputs (e.g., publication rates, time required to conduct research, and percent of grants that are peer-reviewed) and these can be measured in units such as dollars, hours and numbers. PART emphasizes Process Efficiency. Investment Efficiency is best judged by expert advice.

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2 1) **Broaden the interpretation of "land preservation" to take a greater leadership role**  
3 **in future land-use decision making and in managing the consequences of bio-fuels,**  
4 **sprawl, green-field development, and the pressures of unconstrained coastal**  
5 **development.**  
6

7 The Agency's Land Preservation area has historically focused on cleanup activities  
8 associated with contaminated sites, uncontrolled releases, spills, and leaking underground  
9 tanks. More recently efforts have been made to include waste minimization activities,  
10 mostly through the Resource Conservation Challenge (RCC), a voluntary partnering  
11 program aimed at helping companies and institutions overcome barriers to implementing  
12 waste minimization programs. This is a potentially valuable program, but it has not been  
13 systematically evaluated to assess its efficacy or to develop plans for improvement. This  
14 should be done.  
15

16 Perhaps more than most of the other of the Agency's research programs, the Land  
17 Preservation area has less latitude in shifting its programs in response to suggested new  
18 directions. This is due principally to restricted uses of Superfund resources, but also the  
19 genuine, and considerable, needs associated with containing and removing contamination  
20 in the land environment. Still, the Board is concerned that new and broader issues that  
21 this area could also address are not being seriously considered. For example, there is  
22 little research on land use topics such as measuring the benefits of Brownfields cleanup  
23 and revitalization, urban sprawl and the built environment, and the multiple land  
24 sustainability issues that surround agriculture and biofuels. The Board urges that EPA  
25 carefully examine the complimentary nature of an expanded Land Use program and its  
26 nascent, but important, research program in Sustainability with a view toward  
27 recognizing opportunities for cross-disciplinary collaboration.  
28

29 Private actions associated with land use decisions, globalization of the supply chain for  
30 increasing numbers of commodities, water needs for residential and agriculture uses, bio-  
31 fuels as responses to shortfalls in conventional energy resources, and numerous other  
32 examples illustrate choices made in response to the incentives provided by private  
33 markets and current regulations. Experience seems to suggest that we learn the  
34 environmental consequences of these incentive structures after problems have emerged.  
35 Organizing environmental research in all media so that it considers the task of measuring  
36 *ex ante* the environmental costs (or equivalently the benefits) of the available choice  
37 alternatives would require re-casting EPA's research activities. Under this approach EPA  
38 would connect the full environmental consequences to their sources as distinct private  
39 decisions. This organization would also provide an accounting system that is consistent  
40 with sustainability scoring.  
41  
42  
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1        2) **Expand the focus on the environmental consequences of new technologies to include**  
2

3        A number of factors associated with product life cycles influence the types of risks that  
4        are emerging in the U.S. and worldwide, as well as how and why those risks emerge. It  
5        matters where products are manufactured and how they are manufactured. In addition,  
6        new technologies are emerging that will have to be considered in view of their own life  
7        cycles.  
8

9        EPA needs to understand where things will be manufactured in the future. Thirty years  
10       ago, 80 percent of automobile-related manufacturing took place in less than 20 counties  
11       in the U.S. Today that number is less than 50 percent. Auto manufacturing left the  
12       Rustbelt and moved into the American southeast (a shift from Brownfields to  
13       Greenfields). Just-in-time inventory processes have dramatically increased the  
14       transportation-related impacts for the production life cycle, especially for high-weight,  
15       low value inputs. Thus, the location of production and any attendant risks has changed  
16       within the U.S.  
17

18       There is also a need for attention to production activities outside U.S. borders. The  
19       increase of international trade has made it more important to think about how human  
20       health and the environment in the U.S. might be influenced by manufacturing outside our  
21       borders. Production processes for these products, and the products that result from  
22       international production processes, also matter. Risks from production and products need  
23       to be considered where things are produced outside our borders as well as the risks  
24       associated with outside production and products once they are brought into the U.S.  
25

26       Examples of US human health and environmental problems that can result, at least  
27       partially from pollution released in other countries, include not only global effects such as  
28       climate change and stratospheric ozone depletion, but also environmental transport of  
29       pollutants such as particulate matter and mercury. Additionally, transport of  
30       contaminants through products (e.g., lead in children's toys; pesticides in food products),  
31       and accidental or incidental transport of living organisms associated with increased  
32       global transportation (e.g., invasive species such as zebra mussels, disease vectors) can  
33       cause adverse effects to human health and the environment in the U.S.  
34

35       ORD should develop mechanisms and devote resources to anticipating significant  
36       changes in the methods and locations of industrial production that could have impacts on  
37       EPA's mission and programs. Shifts in hydrocarbon synthesis (biofuels) are already on  
38       the radar screen but other changes loom large. Research is needed to better understand  
39       the effects of globalization on risks to human health and the environment in the US and  
40       elsewhere.  
41

42       There is also a need for research on the efficacy of alternative regulatory mechanisms for  
43       protecting health and the environment. Some conventional regulatory approaches (e.g.,

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1 pollution taxes, inspection systems) may be more difficult to implement outside US  
2 jurisdiction and may be limited by free-trade rules, suggesting that alternative approaches  
3 such as programs to assist non-US producers in developing or adopting more  
4 environmentally or health-friendly products and processes (e.g., ongoing US-China  
5 efforts, development of energy-star and other product standards) may be considered in  
6 addition to more conventional regulatory mechanisms.  
7

8 Production locations and methods are not only changing for existing products, but new  
9 technologies are giving rise to new types of products that must be evaluated. For  
10 example, to continue to reduce the cost and size of computer chips, the semiconductor  
11 industry is exploring alternative production methods ranging from water-based  
12 lithography to the use of DNA and nano-scale quantum techniques to produce logic.  
13 Similar transitions are underway in the production of batteries as companies explore  
14 alternatives to lithium ion such as nano-phosphate. These shifts in industrial production  
15 methods could result in dramatic changes in material inputs, water and energy  
16 requirements, emissions, and end-of-life issues. When they happen, where, and how all  
17 need to be better understood by EPA  
18

19 3) **Expand the analysis of water infrastructures, supply, demand and quality in light of**  
20 **changing socio-economic pressures and climate.**  
21

22 Expanding populations in water-short areas of the U.S. (e.g., Atlanta, Las Vegas, and  
23 Phoenix) is increasing the demand for water. This, in turn, is leading local water  
24 management agencies to negotiate agreements for large-scale transfers of water from  
25 distant regions. The long-term ecosystem and ecosystem service impacts of such  
26 transfers have received little study. Because interest in inter-basin transfers of water is  
27 likely to grow in the future, an improved understanding of the ecosystem impacts  
28 associated with such transfers will be necessary to make informed decisions on regional  
29 and interstate water management/reuse as well as land uses which contribute to increased  
30 water demand.  
31

32 4) **Reinvigorate and modernize research on sensitive human and ecological**  
33 **populations.**  
34

35 The study and protection of sensitive populations (including plants, animal, and human)  
36 should continue to be a prime emphasis for the EPA. If the Agency protects those  
37 populations that may be the most susceptible to toxins and other stressors it will likely  
38 fulfill its primary mission of protecting the general population.  
39

40 Sensitive human groups include populations at various stages of life (fetus, pregnant  
41 females, children, elderly, etc) and populations of individuals with specific diseases (such  
42 as asthma), specific genotypes, or specific exposures. Studies of these sensitive  
43 populations, not only provide critical data to protect the general population, but also

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1 provide insight into what chemicals are toxic, their mechanism of action or pathways of  
2 toxicity, and potentially help to identify opportunities to protect these populations and the  
3 general population as a whole.  
4

5 Studies of affects on sensitive plant and animal populations are also important. Such  
6 studies will also provide insight to mechanisms of action of environmental chemicals and  
7 possibly avenues of intervention (including nutraceuticals, nutrition, etc) when  
8 various species or ecosystems are at risk. The study of these sensitive plant and animal  
9 populations is also important in helping to understand the effects of population losses on  
10 the entire ecosystems. The study of sensitive populations must also consider how  
11 changes to sensitive ecosystems can affect the entire system.  
12

13 Often, environmental research and environmental protection actions focus on single  
14 pollutants, species, or stressors. This is not reflective of actual situations in the world.  
15 Thus, there is also a critical need to develop models and approaches that examine human  
16 health and ecological effects of relevant chemical mixtures in the context of other  
17 exogenous and endogenous “background exposures” and to move away from the focus of  
18 intense scrutiny on narrowly conceived single agent scenarios. To do so will require the  
19 development of criteria for selecting the most relevant mixtures and for understanding  
20 how environmental exposures add to the existing burden of endogenous and other  
21 xenobiotic exposure to cause disease. While the Agency has made some progress on  
22 common mechanism mixtures (organophosphate pesticides, dioxin), these represent only  
23 a minor part of the problem. Further, most mixtures to which people and ecosystems are  
24 exposed will be dominated by mixtures that do not have common mechanisms; also  
25 exposures typically occur within the context of other xenobiotic and endogenous  
26 chemical stressors as well as non-chemical risk modifiers that can also change the effects  
27 resulting from such environmental mixture exposures.  
28

29 **5) Improve the science foundation needed to respond to unexpected and emerging**  
30 **problems and environmental disasters.**  
31

32 The science and technologies impinging on human health and environmental evaluations  
33 are exponentially expanding in terms of complexity and pace of development. Examples  
34 include the likely emergence of transforming sciences such as toxicogenomics and  
35 nanotechnology. Resource-limited organizations such as EPA will be increasingly  
36 challenged to develop creative mechanisms to provide the Agency access to this science  
37 within the realistic constraints of EPA human and budget resources.  
38

39 **6) Expand policy relevant research on developing, testing and evaluating new and**  
40 **innovative alternatives to conventional command and control regulation.**  
41

42 The first three of the above examples represent problems that arise from the many  
43 independent decisions made by individuals and organizations that do not face prices, other

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1 incentives, or regulations that capture the full life cycle and longer term consequences of these  
2 decisions.

3  
4 With a few exceptions, such as the new initiative in sustainability, most of EPA's current  
5 research programs are tied to specific media and their focus is driven by current regulatory  
6 strategies, statutory mandates and needs. The SAB understands the forces and budgetary  
7 limitations that have created this situation. However, in thinking about 2012 and beyond the  
8 SAB believes that a broader and more systems-oriented approach to research will be needed.  
9 Many of the elements of such a program already exist, but in the words of Administrator  
10 Johnson, currently the work is much too "stove-piped."

11  
12 Over the coming months the SAB will work to develop more complete and balanced advice  
13 on what a more integrated and systems-oriented research portfolio might look like. At this stage  
14 we offer comments on a number of topics that emerged from our discussions with ORD in  
15 October 2007.  
16

17 **3.2 Human Resources for the Conduct of Science at EPA**

18 EPA is interested in the implications of workforce changes on the quality and  
19 responsiveness of EPA's research programs. EPA's question is primarily focused on how the  
20 skills available through the workforce might be adjusted to further evolve and improve the  
21 research program (i.e., strategic workforce planning). The SAB notes that the issue is not just  
22 one of expanding expertise into new areas. Rather, there is a need to ensure that the existing  
23 expertise base does not undergo erosion as staff turnover from retirement and lack of EPA  
24 investments in science staff, and the laboratory equipment and supplies needed for researchers to  
25 be able to carry out research. The SAB recognizes that new issues will require new skills in the  
26 workforce and it has noted this in several of its recent reviews of EPA research budgets. Skill  
27 will be needed for many of the new emerging issues such as nanotechnology production and risk  
28 as well as in the specialties within the social sciences (e.g., human behavior, communications,  
29 and other). EPA is generally as aware of the new skills it will need as those who are on the SAB.  
30 In many ways, this issue is as much one of making the personnel resources available as it is in  
31 attracting and retaining those with new skills. Given that we are now at a point in which many in  
32 the existing workforce are moving into retirement, the time is good for making these changes.  
33 The Agency must also develop plans for transitional training for new employees to avoid  
34 repeating some of the current issues in the future.  
35

36 There is an issue, though that must be addressed if EPA is to succeed in attracting and  
37 retaining the best and the brightest scientists. The EPA has long enjoyed a remarkably dedicated  
38 and high qualified scientific research staff. However, in our discussions with bench-level  
39 scientists during our October, 2007 visit to RTP, and in the individual interactions that members  
40 of the SAB have had in recent years with both junior and senior agency researchers, several

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1 issues have emerged that deserve ongoing and expanded attention from EPA's senior managers.  
2 These include:

- 3
- 4 a) The erosion and/or disillusionment of senior staff. Continually shrinking research  
5 budgets have resulted in growing numbers of senior staff who are becoming  
6 disillusioned, and this risks loss of the high level of dedication that brought them to the  
7 agency in the first place.  
8
- 9 b) Recruiting and retaining young talent. The agency has developed an outstanding program  
10 to attract postdoctoral scientists to the ORD labs, and an active program to recruit new  
11 young scientific staff. However, we are concerned that too many of the scientists who  
12 are participating in these programs are losing interest when real opportunities and  
13 permanent, challenging jobs are not available, and they are subsequently moving on to  
14 other careers.  
15
- 16 c) Continuing Education and Training. The agency has long had formal and informal  
17 programs to support continued education, up to and including opportunities for MS-level  
18 scientists and engineers to pursue PhD studies. However, it is time to review and  
19 revitalize these activities.  
20

21 With the exception of our recurrent recommendations to reverse the continued erosion of  
22 research budgets, the SAB is not close enough to the details of ORD operations to suggest  
23 specific strategies to address these issues. However we know enough about recent staffing  
24 trends to recommend that the issues of sustaining and strengthening ORD and the Agency's  
25 scientific human resources deserves continued and expanded attention.

26 **3.3 Comments on Research Effectiveness and Efficiency**

27 EPA asked the SAB for advice on the scientific factors that should be considered so that  
28 EPA can transition to its future program focus. Of interest to EPA in such advice was whether  
29 changes in "environmental" science itself would be important; if workforce issues such as skills  
30 available might need to be adjusted to further evolve and improve the research program (i.e.,  
31 strategic workforce planning); and if there are opportunities for improving the research program's  
32 efficiency (e.g., are there opportunities for greater coordination and synergy within ORD, across  
33 EPA, and across other organizations both inside and outside of government; or are there other  
34 research "themes" that could strengthen EPA's research strategy (e.g., cross-cutting advice on  
35 sprawl, disasters, climate change).  
36

37 The recent NAS report on Evaluating Research Efficiency in the US EPA offers valuable  
38 suggestions on evaluating both investment efficiency and process efficiency for US EPA  
39 research programs. The SAB supports the findings of the NAS report and notes tht the role of  
40 expert review by SAB is most helpful in evaluating investment efficiency in research. In this  
41 regard, the SAB offers the following thoughts for consideration.

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1  
2 a) Strategies by which the EPA might make greater use of results from its own research  
3 program (we offer examples in sustainability and in nanotechnology) and relevant  
4 research from other organizations.  
5

6 As a leading research agency, EPA should be the leader in the using its own research  
7 results. The following are examples of current opportunities:  
8

- 9 i) The recent Agency and government-wide initiative on nanotechnology has  
10 provided significant research results demonstrating the properties of  
11 nanomaterials. Incorporation of these results in technology development  
12 activities in the water and air monitoring and treatment arenas could yield  
13 significantly improved process performance.  
14 ii) The Technology for Sustainability Research Program has identified three  
15 interrelated ideas drawn from economics, social, and environmental realms.  
16 These have been translated into 6 program themes. Integration of the ideas  
17 and themes into other research programs will yield program results that  
18 reflect EPA's view of "... meeting basic environmental, economic, and  
19 social needs now and in the future without undermining the natural systems  
20 upon which life depends."  
21 iii) The Ecosystem Research Program's new direction on assessing ecosystem  
22 services needs to be integrated into Agency Program offices and should  
23 help in prioritizing and evaluating the effectiveness of their activities.  
24 iv) ORD has passed the tools developed in EMAP to the Program and Regions;  
25 yet there is an on-going need for the development of new monitoring  
26 strategies and tools. This parallels the opportunities in nanotechnology  
27 presented above.  
28

29 As the leading organization for research efforts that are directed at EPA's specific  
30 mission areas that protect human health and the environment, EPA ORD should actively  
31 look for and use the relevant research results from other governmental and  
32 nongovernmental organizations in ways similar to that noted above for its own research  
33 results.  
34

35 The SAB has noted on many occasions that other governmental and non-governmental  
36 organizations either fund or conduct research that can be useful in supporting EPA's  
37 mission achievement. To its credit, EPA has a long history of using such results to the  
38 extent that they are relevant to EPA's conduct of its own research and in considering the  
39 need for action on various environmental issues. However, as the SAB has remarked  
40 before, much of the research conducted by these outside organizations, though generally  
41 categorized as "environmental research" is not of the type that directly answers important  
42 questions that are relevant to EPA's specific mission.  
43

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1 EPA ORD is uniquely positioned to pursue the most relevant research to support the EPA  
2 mission. This is in fact the primary mission of ORD. That said, it is clear that there is  
3 much research being conducted outside of EPA that can be useful to EPA as it improves  
4 the understanding of components of problems that are a part of its mission. Thus, EPA  
5 should continue to “mine” these efforts for useful knowledge and procedures. However,  
6 EPA should enhance and improve this effort by instituting a systematic process that  
7 ensures that such research results are captured by EPA and used to support the Agency  
8 mission when it is appropriate for such uses. This systematic mining of others’ research  
9 results can also identify opportunities for EPA collaboration and partnerships to leverage  
10 the use of EPA’s own resources.

11  
12 b) Strategies to engage citizens for data collection, and for computational resources for  
13 advanced modeling and analysis.  
14

15 Communications is shifting from a one-to-many paradigm (i.e., the approach that  
16 dominated radio and television for decades) to a many-to-many, net-centric paradigm.  
17 Nicholas Negroponte, the Director of MIT’s Media Lab, called this the move from  
18 “passive old media” to “interactive new media.” Interconnected people now have the  
19 technological tools that allow users to generate and distribute their own content --  
20 everything from computer code (Linux) to course curriculum (iTunes University).  
21 People can collaborate to make their content better (peer-to-peer design and  
22 development) and they can apply their collective wisdom to solving important scientific  
23 challenges.  
24

25 To take advantage of these changes, ORD should develop a strategy to engage a new  
26 generation of “citizen scientists” to help the agency collect, analyze, and apply the results  
27 of these activities to environmental issues. In this, EPA could consider the integration of  
28 citizens and outside organizations into their “macroscope”, possibly as a Citizen’s  
29 Science Corps. In this manner, EPA could create opportunities for citizens to work as  
30 observers and participants in a variety of efforts that would be useful to EPA’s  
31 achievement of its mission. Citizens could perform measurements, analyze data, and  
32 support efforts to attain environmental improvements. In addition to making direct  
33 observations; such a “Science Corps” could participate in EPA websites to give their  
34 advice on what EPA should be doing on various issues (e.g., Wikipedia); and they can  
35 analyze EPA’s data bases through competitions that reward the best ideas for new  
36 environmental science, solutions, and technologies (reference *Wikinomics: How Mass*  
37 *Collaboration Changes Everything*, 2006). The Agency might, with some imaginative  
38 effort determine how it could turn a few million GPS-enabled cell phones with cameras  
39 into a participatory sensing system? EPA might consider using a virtual world like  
40 Second Life to test reactions to product labeling schemes or work on collaborative  
41 strategies to manage ecosystems?  
42

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1 An example of a successful venture in this area is the effort to link together America's 70  
2 million bird watchers. Web-based systems like *Bird Source* and *Journey North* have  
3 allowed birders to share sitings and see new spatial patterns of migration never before  
4 possible. John Fitzpatrick, director of the Laboratory for Ornithology at Cornell,  
5 commented that, "We'll be able to count them, monitor them, and observe their  
6 population crashes, on a continental scale."  
7

8 In addition, a few years ago, NASA found that people with a bit of training could identify  
9 craters on the surface of Mars and classify them by age (humans can still beat computers  
10 on many pattern recognition tasks). Instead of just borrowing computer power (SETI  
11 project) NASA borrowed the brains of thousands of people in what was called the  
12 Clickworker's Project. People did this for the challenge and learning experience, not for  
13 money.  
14

15 More recently, thousands of people poured over satellite images trying to find the  
16 downed plane of pilot Steve Fossett (Help find Steve Fossett with Google Earth). A  
17 similar technique was used to search for Jim Gray, a Microsoft scientist who went  
18 missing on his sailboat off the coast of California.  
19

20 c) Expansion and greater integration of behavior and decision science into many ORD  
21 research programs  
22

23 Without a scientific understanding of human behavior, the Environmental Protection  
24 Agency cannot fulfill its responsibility to the American people.  
25

26 An element of human judgment is part of every analysis that the Agency conducts. It is  
27 present in the definition of fundamental terms, such as risk, benefit, exposure, discount  
28 rate, and equity. It is present in the selection and weighting of data. It is present in the  
29 selection of values for sensitivity analyses and the assessment of scientific uncertainties.  
30 The roles of judgment and their limits have been studied extensively for some forty years.  
31 If that science is not reflected in EPA's analytical processes, then the results of those  
32 analyses are less than they should be and they are conveyed with greater confidence than  
33 is warranted. These are the issues that, in part, motivated OMB's Risk Assessment  
34 Bulletin. Although that effort was faulted as fundamentally flawed by the National  
35 Academy of Sciences and subsequently abandoned by OMB, the need for systematic  
36 treatment of scientific judgment remains.  
37

38 Many EPA analyses attempt to assess processes that depend on human behavior. For  
39 example, the risks from toxic chemicals depend on exposure processes shaped by human  
40 behavior (e.g., what people eat, whether they can use protective clothing); they may also  
41 depend on the behavior of people who must maintain equipment, interpret malfunctions,  
42 issue warnings, and respond to cautions or evacuation orders. In the publicly available  
43 reports from two consultations, the SAB's Homeland Security Advisory Committee

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1 raised serious questions about the behavioral realism of important programs that were  
2 sound in other ways. Unless EPA bases its analysis on social and behavioral science, its  
3 assumptions will be little more than guesswork.  
4

5 The value of much of EPA's work depends on its ability to convey its results to people  
6 who must make decisions based on them. It is well established in the scientific literature  
7 that many technical issues are understood in different ways by expert and lay audiences.  
8 With scientifically sound communications, however, it is possible to make research  
9 results clear to those willing to attend to them. At one time, the Agency was a leader in  
10 scientifically sound communication. Today, however, EPA's communications are almost  
11 all improvised, without any rigorous analytical identification of its audiences' information  
12 needs or empirical evaluation of its effects. As a result, the Agency may not only fail to  
13 extract the full value of its research, but inadvertently misinform its audiences.  
14

15 The Agency is in dire need of an ambitious program of scientific research in the social  
16 and behavioral sciences. At the moment, its ranks are so depleted that it has difficulty  
17 commissioning sound work from the outside, lacking staff with the expertise needed to  
18 evaluate proposals and products. There is no substitute for aggressive hiring, investment  
19 in dedicated STAR graduate fellowships, and extramural research to fulfill the most  
20 pressing gaps until EPA has created adequate intramural research programs. It may be  
21 wise for EPA to partner with an agency with social science expertise in order to build this  
22 program, as it did in the early days of its decision making program.  
23

24 d) An alternative organizational structure for EPA Research  
25

26 The Agency may wish to consider alternative models for the management of the activities  
27 pursued within its laboratory system. Historically EPA research has been organized  
28 according to media-specific, pollutant-specific, and problem-specific areas as well as the  
29 risk management paradigm (air, radiation, assessment, effects, toxicology, exposure, risk  
30 management, homeland security, etc.). Such a model serves the regulatory side of the  
31 Agency well, but makes it difficult to respond to modern environmental problems which  
32 are increasingly cross-media, systemic, and complex. A focus that is finely tuned to the  
33 regulatory side of the Agency also is sensitive to changes in regulatory priorities.  
34 Because of this the SAB has seen over the years a tendency for calls at EPA to shift away  
35 from existing research – research that may have taken several years to incorporate within  
36 plans and budgets – into new areas. This undermines the normal pursuit of research  
37 which almost always requires conduct over some protracted timeframe to reach  
38 successful conclusion. Alternative models that are more adaptive, multidisciplinary, and  
39 systems-oriented would allow the Agency to better anticipate new environmental  
40 challenges, and be less reactive. These would very likely permit cost and functional  
41 efficiencies to be gained, as well as create a more stable research environment within the  
42 research organization. The Board recognizes that a transition to an alternative model for  
43 management is a painstaking endeavor accompanied by a culture change and resistance

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1 by some. The long term rewards, however, would be best for the protection of human  
2 health and the environment.  
3

4 **3.4 Moving Forward with the SAB – EPA Strategic Research Discussions**

5 EPA asked how future SAB-to-EPA interactions on strategic science planning might be  
6 improved? Since 2005, the responsibility for reviewing the EPA research budget has been the  
7 responsibility of the Chartered Science Advisory Board. The SAB made the decision to move  
8 the review from an SAB subcommittee to the full Board because of its desire to reflect the  
9 importance of the review and because it allowed the Board to add to the number of individuals  
10 on the team that actually reviewed the report. It also permitted the span of expertise used in the  
11 review to be increased. The SAB believes that retaining this activity as a Chartered SAB  
12 responsibility will allow the improvements already gained from this change to be preserved and  
13 it will also allow the benefits to be increased in the future.  
14

15 In its consideration of EPA’s overall research picture, largely through the window of a  
16 budget review, the SAB has explored a variety of approaches to conduct the actual review and  
17 considered a variety of types of information that would help it in the conduct of these reviews.  
18 EPA and the SAB continue to work to identify an optimal set of background documents to be  
19 given to the SAB so that it can carry out a meaningful review of EPA’s research budget. Over  
20 time the amount of documentation has decreased. The SAB believes that it should continue to  
21 work with EPA to refine the set of background documents necessary to allow a high quality  
22 review of EPA’s research program portfolio.  
23

24 In addition, the SAB and EPA have varied the specific organizations involved in the  
25 review from having the SAB interact with just ORD to having all the client offices participate in  
26 the discussions of research needs. This is because the span of activities conducted under the  
27 ORD research and development program overlaps with similar activities that are pursued by  
28 various program and regional offices. Thus, it has been the goal of the SAB and ORD to have  
29 regional and program offices all involved in the discussions so that the full science program  
30 would be a part of the discussions, not just that part carried out by ORD. At this point, the  
31 Program and Regional Offices are not participating in the interaction as fully as the SAB and  
32 ORD would like. The SAB believes that EPA’s program and regional offices should be more  
33 involved in these discussions in the future. This is both so that the SAB can learn from programs  
34 and regions of how well their needs are being met by ORD and also because program and  
35 regional offices also conduct science activities that are of a similar nature to those conducted by  
36 ORD. To best provide advice to ORD on how its research efforts should evolve, it will be  
37 important to understand the full EPA science program and those components that are not under  
38 the direction of ORD.  
39

40 The SAB has long thought that engaging in discussions of the overall research program  
41 over the long term was not as successful when done in association with discussions on EPA’s

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1 research budget. Generally, open discussion is restricted when it occurs as a part of the budget  
2 process because of rules that constrain the Agency's ability to thoroughly discuss how well a  
3 given budget meets the needs for conducting research that is identified in its long-term strategic  
4 planning. Thus, the SAB and ORD agreed to separate the two activities into a two-phased  
5 process in which the SAB and EPA are engaging in a continuing series of discussions of the  
6 strategic directions for EPA research so that the Board can better understand the overall  
7 directions of Agency research and how that might change. In addition, the SAB each February  
8 evaluates and advises the Administrator on the coming year's research budget in terms of how  
9 that budget will contribute to the Agency's accomplishment of the goals and objectives that are  
10 embodied in the longer term strategic directions for each research program. The SAB believes  
11 that continuing this separation, and pursuing discussions with EPA over time will contribute to  
12 better communications between the SAB and ORD on the overall research program. This will,  
13 in turn, provide a contextual basis for the SAB's use in advising EPA, and the U.S. Congress, on  
14 each year's budget.  
15

16 The topics which come to the SAB for consideration and advice-giving differ from those  
17 sent to the ORD Board of Scientific Counselors (BOSC) and other advisory bodies. For  
18 example, SAB review topics tend more toward being peer reviews of scientific assessments or  
19 assessment methods than the actual conduct and progress on specific research programs – the  
20 latter usually being done by the BOSC. The SAB believes that deliberations on the adequacy  
21 and completeness of EPA research program strategies and budgets could be enhanced if it  
22 incorporates additional representation from other advisory bodies into its own reviews. The SAB  
23 will pursue this for future activities in these two areas.  
24

25 One of the difficulties in evaluating research budgets and strategies from year to year comes  
26 from changes that EPA makes to the structure, nomenclature, and organization of its research  
27 programs. Thus, from one year to the next, the location of specific research topics might fall  
28 within different categories. Further, when considering resource levels allocated to specific  
29 programs, and to the component activities within given programs, it is important to have  
30 information on what resource levels are actually associated with each component and program  
31 from year to year. Without this, it is quite difficult to know how a program is progressing over  
32 time. In addition, resource allocations rarely are given, when they are given, on a consistent  
33 basis over a series of years (e.g., some years show budget levels while some show appropriated  
34 levels) and thus it is difficult to see resource trends over time. The SAB believes that its  
35 discussions on EPA research could be improved if it could be provided with a consistent set of  
36 resource numbers over a period of at least 5 years for specific programs and program  
37 components. Further, if requirements change in a way that causes programs, and their  
38 components, to be renamed from one year to the next, information should be provided that  
39 makes those changes clear.  
40

41 Contrary to popular belief, specific research programs carried out by or for EPA do have an  
42 actual beginning and an actual ending. Often the end of an activity within an ORD research  
43 program signals the need for a follow-on action by a Program or Regional Office. The SAB

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1 believes that improved consideration of EPA's research programs conducted by ORD could be  
2 gained from participation of Regional and Program Office personnel who could indicate how  
3 specific completed research activities are to be implemented in their own offices (e.g., the  
4 continuation of the EMAP is such an issue since it is being indicated by ORD now as an area  
5 where research has completed the development of a method/approach and that the benefits  
6 gained from information coming from implementation of those methods will now be the  
7 responsibility of other EPA offices. Knowing that such things will happen is important to the  
8 SAB as it develops its advice on ORD's research programs and budgets).

9  
10 **3.5 Commentary on EPA's Specific Research Areas**

11  
12 The key directions for each of these research areas are briefly summarized in the  
13 following paragraphs.

14  
15 a) Land Preservation and Restoration:

- 16 • Develop sustainable planning criteria for land use plans, e.g., Brownfields.
- 17 • Evaluate alternative remediation technologies for contaminated sediments.
- 18 • Emphasize in situ treatments and PRBs for ground water protection, study the  
19 operation of landfills as bioreactors, and help assess asbestos risks.

20  
21 b) Nanotechnology

- 22 • Understand sources, fate, transport, and exposure throughout the life-cycle of  
23 nanomaterials.
- 24 • Develop risk assessment and test methods.

25  
26 c) GEOSS / Advanced Monitoring Initiative

- 27 • Transition from pilot projects to focusing on user needs, capacity building, and  
28 communities of practice.
- 29 • Develop best practices guide to forecast air quality and inform decision making.

30  
31 d) Economics and Decision Sciences

- 32 • Develop risk assessment metrics that can be used for valuation purposes.
- 33 • Find ways to transfer air market mechanisms to other environmental issues.
- 34 • Advance computational tools to develop analytic models capable of evaluating  
35 policies on both micro- and macro-economic scales.

36  
37 f) Technology for Sustainability

- 38 • Develop sustainability metrics to include in EPA's Report on the Environment,  
39 inform design and production, and evaluate innovative technologies.
  - 40 • Provide decision support tools that address energy and environmental impacts,  
41 e.g., water and land use.
  - 42 • Promote collaborative partnerships.
- 43

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1 g) Ecosystems Protection

- 2 • Assess the benefits of ecosystem services to human well-being.  
3 • Understand how policy and management choices affect the type, quality, and  
4 magnitude of services we receive from ecosystems.  
5

6 h) Water Quality

- 7 • Support aquatic life guidelines and recreational water criteria, by studying the  
8 impact of stressors, including habitat alteration, nutrients, pathogens, and  
9 emerging contaminants.  
10 • Improve watershed management by applying diagnostic tools to assess  
11 impairment and guide mitigation efforts to manage both point and non-point  
12 sources.  
13

14 i) Drinking Water

- 15 • Develop sustainable source water protection approaches.  
16 • Assess exposure to contaminants from water storage and distribution systems.  
17 • Improve tools for characterizing and monitoring pathogens and biofilms, and  
18 develop methodologies for microbial risk assessment.  
19 • Develop methodologies to quantify the impacts of SDWA rule implementation  
20 on public health outcomes.  
21

22 j) Homeland Security

- 23 • Identify and validate methods to detect and quantify biological agents.  
24 • Develop a methodology to assess microbial risks and risk-based advisory levels.  
25 • Develop decontamination and disposal approaches for CBR agents in both large  
26 outdoor areas and in water infrastructure.  
27 • Improve the communication of risk and risk management options during a crisis.  
28

29 k) Clean Air

- 30 • Support the development and implementation of the NAAQS and other air  
31 quality regulations.  
32 • Develop a multi-pollutant “one atmosphere” approach, focusing on identifying  
33 specific source-to-health-outcome linkages, e.g., near roadway exposures.  
34 • Assess health and environmental improvements from past actions.  
35

36 l) Global Change

- 37 • Continue to prepare the Synthesis and Assessment Products mandated by the  
38 Global Change Research Act.  
39 • Refine the assessment of climate change on air quality in the U.S.  
40 • Characterize the potential impacts of global change on water quality and aquatic  
41 ecosystems.  
42  
43

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1 m) Human Health:

- 2 • Establish relationships between environmental decisions and changes in health  
3 indicators.  
4 • Focus on characterizing toxicity pathways for dose-response and extrapolation  
5 models for risk assessment.  
6

7 n) Computational Toxicology

- 8 • Provide predictive models for screening and testing of chemicals to improve  
9 source-to-outcome linkages.  
10 • Develop new approaches and technologies to better predict a chemical's hazard,  
11 and identify toxicity testing priorities.  
12 • Develop new systems biology models, such as the virtual liver.  
13

14 o) Endocrine Disruptors

- 15 • Complete development of protocols for EDC screening and testing assays.  
16 • Improve understanding of EDCs' mechanisms of action, dose response, and  
17 cumulative risk issues.  
18 • Develop exposure assessment and risk management tools to characterize and  
19 reduce exposure to EDCs.  
20

21 p) Human Health Risk Assessment

- 22 • Continue to support IRIS profiles, PPRTVs, and other priority assessments.  
23 • Develop methods, models, and guidance for improved health risk assessments.  
24 • Conduct integrated science assessments for ambient air pollutants.  
25

26 q) Safe Pesticides and Products

- 27 • Develop predictive tools for chemical prioritization and testing requirements,  
28 and enhanced interpretation of exposure and toxicity studies.  
29 • Develop mathematical models for integrating dose-response and habitat  
30 relationships for wildlife population and plant communities.  
31 • Develop approaches to assess allergenicity potential from GM crops and to  
32 assess the risks of gene flow from GM crops.  
33

34 a) Technology Research Comments

35  
36 For the purposes of these discussions between the SAB and ORD, the Technology  
37 Research Area includes: i) Land Preservation and Restoration, ii) Nanotechnology, and  
38 the iii) Global Earth Observation System of Systems/Advanced Monitoring Initiative  
39 (GEOSS/AMI). Each of these programs has attributes the SAB believes represent the  
40 evolution and revolution changes in the environmental arena. Research activities in the  
41 Land Preservation and Restoration Program have evolved from the traditional studies on  
42 hazardous waste treatment and management to Brownfields cleanup and revitalization.  
43 The Nanotechnology Research and GEOSS/AMI represent strategic research initiatives

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1 on, respectively, the implications of modern technology and on innovative uses of data to  
2 support EPA's mission.

- 3  
4 i) **Land Preservation & Restoration** research supports the research needs of RRA,  
5 CERCLA, and the Office of Solid Waste and Emergency Response (OSWER) on  
6 the detection, assessment, and evaluation of the effects on and risks to human  
7 health of hazardous substances in the environment. The purpose of the research  
8 program is to provide more cost-effective tools, models, and methods to support  
9 decisions on land restoration, materials management, and reuse/land revitalization  
10 (SAB, 2007a).

11  
12 The key directions of ORD's current research program in this area include  
13 (Teichman, 2007a):

- 14  
15 ♦ Development of sustainable planning criteria for land use plans, e.g.,  
16 Brownfields.  
17 ♦ Evaluation of alternative remediation technologies for contaminated sediments.  
18 ♦ *In situ* treatments and permeable reactive barriers for ground water protection,  
19 study of the operation of landfills as bioreactors, and assessment of asbestos  
20 risks.

21  
22 **SAB Comment:** The Agency's Land Preservation area has historically focused  
23 on cleanup activities associated with contaminated sites, uncontrolled releases,  
24 spills, and leaking underground tanks. More recently efforts have been made to  
25 include waste minimization activities, mostly through the Resource Conservation  
26 Challenge (RCC), a voluntary partnering program aimed at helping companies  
27 and institutions overcome barriers to implementing waste minimization programs.  
28 This is a potentially valuable program, but it needs to be systematically evaluated  
29 to assess its efficacy or to develop plans for improvement.

30  
31 The Board recognizes that there are emerging environmental research needs that  
32 fall within the purview of this technology area that should be explored.  
33 Generally, these research needs fall within the well-recognized field of Land Use  
34 and include, but are not limited to, measuring the environmental and economic  
35 benefits of Brownfields cleanup and revitalization, documenting the multiple  
36 environmental challenges associated with urban sprawl and the built environment,  
37 clarifying the complex relationship between agriculture, biofuels, and  
38 environmental protection, and improvements in the rigor of LCA for use in land  
39 use remediation and protection. The Board urges the EPA to examine more  
40 closely the complimentary nature of an expanded Land Use program and its  
41 nascent, but important, research program in Sustainability with a view toward  
42 recognizing opportunities for cross-disciplinary collaboration.  
43

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1 The EPA ETV and SITE programs are essential to moving technology to  
2 commercialization and have involved substantial leveraging of limited EPA  
3 funds. NACEPT and other studies view these evaluation activities as having high  
4 value to private environmental technology organizations.  
5

- 6 ii) **Nanotechnology Research** addresses the environmental protection challenge of  
7 ensuring "...that, as nanotechnology develops and engineered nanomaterials are  
8 manufactured and used, unintended consequences of exposures to humans and  
9 ecosystems are prevented or minimized. In addition, knowledge concerning how  
10 best to apply products of this emerging technology to detect, monitor, prevent,  
11 control, and clean up pollution is also needed." In this regard, EPA has developed  
12 a research portfolio by working with others including federal agencies, industry,  
13 academia, and non-governmental organizations to ensure research gaps are  
14 covered, critical issues are addressed, and information is communicated to all  
15 interested parties." (SAB, 2007a).  
16

17 The key directions of ORD's current research program in this area include  
18 (Teichman, 2007a):  
19

- 20 ◆ Understanding sources, fate, transport, and exposure throughout the life-cycle  
21 of nanomaterials.  
22 ◆ Developing risk assessment and test methods.  
23

24 **SAB Comment:** The Agency's Nanotechnology research program appears to be  
25 well integrated into the broader National Nanotechnology Initiative, a positive  
26 development, and has shown that it can reach out to the broader international  
27 community as well as the manufacturing companies themselves. The ORD  
28 program on nanomaterials has been formulated strategically, considering EPA  
29 needs and with an eye towards leveraging and potential future regulatory  
30 decisions. There is involvement with many external groups. EPA has given  
31 careful attention to building on areas of internal expertise such as fate and  
32 transport, ecological assessment, and small particle inhalation. The program  
33 integrates activities at the international, national, and cross-agency levels. An  
34 important, unaddressed challenge is the implication of mixtures and environmental  
35 transformations of nanomaterials and other contaminants.  
36

- 37 iii) **Global Earth Observation System of Systems/Advanced Monitoring**  
38 **Initiative.** EPA's GEOSS/AMI program grew from recognition that the goals of  
39 the US EPA's 2006-2011 strategic plan (US EPA, 2006a) and those of the GEOSS  
40 were mutually reinforcing. GEOSS envisions a future in which "...decisions and  
41 actions are informed by coordinated, comprehensive, and sustained Earth  
42 observations and information." GEOSS intends to integrate "...multiple Earth  
43 observation systems (networks, databases) and using computer modeling and

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1 decision support tools to help revolutionize our understanding of Earth's complex  
2 processes." EPA activity in this multi-agency program began with its participation  
3 in groups leading the effort to plan and support GEOSS and with its own  
4 Advanced Monitoring Initiative that is aimed at showing some major tangible  
5 results by September 2008. EPA's efforts involve 34 projects in four areas (Air  
6 Quality Forecasting/Assessment and Decision-making for Human Health;  
7 Coastal/Source Water Quality and Decision-making for Human Health; Integrated  
8 Air-Water-Land-Biota Decision-making for Healthy Communities and  
9 Ecosystems; and Information Technology/Information Management (SAB,  
10 2007a).

11  
12 The key directions of ORD's current research program in this area include  
13 (Teichman, 2007a):

- 14
- 15 ◆ Transition from pilot projects to focusing on user needs, capacity building, and
- 16 communities of practice.
- 17 ◆ Develop best practices guide to forecast air quality and inform decision
- 18 making.
- 19

20 **SAB Comment:** The GEOSS/AMI initiative is well-conceived and planned. It  
21 has a strong cross-media focus, especially for air and water, supports the goals of  
22 multiple MYPs, and has good cross-agency (e.g. NSF) connections. Some of the  
23 benefits of GEOSS are that it develops a technologically collaborative culture,  
24 creates an understanding of the need to plan for such collaboration, and, done  
25 right, it will work itself out of business. To accelerate and further the development  
26 of this technologically collaborative culture, the Agency should select a few high  
27 impact projects, such as the Chesapeake Bay and Mississippi River, for  
28 demonstration during the next phase of this program.

29  
30 At this early stage the Board supports GEOSS/AMI, but with two caveats:

- 31
- 32 ◆ There is a need to guard against moving toward a "data-rich/information poor"
- 33 state, and
- 34 ◆ Parallel concerns about the need for evaluating data quality and uncertainty
- 35 exist.
- 36

37 One potential application of GEOSS/AMI in relation to Homeland Security would  
38 be to organize the data from multiple labs from multiple samples from multiple  
39 field teams of the air, water, and land. However, without additional integration  
40 with economics and decision sciences, it would become just another store house of  
41 data, without much assessment. By adding the components of cost benefit  
42 analyses, compliance/ and participation behavior, it would be possible to  
43 determine if allowing the public back into an contaminated area, but restricting

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1 their exposure through protective actions such as interdiction of crops would be  
2 adequately protective of public health and would be publicly acceptable.

3  
4 As a specific example, there are a number of protective actions which have been  
5 discussed involving milk which had been contaminated with a short lived  
6 radionuclide. Would it be acceptable to use the milk to make cheese since the  
7 aging process would allow radioactive decay to take place? Could it be turned into  
8 powdered milk for consumption after 10 half-lives? What would the public's  
9 reaction to this milk be? By integrating economics and decision sciences with  
10 geo-mapped land use areas, it would be possible to make some better assumptions  
11 about public acceptance.

12  
13 Another specific example would be to allow people to return to their homes  
14 following an incident involving deposition of a hazardous substance in their  
15 neighborhood, but not allow them to consume vegetables from their backyard  
16 garden, and require them to wipe their pet's feet every time the pet enters the house  
17 after running around on the lawn. Would people comply with this direction?  
18

19 **b) Economics and Sustainability Research Areas**

20  
21 For the purposes of these discussions between the SAB and ORD, the Economics and  
22 Sustainability Research Area includes: i) Economics and Decision Sciences, and ii)  
23 Technology for Sustainability.

- 24  
25 i) **Economics and Decision Sciences.** This research program area is managed by  
26 the EPA National Center for Environmental Economics (NCEE) which plans the  
27 research component of its program in cooperation with the Office of Research and  
28 Development. This "...research is designed to improve our understanding of  
29 human and organizational environmental behavior and preferences, which is  
30 critical for improving EPA's decision-making, cost-benefit analyses, and  
31 implementation strategies."...This research program "...focuses on how people  
32 value their health and the environment; corporate and consumer environmental  
33 behavior; and market mechanisms and incentives (SAB, 2007a).

34  
35 The key directions of NCEE's current research program in this area, include  
36 (Teichman, 2007a):

- 37  
38 ♦ Developing risk assessment metrics that can be used for valuation purposes;  
39 ♦ Finding ways to transfer air market mechanisms to other environmental issues;  
40 and  
41 ♦ Developing advanced computational tools needed to support analytic models  
42 capable of evaluating policies on both micro- and macro-economic scales.  
43

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1           **SAB Comment:** The research plan for EDS follows closely the *Environmental*  
2           *Economics Research Strategy*. It identifies three major research areas (pp. 56-  
3           57):<sup>2</sup>  
4

- 5           ◆ health benefits valuation (both mortality and morbidity),
- 6           ◆ ecological benefits valuation, and
- 7           ◆ treatment of uncertainty.
- 8

9           It also proposes research in three additional areas: environmental justice, costs and  
10           benefits of climate change, and compliance/participation behavior.

11  
12           The health valuation research is designed to improve the estimation of costs and  
13           benefits of EPA actions, primarily for use in RIAs and related assessments. An  
14           extensive literature exists on the valuation of mortality risks (i.e., estimating the  
15           value of a statistical life (VSL)), and the proposed research appears to be aimed at  
16           refining those estimates to provide estimates that vary with factors such as income,  
17           age, and health status. While more information on this topic would clearly be  
18           valuable, before investing significant additional resources in VSL estimation by  
19           sub-group, the SAB urges the Agency to consider how the new information will be  
20           used in benefits assessment to ensure that the research results are policy-relevant.

21  
22           The SAB applauds the research direction related to ecological benefits valuation.  
23           Since this work requires extensive integration of ecological and economic analysis,  
24           the SAB urges the Agency to extend this research area to include participation  
25           from other program areas. Note that meaningful ecological benefits valuation  
26           requires more than applying an average value estimate (e.g., the “value of a  
27           hectare of wetlands”) to an estimate of environmental effect (e.g., hectares of  
28           wetlands preserved). Rather, it requires a meaningful assessment of the value of a  
29           policy-driven change in ecosystem services that reflects important bio-physical  
30           and socio-economic characteristics of the impacted ecosystem and population.  
31           Research in this area should build on results of the recent SAB project on valuing  
32           the Protection of ecological systems and services (CVPESS).

33  
34           The EDS strategy focuses almost exclusively on economics, particularly  
35           measuring costs and benefits, with little attention to other behavioral and decision  
36           science issues (other than the proposed work on compliance/participation in  
37           voluntary programs). Yet, behavior of firms and individuals drives environmental  
38           performance. This behavior is in response to policy-induced incentives, as well as  
39           cognitive and decision-making processes employed by individuals. The SAB

---

<sup>2</sup> Note that these three areas are not the same as the three “bullets” on the overview slides by Kevin Teichman. We did not feel that the bullets on the slide accurately captured the main components of the research strategy proposed for EDS.

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1           urges EPA to expand the EDS research strategy to include research focused on  
2           these issues. This could include work on the incentives and likely effectiveness of  
3           alternative policy approaches (evaluated relative to specific policy contexts),  
4           business management decisions, information processing, technology/product  
5           adoption (including consumer behavior), and risk and other communication  
6           strategies.

7  
8           As a practical example, with the growing emphasis on energy conservation, a  
9           market for compact fluorescent lamps (CFLs) has been stimulated. It is common  
10          to see CFLs in mass distribution markets, such as most major department stores.  
11          However, CFLs contain mercury which is released if the bulb is accidentally  
12          broken. It may be necessary to consider whether regulation is needed to require  
13          locations that sell CFLs to institute “take-back” programs. What incentives will  
14          inspire the public to return the bulbs rather than put them into the normal  
15          household waste stream?

16  
17          More generally, the EDS research strategy should be broadened to identify and  
18          include links with other program areas. The current strategy is defined more from  
19          a disciplinary than a problem-oriented perspective. For nearly all of the EDS  
20          research areas, closer interaction with other program areas would be fruitful.  
21          Specific examples include revitalization of contaminated lands (with land  
22          preservation), effectiveness of TMDLs (with water), and managing water quantity  
23          (with water and global change).

24  
25          Finally, the EDS research strategy seems to be driven to a large extent by short-  
26          term national assessment needs, most notably for RIAs. This is likely to become  
27          even more pronounced now that EDS has moved from ORD to the EPA National  
28          Center for Environmental Economics (NCEE) and its budget has been sharply  
29          reduced. The SAB urges the Agency to broaden its research agenda to contribute  
30          to improvements in other decision contexts (e.g., regional planning applications  
31          and site-specific decisions) and to look beyond the short-term in identifying  
32          research priorities.

- 33  
34          ii)    **Technology for Sustainability** research has emerged as the new emphasis for  
35          programs that originated at EPA under the concepts of pollution prevention in the  
36          early 1990’s. According to EPA, in this context, “sustainability” refers to  
37          “...meeting the needs of the present without compromising the ability of future  
38          generations to meet their own needs. From a public policy perspective,  
39          sustainability means meeting basic environmental, economic, and social needs  
40          now, and in the future, without undermining the natural systems upon which life  
41          depends.” Sustainability goes “...beyond traditional end-of-pipe control strategies  
42          and embraces system-based, long-term solutions.” Early efforts under Pollution  
43          Prevention and New Technologies aimed to provide “...tools and technologies that

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1 advanced the idea of environmental systems management while preventing and  
2 controlling pollution and reducing risks to human health and ecosystems  
3 originating from multiple economic sectors.  
4

5 Strategic directions for the STS research program begin with the notion that  
6 sustainability "...must combine interrelated ideas drawn from economic, social  
7 and environmental realms" – often thought of as the "Three Pillars of  
8 Sustainability." Given EPA's narrowly focused mission, the EPA STS research  
9 program is focused on environmental dimension of sustainability while  
10 recognizing that sustainable environmental outcomes are best achieved in a  
11 systems-based context." The resulting EPA research program is broader than  
12 normal "stove-piped media-focused programs to a focus that is multimedia and  
13 systems wide. EPA's sustainability research program has six themes: 1) Natural  
14 Resource Protection, 2) Non-renewable Resource Conservation; 3) Long-term  
15 Chemical and Biological Impacts; 4) Human-built Systems and Land Use; 5)  
16 Economics and Human Behavior; and 6) Information and Decision-making (SAB,  
17 2007a).  
18

19 **The key directions of ORD's current sustainability research program include**  
20 **(Teichman, 2007a):**  
21

- 22 ♦ Development of sustainability metrics for use in EPA's Report on the  
23 Environment, informing design and production, and evaluating innovative  
24 technologies.
- 25 ♦ Provide decision support tools to address energy and environmental impacts,  
26 e.g., water and land use.
- 27 ♦ Promote collaborative partnerships.  
28

29 **SAB Comment:** The ORD's research initiative in area of sustainability is an  
30 important and timely step forward. The SAB supports ORD's research efforts to  
31 develop metrics and tools to advance the Agency's ability to achieve protection of  
32 human health and the environment through sustainable practices. The SAB  
33 believes the "6 Themes of Environmental Sustainability" identified as the  
34 framework for this research are appropriate and important areas upon which to  
35 focus. Additionally, EPA's intent to work on sustainability metrics, decision  
36 support tools and innovative technologies expressed in the long-term goals  
37 statements seems to capture the broad categories of tools and techniques in which  
38 the agency should be working. That said the review team felt that the written  
39 description provided to the SAB on the intended research actions under the long-  
40 term goals did not clearly link to the 6 themes for sustainability. The agency  
41 representatives did note that their forthcoming research strategy document will  
42 show this linkage. A post meeting, inspection of the June 13' 2007 draft of the  
43 strategic research strategy draft contains a table (5.1) on page 43 which gives some

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1 indication of linkages between the 6 themes and the 3 long-term goals. A table  
2 such as this with some more details on research projects would have been helped  
3 to clarify these linkages in the information provided for this current discussion.  
4 The SAB looks forward to seeing those linkages further developed in the final  
5 Sustainability Research Strategy.  
6

7 In conclusion, the SAB suggests that the agency allow itself wide latitude in the  
8 way it approaches sustainability research since this new systems-based approach to  
9 environmental protection will require a fundamental departure from the current  
10 stove-pipe single-media based regulatory framework. The SAB recommends the  
11 following (expanded details for each of these recommendations are included in  
12 Appendix A of this Advisory).  
13

14 **Recommendations**  
15

- 16 ◆ Clearly define the intended audience(s)
- 17 ◆ Behavior and decision science research is needed
- 18 ◆ Establish (or clearly define) linkage to other Research areas and programs
- 19 ◆ Go beyond Technology – green chemistry and pollution prevention
- 20 ◆ LCA tools don't incorporate directly what matters to people so they can't  
21 incorporate value or benefits
- 22 ◆ Need for a clear definition of the sustainable condition or future state the  
23 agency desires to maintain or achieve.
- 24 ◆ Explore developing a bridge between risk and performance to achieve  
25 sustainability.  
26

27 **c) Ecosystems, Water and Security Research Areas**  
28

29 For the purposes of these discussions between the SAB and ORD, the Ecosystems, Water and  
30 Security Research Area includes: a) Ecosystem Protection, b) Water Quality, c) Drinking  
31 Water, and d) Homeland Security.  
32

- 33 i) **Ecosystem Protection.** The Ecological Research Program (ERP) is taking a new  
34 strategic direction that is intended to fill the need "... for better understanding the  
35 implications of human impacts on ecosystems and the resources they provide."  
36 This new program direction recognizes that even though, "The nation's health,  
37 security, economic potential, and much of its culture are directly and intimately  
38 tied to ecosystem characteristics and quality"[.] environmental policy "...decisions  
39 have failed to take these relationships into account." The redirected ERP intends  
40 to build on past research efforts in ecosystem monitoring, restoration, and  
41 functions, to develop operational methods to incorporate quantitative information  
42 on ecosystems services into decision making routines. Using internal resources,  
43 and a suite of unique partnerships with outside organizations (academia, NGOs,

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1 other governmental agencies, etc.), the ERP will conduct research designed to  
2 “...answer multiple questions about ecosystem services. ... and develop multiple  
3 measures of services, including biophysical and monetary measures, to estimate  
4 incremental changes to ecosystem services, as well as suites of ‘bundled’ services  
5 associated with land, air, and water systems over explicitly defined spatial and  
6 temporal scales.” The “...goal is to inform a wide range of issues related to  
7 questions of social choice, with a special focus on informing trade-offs among  
8 ecosystem services provided under alternative management and policy decisions.”  
9 ERP, through its own work and that of its partners, will create products in four  
10 categories: 1) measurements and dynamic maps of ecosystem services; 2)  
11 predictive models relating to the response of stressors; 3) tools for analysis of  
12 management options; and 4) decision support tools (SAB, 2007a). Approaches  
13 developed by ORD to monitor ecosystem conditions (e.g., Environmental  
14 Monitoring and Assessment Program-EMAP) will now be passed to the Program  
15 and Regional Offices to implement.

16  
17 The key directions of ORD’s current ecosystems research program, include  
18 (Teichman, 2007a):

- 19  
20 ◆ Assessing the benefits of ecosystem services to human well-being, and  
21 ◆ Understanding how policy and management choices affect the type, quality,  
22 and magnitude of services we receive from ecosystems.

23  
24 **SAB Comment:** The SAB noted the changes from the historically, diverse  
25 research program in this area to one that is refocused on ecosystem services. The  
26 SAB believes that ORD has a strong vision of where it is going in this area;  
27 however, that vision is not yet integrated across EPA Research and EPA Program  
28 Offices. Additionally, even though ORD has passed the tools developed in EMAP  
29 to the Program and Regional Offices for implementation, the SAB believes that  
30 there continues to be a need to link conditions to goals through and that there is a  
31 need for additional development of monitoring systems, especially for some of the  
32 contemplated trading systems that involve ecosystem services. Success in this  
33 research area will be enhanced if EPA adds expertise in economics to the program.  
34 Decision support tools are also critical to this program. ORD should invests in  
35 system support science more heavily in the future given that it will benefit  
36 Ecosystems Research as well as several other programs. ORD has a history of  
37 taking the outcomes from their research and helping to infuse those results into  
38 EPA practice. This will be very important for research on ecosystem services. An  
39 ecosystem services perspective will require staff with a holistic perspective and  
40 this perspective must be communicated to user communities. This new focus will  
41 also require support of the STAR grants program to be successful. The  
42 opportunity to think at the strategic level instead of just focusing on the “issue of

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1 the week” is important to getting these new programs on a strong footing.  
2 Integrating across diverse scales is important.

3  
4 Several National Program areas have responsibilities for water-related research  
5 areas, including Water Quality, Drinking Water, Ecosystems, Global Change, and  
6 Sustainability. While there are structures in place to encourage and facilitate  
7 interactions among the research programs and the program offices, these  
8 arrangements are not always effective in communicating when ORD’s effort is to  
9 end and OW’s effort is to begin.

10  
11 The Office of Research and Development recognizes the importance of  
12 establishing research partners in the broader research community to accomplish its  
13 challenging goals. However, it is disappointing that the ERP-STAR program will  
14 not continue to be vehicle for collaboration with universities due to budget cuts.  
15 The SAB believes that this is a strategic error.

16  
17 The ERP description reports that the EMAP program (a status and trend program)  
18 has been transferred to the Water Quality Program for technical support and to the  
19 Program Offices for survey monitoring and assessment. In light of the SAB’s  
20 criticism of the Report on the Environment 2007 for not including long-term trend  
21 information and little trend analysis for indicators questions arises in my mind 1)  
22 does the Water Quality Program have the capability to provide technical assistance  
23 needed, 2) and do the Program Offices have the capability to implement the survey  
24 monitoring and assessment need to generate indicator trend data and analysis for  
25 future Reports on the Environment.

26  
27 *[At the Board’s Request ORD has Commented Regarding Advice on its*  
28 *Ecosystems Research Program:*

29 *The report states that the ecosystems research needs to be better integrated into*  
30 *the work of the PEA program Offices and that a shared vision has yet to emerge.*  
31 *The SAB proposes that an entity be identified to facilitate the integration and to*  
32 *help shape the outcomes of ths research program. ORD does not dispute the*  
33 *need for stronger ties between the ecosystem research program and our*  
34 *colleagues iin the Program Offices. While we appreciate the SAB’s willingness*  
35 *to become an active facilitator for this effort, we believe that this function is*  
36 *better managed internally within EPA. One of the NPD’s functions is to ensure*  
37 *good ORD/Program Office coordination. ORD believes it is best to rely on the*  
38 *Eco NPD to ensure that the ecosystems research program is better integrated*  
39 *into the work of the Program Offices.*

40  
41 *The SAB states that several research areas have responsibilities for water-*  
42 *related research, including Water Quality, Drinking Water, Ecosytemes, Global*  
43 *Change, and Sustainability. ORD recognizes that there are overlapping*  
44 *responsibility areas between multi-year plans. ORD has mechanisms in place to*

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1 *encourage and facilitate interactions among the research programs to ensure*  
2 *that research activities are coordinated. In addition, ORD is undertaking a*  
3 *review of its multi-year plan categories, and is considering options for merging*  
4 *some plans. One objective in merging the plans is to address the concerns raised*  
5 *by the SAB. The SAB may want to share in its report its thoughts on this effort*  
6 *and its contribution to mitigating their concern about program overlap.]*  
7

- 8 ii) **Water Quality** research supports EPA's Office of Water and Regional Offices in  
9 implementation of the Clean Water Act (CWA). The restructured water quality  
10 research program (WQRP) consolidates past work done under a separate goal into  
11 three remaining goals that focus on: 1) **Water Quality Integrity Research** - research  
12 in support of aquatic life guideline revisions, recreational water criteria, emerging  
13 contaminants, nutrients, biocriteria, stream biota, and biological condition  
14 gradients for Tiered Aquatic Life Uses; 2) **Watershed Management Research** -  
15 research in support of Total Maximum daily Load allocation processes; and 3)  
16 **Infrastructure Research** - research on innovative solutions to manage the nation's  
17 aging water and wastewater infrastructure (SAB, 2007a).  
18

19 The key directions of ORD's current research program in this area, include  
20 (Teichman, 2007a):  
21

- 22 ◆ Supporting development of aquatic life guidelines and recreational water  
23 criteria, by studying the impact of stressors, including habitat alteration,  
24 nutrients, pathogens, and emerging contaminants.  
25 ◆ Improving watershed management by applying diagnostic tools to assess  
26 impairment and guide mitigation efforts to manage both point and non-point  
27 sources.  
28

29 **SAB Comments:** The SAB believes that EPA must begin to actively integrate its  
30 research and programs for water quality and drinking water. A holistic "Clean  
31 Water" program should be pursued analogous to the way in which research is now  
32 pursued as a "one atmosphere" concept in the air medium. More work is needed  
33 in watershed management, infrastructure, and integrated criteria development  
34 (across biological, chemical and physical criteria). Research is also needed on  
35 modeling, monitoring, and measurement to support water quality decision making.  
36 Climate change, and the relationship of water quality to land use practices, must be  
37 incorporated through out this research area.  
38

- 39 iii) **Drinking Water** research is "...an applied research program designed to develop  
40 new scientific data, models, innovative methods, and cost-effective technologies  
41 for characterizing and managing the quality and sustainability of drinking water  
42 resources in support of EPA's goal of 'Clean and Safe Water.'" "The Drinking  
43 Water Research Program (DWRP) is moving towards an integrated framework for

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1 addressing drinking water issues in the context of the water cycle.” Major themes  
2 in the DWRP are in the areas of 1) Assessment Tools; 2) Source Water/Water  
3 Resources; 3) Treatment/Residuals; 4) Distribution/Storage/Infrastructure; and 5)  
4 Water Use/Health Outcomes. Increased emphasis is being placed on source water  
5 protection and sustainability; water distribution/storage systems/infra-structure;  
6 microbial risk associated with pathogen exposure; and health outcomes” (SAB,  
7 2007a).

8  
9 The key directions of ORD’s current research program in this area, include (ORD,  
10 2007a):

- 11 ♦ Develop sustainable source water protection approaches.
- 12 ♦ Assess exposure to contaminants from water storage and distribution systems.
- 13 ♦ Improve tools for characterizing and monitoring pathogens and biofilms, and
- 14 develop methodologies for microbial risk assessment.
- 15 ♦ Develop methodologies to quantify the impacts of SDWA rule implementation
- 16 on public health outcomes.
- 17
- 18
- 19

20 *[At the Board’s Request ORD has Commented Regarding Advice on its Drinking*  
21 *Water Research Program: The SAB noted that for Drinking Water Research*  
22 *“most attention is on total coliform and CCL research with groundwater source*  
23 *protection getting some attention. More attention is needed for surface source*  
24 *water protection and distribution systems.” The SAB may have gotten the*  
25 *incorrect impression that most of the attention is on TCR and CCL because of*  
26 *comments made by the NPD at the strategic directions meeting when she*  
27 *explained that t the regulatory drivers for the research program are TCR, CCL,*  
28 *and UIC – this was not to imply that most of the research attention is on TCR and*  
29 *CCL. The Drinking Water Reserch Program has substantively increased emphasis*  
30 *on source water protection and distribution systems (e.g., a recent initiative on*  
31 *infrastructure). ORD suggests tht this section be reframed as follows: “Members*  
32 *noted that the regulatory drivers for Drinking Water Research are the revision of*  
33 *the total coliform rule (and potential distribution system rule), CCL3, and the*  
34 *proposed rule for geologic sequestration under the UIC program. Research on*  
35 *protection of surface water soruces of drinking water is at the intersection of*  
36 *SDWA and CWA. More attention is needed on both surface source water*  
37 *protection and distribution systems. Again, the One Hydrosphere approach is*  
38 *suggested for EPA to use in integrating its research on a variety of water issues.]*  
39

40 **SAB Comment:** Members noted that for Drinking Water Research most attention  
41 is on total coliform and CCL research with groundwater source protection getting  
42 some attention. It is understood that these priorities are driven by the regulatory  
43 drivers of the Total Coliform Rule, the Candidate Contaminant List (CCL), and  
44 Underground Injection Control (UIC, geologic carbon sequestration). While the

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1 regulatory drivers are important, the future sstrategic direction should focus on the  
2 most important risks which could be non-regulatory. A watershed focus may  
3 provide the greatest opportunity for pubic health protection via prevention. More  
4 attention is needed for surface source water protection and distribution systems.  
5 Again, the “One Hydrosphere” approach is suggested for EPA use in integrating  
6 its research on a variety of water issues.

- 7  
8 iv) **Homeland Security** responsibilities of EPA include: 1) the protection of water  
9 systems in general and for detecting and recovering from terrorist attacks affecting  
10 water systems; 2) decontaminating buildings and outdoor areas impacted by a  
11 terrorist attack; and 3) developing a nationwide laboratory network to support  
12 routine monitoring and response requirements. The EPA Homeland Security  
13 Research Program “...is currently conducting a year-long exercise to align the  
14 program more closely with these responsibilities. The original Homeland Security  
15 Research Program covered broad emergency response issues; however, the  
16 realigned research program will focus primarily on terrorist attacks. Even so,  
17 “...the program will continue to nurture research collaborations with the broader  
18 scientific community, seeking supplemental expertise, fostering valuable  
19 collaborations and leveraging of additional resources. In addition, although  
20 research products will be planned to meet the needs of Agency customers, ORD  
21 will conduct research that benefits multiple EPA programs and other Federal  
22 agencies as much as possible.” Goals focus on developing 1) “...products and  
23 expertise to improve protection from and the capability to respond to terrorist  
24 attacks on the nation’s water and wastewater infrastructure” and 2) “...products  
25 and expertise to improve the capability to respond to terrorist attacks affecting  
26 buildings and the outdoor environment.” Behavioral research program  
27 requirements are still being explored in a white paper being developed by EPA on  
28 homeland security-related research needs in the behavioral sciences (e.g., risk  
29 communication and perception during crises) (SAB, 2007a).

30  
31 The key directions of ORD’s current homeland security research include  
32 (Teichman, 2007a):

- 33  
34 ♦ Identifying and validating methods to detect and quantify biological agents.  
35 ♦ Developing a methodology to assess microbial risks and risk-based advisory  
36 levels.  
37 ♦ Developing decontamination and disposal approaches for CBR agents in both  
38 large outdoor areas and in water infrastructure.  
39 ♦ Improving the communication of risk and risk management options during a  
40 crisis.

41  
42 **SAB Comment:** The SAB recognizes that the Homeland Security Research  
43 program began in a crisis mode and focused on getting as much as possible as

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1 quickly as possible. The need now is to become more strategic and to define  
2 program boundaries so that this strategic focus has a goal. Even though the  
3 strategic directions state the intent to focus only on terrorism, EPA must think  
4 beyond terrorism and conduct research to enhance responses to natural disasters.  
5 EPA also needs to think about how to increase collaborative research with other  
6 agencies and other stakeholders as well as to obtain more collaboration within  
7 EPA. A cross-cutting issue is the need to coordinate with others to better define  
8 EPA's niche in the response area and how that influences research needs.  
9 Important research areas identified include: risk communications; detection  
10 methods for contamination, decontamination, disposal and outdoor exposure.  
11 Issues such as determining "how much clean up is necessary" have social research  
12 needs beyond communications.

13  
14 EPA should ensure that it integrates the work and lessons learned from others,  
15 including:

- 16 ♦ Other countries (UK, Canada, Australia)
- 17 ♦ Other federal agencies (DoD, USDA, CDC, DHS, DOE),
- 18 ♦ Multiple EPA offices (ORD, OW; other multi-year plans),
- 19 ♦ The States, and
- 20 ♦ Involves new areas/opportunities with new resources.

21  
22  
23 *[At the Board's Request ORD has Commented Regarding Advice on its*  
24 *Homeland Security Research Program:: The SAB writes n the Homeland*  
25 *Security section tht "There is an appearance that the Program and the NHSRC*  
26 *are doing same or similar work. EPA needs to clarify how work of the two*  
27 *organizations work together and not in duplication." The NHSRC is*  
28 *responsible for planning and implementing EPA's Homeland Security*  
29 *Research Program, and the program and regional offices use ORD products in*  
30 *their operations. For example, ORD has developed over 80 provisionary*  
31 *advisory levels (PAL) for selected toxic industrial chemicals and warfare*  
32 *agents for acute, short-term, and chronic exposure conditions. We suggest that*  
33 *the SAB delete or expand upon and clarify this comment.]*

34  
35 **d) Air and Global Change Research Areas**

36  
37 For the purposes of these discussions between the SAB and ORD, the Air and Global Change  
38 Research Area includes: a) Clean Air, and Global Change.

- 39  
40 i) **Clean Air Research** provides research results needed to develop and implement  
41 the National Ambient Air Quality Standards (NAAQS) – primarily particulate  
42 matter (PM) and ozone as high risk pollutants. Secondly it also provides  
43 research for Hazardous Air Pollutant (HAP) management. Clean Air Research

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1 (CAR) has been restructured over the last several years into an integrated program  
2 in contrast to the previous research program that focused on individual pollutants.  
3 Ultimately the research program will provide information that allows EPA to adopt  
4 a multi-pollutant program that will lead to targeted control of emissions products  
5 that most affect human health. Long-term goals for the CAR fall into five  
6 thematic areas.

- 7
- 8 ♦ Theme 1 supports the development of NAAQS and other air quality  
9 regulations;
- 10 ♦ Theme 2 supports implementation of air pollution regulations;
- 11 ♦ Theme 3 develops a multi-pollutant approach to research;
- 12 ♦ Theme 4 identifies specific source-to-health linkages using ‘near roadway’  
13 as the prototype; and
- 14 ♦ Theme 5 assesses health and environmental improvements due to past  
15 regulatory actions (SAB, 2007a).
- 16

17 The key directions of ORD’s current research program in this area, include  
18 (Teichman, 2007a):

- 19
- 20 ♦ Support the development and implementation of the NAAQS and other air  
21 quality regulations.
- 22 ♦ Develop a multi-pollutant “one atmosphere” approach, focusing on  
23 identifying specific source-to-health-outcome linkages, e.g., near  
24 roadway exposures.
- 25 ♦ Assess health and environmental improvements from past actions
- 26

27 **SAB Comment:** As noted above, the Clean Air Research Program identified three  
28 key directions for their research agenda. The SAB agrees that all of these meet the  
29 criteria of being high priority research areas and are particularly supportive of the  
30 more holistic systems approach that the “one atmosphere” concept encompasses.  
31 In addition, we believe it is also important for ORD to maintain a robust research  
32 program on air toxics, and on air quality in indoor environments, which are critical  
33 for human exposure. In addition to these current focus areas, the SAB agrees that  
34 research on interactions of global change and air quality is an important new  
35 priority for both the Clean Air and Global Change programs. Further, the SAB  
36 believes significant societal benefits would result from increased research on the  
37 global mass balance of mercury and its fate and transport. Research to develop  
38 and assess alternative policy approaches (e.g., marketable permit systems for  
39 multimedia pollutants, effectiveness of various types of voluntary instruments,  
40 etc.) would also yield high social returns.

- 41
- 42 ii) **Global Change research at EPA is a part of the interagency U.S. Climate**  
43 **Change Science Program (CCSP) mandated by the Global Change Research Act**

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1 of 1990. "The primary focus of ORD's Global Program is on the assessment of  
2 the potential consequences of global change (particularly climate variability and  
3 change) on air quality, water quality/aquatic ecosystems, and human health.  
4 Results of the program's assessments are used to investigate adaptation options  
5 that improve society's ability to effectively respond to the risks and opportunities  
6 presented by global change. The program emphasis is shifting toward developing  
7 decision support tools to help managers consider global change during the decision  
8 making process (SAB, 2007a).  
9

10 The key directions of ORD's current research program in this area, include  
11 (Teichman, 2007a):  
12

- 13 ♦ Continue to prepare the Synthesis and Assessment Products mandated by the  
14 Global Change Research Act.
- 15 ♦ Refine the assessment of climate change *on* air quality in the U.S.
- 16 ♦ Characterize the potential impacts of global change on water quality and  
17 aquatic ecosystems.  
18

19 **SAB Comment:** The first key direction is largely driven by regulatory  
20 requirements whereas the second two areas are more anticipatory in nature. There  
21 seems to be very strong collaboration between the global change program and  
22 other research areas such as the water quality research, ecosystems protection, and  
23 clean air. There also appears to be a very healthy view concerning coordination of  
24 research efforts with other agencies. One area that could yield high returns from a  
25 focused research program is the development of guidance concerning mitigation  
26 and adaptation strategies, particularly with respect to the additional environmental  
27 benefits (or costs) these strategies might have (e.g., a practice that sequesters  
28 carbon in agricultural soils might also generate increase nutrient runoff). A second  
29 key direction of high importance is research on the design and development of  
30 policy instruments to implement greenhouse gas reductions cost-effectively.  
31

32 Relative to reducing the nation's greenhouse gas emissions, Carbon Capture and  
33 Sequestration (CCS) is thought to be mandatory for the use of coal in the future.  
34 CCS is a major research area in which EPA will likely be involved in regulating  
35 and permitting carbon dioxide geological sequestration, but also in encouraging  
36 and leading research and demonstration efforts (especially in view of the recent  
37 cancellation of the Future-Gen project, the only major CCS demonstration project  
38 in the country to date). At the present time, EPA has taken a rather narrow view of  
39 its charge in this area to be limited to protection of groundwater quality under the  
40 Clean Water Act. SAB recommends that ORD begin partnering with DOE to  
41 provide risk assessments, encourage demonstration projects, and estimate  
42 leakages to the atmosphere. This should be a high national priority and EPA  
43 should play a prominent role."

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1  
2 **e) Human Health Area**  
3

4 For the purposes of these discussions between the SAB and ORD, the Human Health  
5 Research Area includes: a) Human Health, b) Computational Toxicology, c) Endocrine  
6 Disruptors, d) Human Health Risk Assessment, and the e) Safe Pesticides and Safe Products.  
7

8 *[At the Board's Request ORD has Commented Regarding Advice on its Human*  
9 *Health Research Program: The grouping of research areas for review presents a*  
10 *challenge. For example, both the SP2 and EDC programs have ecological as well*  
11 *as human health components. During the February 28 meeting, ORD will present*  
12 *a new framework for ORD research that may be useful in future SAB reviews.]*  
13

- 14 **i) SAB General comments on Human Health.** Research directed at human health  
15 impacts should encompass a broad perspective to include public health  
16 approaches, exposure assessment, and epidemiology. Potential gene-environment  
17 interactions, including lifestyle, the built environment, diet, drug, and other  
18 xenobiotic exposures, should be included in assessment of human health  
19 endpoints. This will require adequate numbers of individuals trained in  
20 epidemiology and public health.  
21

22 A critical evaluation of how new toxicological testing paradigms, including in  
23 vitro and in vivo approaches, can support risk assessment and ultimately risk based  
24 decision-making should be conducted within the next five years. This dialogue  
25 should include industry, NGOs, the public, and international groups in making this  
26 evaluation.  
27

28 The Agency has put forward an impressive array of research objectives to support  
29 long term needs in human health assessment, including an increased emphasis on  
30 research to support the new toxicity testing paradigm. The SAB notes that there  
31 are some important areas of research that were not included in the materials  
32 received by the Board for its October 2007 meeting. Still, the research portfolio  
33 presented had few items where efforts may be decreased, and these were already  
34 noted by the agency. Therefore the additional research areas identified below and  
35 discussed in Appendix A would ideally be accomplished with the infusion of  
36 funding. Only one long term goal was identified as an objective that could be de-  
37 emphasized. The Board did not have enough time to make any firm  
38 recommendations on prioritizing this research.  
39

40 The following outlines important areas of research that could be given increased  
41 emphasis in the general research area of human health, and then briefly comments  
42 on research by individual groups or laboratories as described in the October 2  
43 presentation by Dr. Kevin Teichman.

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- ◆ Research to Support Toxicity Testing Paradigm Shift. These include:
  - Predicting metabolism
  - Addressing exposure duration-
  - Addressing novel agents
  - Epidemiologic surveillance
- ◆ Research to Develop Numerical (IRIS) Guidance Levels for Chemicals with Limited Apical Endpoint Test Data.
- ◆ Evolving Agency Hazard Identification and Dose Response Practice and Guidance as New Test Data Emerge.
- ◆ Epidemiological Research: Surveillance, Understanding Gene-Lifestyle-Environment Interactions.

ii) **Human Health** research provides fundamental information to improve our understanding of and to predict levels of human health effects associated with environmental agents that are managed through a variety of statutory mandates. Research themes in the HHRP focus on: 1) developing data, methods and models for risk assessment; 2) research to characterize aggregate and cumulative risk; 3) research on susceptible subpopulations; and 4) research to evaluate the public health impact of environmental decisions. Historically, Human health research has th biological mechanism of toxicity, cumulative effects associated with exposures, understanding susceptible subpopulations, the internal factors associated with vulnerability, life stages in relation to vulnerability, and the evaluation of public health outcomes. A recent NAS report (NAS, 2007) has made it clear that additional emphasis is needed on the development of new ways to characterize and predict toxicity. In addition, EPA’s desire to continue to improve its “Report on the Environment” requires research for evaluating the effectiveness of decisions targeting public health (SAB, 2007a).

The key directions of ORD’s current research program in this area, include (Teichman, 2007a):

- ◆ Establish relationships between environmental decisions and changes in health indicators.
- ◆ Focus on characterizing toxicity pathways for dose-response and extrapolation models for risk assessment.

**SAB Comment:** Long term research focused on both of the key research directions is needed but should not sacrifice critical research efforts addressing sensitive populations and understanding their vulnerability. The main goals for the new initiative in toxicity testing approach are expected to achieve results in the 10 to 20 year time frame. Nearer term, research outputs are needed to support

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1 program office needs in cumulative and aggregate risk assessment, and support  
2 characterizations of human susceptibility and variability to develop more scientific  
3 approaches for modeling dose response relationships. Also, methods are needed to  
4 take existing test data to the next step to enable better predictions especially for  
5 chemicals with non-apical endpoint data or limited data sets, as discussed in  
6 Appendix A. Community level risk assessment can better direct regulatory focus  
7 and depending on the nature of the assessment tool provide a conduit for  
8 stakeholder involvement in decision-making. There is an increasing need for tools  
9 that can be used by communities. On the ground for particular problems,  
10 collaborations between an EPA Region and local authorities in both risk  
11 assessment and risk management aspects can be important, but on a research level  
12 tools developed by agency would help facilitate efforts in the field.

13  
14 To the extent that the program is continuing to support methods to characterize  
15 variability, susceptibility and cumulative risk, it should be explicitly noted for  
16 transparency and clarity, both internally in organizing efforts and for external  
17 evaluations. It is not clear whether the repackaging of the research portfolio  
18 presented by the Agency, actually, represents a shift in program focus away from  
19 some of the critical nearer term objectives.

- 20  
21 iii) **Computational Toxicology** research develops enhanced tools for prioritization of  
22 hazards, and improved methods for quantitative risk assessment. Traditional  
23 methods can not keep pace with the current demands for hazard and risk  
24 evaluations, thus methods employing modern tools of molecular biology,  
25 information management, and computational models are being developed to  
26 identify, characterize hazard and risk quicker, cheaper and in a more scientifically  
27 robust way. Objectives of the program are to improve our understanding of the  
28 link between chemical sources and adverse health outcomes; to provide predictive  
29 models for screening and testing; and to improve quantitative risk assessment by  
30 providing a better understanding of basic mechanisms and their underlying biology  
31 (SAB, 2007a).

32  
33 The key directions of ORD's current research program in this area include  
34 (Teichman, 2007a):

- 35  
36 ♦ Provide predictive models for screening and testing of chemicals to improve  
37 source-to-outcome linkages.  
38 ♦ Develop new approaches and technologies to better predict a chemical's  
39 hazard, and identify toxicity testing priorities.  
40 ♦ Develop new systems biology models, such as the virtual liver.

41  
42 **SAB Comment:** The Board believes that this program continues to be headed in  
43 the right direction. The objectives of providing predictive models for screening

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1 and testing chemicals, developing new approaches and technologies for predicting  
2 chemical hazard and testing priorities and developing new systems biology models  
3 such as the virtual liver are reasonable objectives to advance toxicity testing and  
4 predictive biology within the agency. Ultimately, a large research effort will be  
5 needed to fully realize the NAS toxicity testing vision so that the testing strategy  
6 can serve as the basis for most agency assessments. This can not be accomplished  
7 by elements reflected in the current research strategy. The Computational  
8 Toxicology Research Program is taking the first steps to build capacity and  
9 collaborations and to lay down initial work for proof of concept. The Board heard  
10 about the Agency's efforts to ensure that data supporting the work of the Program  
11 was publicly available on-line and the SAB compliments the Program for  
12 overcoming the obstacles to make this happen.

- 13  
14 iv) **Endocrine Disruptors** research improves our understanding of chemicals that  
15 interact with the endocrine system. Research has been conducted to: 1) develop  
16 methods, models and measures for understanding and managing risks from  
17 endocrine disrupting chemicals (EDCs); 2) apply these methods to determine the  
18 extent of endocrine disruptor impacts to humans and wildlife; and 3) support the  
19 EPA screening and testing program on EDCs mandated by the Food Quality  
20 Protection Act and the Safe Drinking Water Act Amendments. Over the last five  
21 years, the program has increased its emphasis on research to characterize sources  
22 and occurrences of EDCs (SAB, 2007a).

23  
24 The key directions of ORD's current research program in this area, include  
25 (Teichman, 2007a):

- 26  
27 ♦ Complete development of protocols for EDC screening and testing assays.  
28 ♦ Improve understanding of EDCs' mechanisms of action, dose response, and  
29 cumulative risk issues.  
30 ♦ Develop exposure assessment and risk management tools to characterize and  
31 reduce exposure to EDCs.

32  
33 **SAB Comment:** This program has been focused on completing the screening and  
34 testing assays, and is well along in this effort. The SAB agrees with the phase  
35 down for Tier I test development and suggests a greater attention to support hazard  
36 identification and explore how dose response can be characterized based on less  
37 than ideal data sets. The SAB also suggests exploring methods for estrogen and  
38 androgen compounds considering "background" exposures and exploring  
39 cumulative risk assessment approaches given background levels. The Agency  
40 might explore developing TEF approaches for several classes of compounds.

- 41  
42 v) **Human Health Risk Assessment.** This research program is at the forefront of  
43 applying quantitative methods advances to risk assessments (e.g., use of PBPK

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1 models to reduce uncertainty in risk extrapolations or to replace default uncertainty  
2 factors). The program maintains its leadership role in incorporating mode of  
3 action evaluations to support decision-making. Products of the program include  
4 IRIS assessments, Integrated Science Assessments (ISAs), and other assessments  
5 that respond directly to Program Office needs and are primary considerations in  
6 Agency actions to protect human health and the environment. HHRA also  
7 incorporates contemporary science advances into agency practice to improve risk  
8 assessment methods, models, and guidance for other EPA offices (SAB, 2007a).  
9

10 The key directions of ORD's current research program in this area, include  
11 (Teichman, 2007a):  
12

- 13 ♦ Continue to support IRIS profiles, PPRTVs, and other priority assessments.
- 14 ♦ Develop methods, models, and guidance for improved health risk assessments.
- 15 ♦ Conduct integrated science assessments for ambient air pollutants.

16  
17 **SAB Comment:** The SAB recognizes that this as one of EPA's "bread and  
18 butter" research programs. The Board supports the three objectives in this  
19 research area and notes that there is an opportunity for developing and  
20 incorporating new approaches for sparse data sets to expand the capacity to  
21 develop guidance values. Staff in this research program should therefore  
22 collaborate closely with those in the Human Health Research program in these  
23 efforts. In addition, to have better assurance that sensitive populations are  
24 adequately addressed, collaboration between these programs is also needed to  
25 develop a better understanding of how to approach the use of variability  
26 assumptions in risk assessment. EPA should also consider better integration of  
27 HHRA with its Endocrine Disruptor Program to develop RfDs for chemicals with  
28 less than optimal data sets.  
29

30 The Board notes its concern with delays and challenges posed by OMB reviews.  
31 The SAB encourages the EPA to make use of suggestions provided in the recent  
32 NAS document (NAS 2008) on reviewing research efficiencies to improve their  
33 ability to work with OMB in a more efficient manner. The Board's sense is that  
34 OMB has a very limited scientific review capacity and EPA needs to find  
35 improved ways of addressing these delays. One way is to work with OMB to  
36 develop a sufficient level of comfort so that OMB will increasingly rely on EPA's  
37 own document review processes.  
38

- 39 vi) **Safe Pesticides and Products** research supports the problem-driven science needs  
40 of EPA's Pesticides and Toxic Substances programs. Safe Pesticides and Safe  
41 Products research tends to focus on high priority science needs that are not  
42 addressed by other research programs and work on both human health issues and  
43 ecological issues. The program's long-term goals focus on: 1) developing

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1 methods, models and data as the scientific foundation for prioritizing test  
2 requirements, enhancing data interpretation, and improving decision-making; 2)  
3 developing probabilistic risk assessments focused on natural populations of birds,  
4 fish, other wildlife, and plants; and 3) conducting research to provide the scientific  
5 foundations for decision-making on biotechnology products (SAB, 2007a).

6  
7 The key directions of ORD's current research program in this area, include  
8 (Teichman, 2007a):  
9

- 10 ♦ Develop predictive tools for chemical prioritization and testing requirements,  
11 and enhanced interpretation of exposure and toxicity studies.
- 12 ♦ Develop mathematical models for integrating dose-response and habitat  
13 relationships for wildlife population and plant communities.
- 14 ♦ Develop approaches to assess allergenicity potential from GM crops and to  
15 assess the risks of gene flow from GM crops.

16  
17 **SAB Comment:** The SAB believes that this research area has reasonable  
18 objectives. However, there is a need for greater emphasis on toxicity tools to  
19 enable migration to safer products based on human, as well as ecological systems  
20 health protection.

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1  
2 **APPENDIX A: DETAILED RECOMMENDATIONS**  
3

4 **1. Detailed Recommendations Technology for Sustainability Research Program (See**  
5 **Report Part 6 number 2 b, Page 27)**  
6

7 **a) Clearly define the intended audience(s):** It appeared to the review team that the  
8 ultimate objective of this research is to develop improved information, tools and  
9 approaches that will lead to changes in behavior. The intended audience or audiences  
10 (e.g., Agency, firms, and individuals) from which such behavior change is expected is not  
11 clear and needs to be more explicit. For example, who are EPA’s “clients” as mentioned  
12 in paragraph 5 under section “Making a Difference”?  
13

14 **b) Behavior and decision science research is needed:** The concept of sustainable  
15 development has an implicit element of people or organizations making decisions that  
16 lead to behaving in a manor such that their actions do not diminish environmental  
17 conditions resulting in either current impacts to human health or the environment nor  
18 reduce opportunities for use of that environment by future generations. Therefore, the  
19 area of behavioral and decision sciences should play an important role in helping EPA  
20 develop tools and information to aid such sustainable practice by individuals and  
21 organizations. The current research strategy does not reflect a focus on behavioral or  
22 decision science and the designers should revisit this area for research opportunities.  
23 Although the agency is planning to work on decision support tools such as life-cycle  
24 assessment (LCA) this is not the same as research on how and why people or  
25 organizations make decisions with regard to sustainability. Such behavioral research  
26 should not only address whether behavior is elicited but also if once elicited it is leads to  
27 positive improvements.  
28

29 **c) Establish (or clearly define) linkage to other Research areas and programs:**  
30 Sustainability as a research area is truly cross-cutting at it core. Although the research  
31 strategy overview provided to the SAB indicates a degree of cross linkage in planning  
32 with other ORD areas, the SAB recommends a systematic and thorough planning effort  
33 that cross-links sustainability research with other programs. Examples of opportunities  
34 for such cross planning include:

- 35 • Revitalization of contaminated lands (economics and Land restoration)
  - 36 • Effectiveness of TMDLs (economics and water)
  - 37 • Managing water quantity (water-Global change- sustainability)
- 38

39 In addition, the agency should be taking a fresh page on this research. Don’t just  
40 repackage former areas such as “land preservation” go beyond land contamination to  
41 management to avoid reduction in ecological services and or other human health services  
42

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1 **d) Go beyond Technology – green chemistry and pollution prevention:** E.g. Research  
2 on Smart growth; sustainable cities I am not sure what we want to say on this topic so  
3 appreciate if others could add their thoughts  
4

5 **e) LCA tools don't incorporate directly what matters to people so they can't**  
6 **incorporate value or benefits.**  
7

8 The review team also supports EPA's move towards taking a "systems" approach to  
9 environmental management. To this we note ORD's interest in focusing on tools based  
10 on LCA techniques. The review group cautions that the typical system boundaries and  
11 the inputs and out-puts of such analysis do not include any consideration of the benefits  
12 or the costs associated with the process or system under review. LCA as currently  
13 practiced is an excellent planning and design aid to manage raw material consumption,  
14 energy, hazard and waste production but it should not be relied on for integrated  
15 management decisions or balancing trade-offs among benefits without further  
16 development. It would be exciting and important if the agency can identify opportunities  
17 to integrate or couple LCA, and similar tools, with economic or valuation techniques.  
18

19 **f) Need for a clear definition of the sustainable condition or future state the agency**  
20 **desires to maintain or achieve.** Sustainability, or its stated operational objective,  
21 sustainable development, has a variety of meanings depending on the audience that  
22 considers the term. Therefore, it seems essential that the agency start its sustainability  
23 effort by defining in specific systems terms the operating condition it plans to protect or  
24 restore. For example, water quality is generally defined in terms of expected or  
25 designated uses such as fishable, swimable or drinkable. If such conditions were  
26 attained, would EPA deem these systems to be sustainable? If so, what metric would the  
27 agency use to track sustainability? To the degree that the agency can specifically define  
28 the acceptable operating conditions for any specific environmental regime, it will assist  
29 itself in identifying sustainable metrics and designing sustainability tools to support  
30 sustainable practice for that regime. The definition of an environmental regime is itself  
31 in question. Historically one might that appropriate regimes are air, water and land, but if  
32 one attempts to manage a river or a lake, sustainable outcomes will not be achieved if the  
33 interfaces of land and air with that water body are not part of the management strategy  
34 and design of sustainable practices. The SAB does not suggest that this will be easy, or  
35 even how this might be done, but EPA should work diligently to do a conceptual  
36 mapping or otherwise the breakthrough expected from the sustainability research will not  
37 yield the needed behavioral changes that achieve sustainable conditions.  
38

39 There may be value for EPA if it were to develop a vision of sustainable conditions in  
40 collaboration with other agencies that have complimentary responsibilities for land (e.g.  
41 USDA/NRCS), and water (e.g. USGS and ACOE).  
42

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1 **g) Explore developing a bridge between risk and performance to achieve**

2 **sustainability:** The risk assessment paradigm is a core management conceptualization  
3 for EPA, and for that matter most of the entities it regulates. If the Agency plans to lead  
4 the nation to a higher state of environmental management performance, then it must build  
5 a bridge of understanding between the risks associated with the stressors it manages and  
6 how they link to functional process and the benefits associated with those processes. So  
7 in ecological terms this would mean linking chemical, physical or biological stressor  
8 loads to predicted adverse ecological responses in functional ecological processes which  
9 are ultimately linked to the ecological services humans enjoy from a landscape. If the  
10 agency succeeds in establishing this analytical chain then it can test and understand the  
11 implications of risk management to ecological performance sustainability. This would  
12 suggest the agency should be trying to move beyond the management of individual  
13 agents to the management of environmental regimes or landscapes (e.g. lakes, rivers,  
14 forests, cities etc.) based on their actual condition or performance.  
15

16 The Agency should test the assumption that following a risk assessment/risk reduction  
17 strategy can lead to defining sustainability tools and achieve sustainable practices. The  
18 SAB believes that sustainability is tied to an expected set of performance criteria and the  
19 absence of unacceptable risk or risk reduction to acceptable levels is no guarantee of a  
20 sustainable outcome. The extreme but very real example of controlling ecological risks  
21 by removing the forest to get to the underlying contaminated soil highlights a use of risk  
22 assessment that is not framed in a sustainability context. If the Agency wants to achieve  
23 sustainable management of contaminated sites it will need to put risk projections into the  
24 context of actual ecological conditions which should be held up against a definition or set  
25 of design criteria of sustainable condition for the ecological habitat in question. Clearly,  
26 this means that data collected on sites must include data on ecological conditions and not  
27 just levels of contamination. This example is intended to illustrate the need to understand  
28 how the risk paradigm aligns with the type of decisions to be made, and that the current  
29 practice used to conduct regulatory reviews and reach decisions (e.g. data we collect)  
30 may need to evolve within the policy context of sustainability rather than risk control.  
31

32 **2. Additional Research Topics For the Human Health Area**

33 (See Report Part 6 number 5, Page 35 - 36)  
34

35 What follows outlines important areas of research that could be given increased emphasis in the  
36 general research area of human health, and then briefly comments on research by individual  
37 groups or laboratories as described in the October 2 Compilation and captured in bullets in  
38 Deputy Assistant Administrator Teichman's presentation.  
39

40 **a) Research to Support Toxicity Testing Paradigm Shift.** In support of the new  
41 toxicity testing initiative, various areas for increased emphasis were noted. These  
42 include:  
43

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- 1 • *Predicting metabolism:* Development of strategies to support identification and  
2 characterization of possible active metabolites in humans and breakdown products.  
3 This is a critical area for research because failure to miss important metabolites can  
4 lead to missing toxic activities and under-predicting human risk.  
5
- 6 • *Addressing exposure duration:* Rapid high throughput tests of exposed cells and cell  
7 components will eventually be used to shed light on the consequence of complex,  
8 long term human exposures – by their nature reflecting real life exposure of cells at  
9 various ages to a wide spectrum of various endogenous and exogenous chemicals.  
10
- 11 • *Addressing novel agents:* An understanding of the extent that the tests capture the  
12 behavior of agents that fall outside the chemical sets used to develop the assays, and  
13 approaches to address novel agents will be needed.  
14
- 15 • *Epidemiologic surveillance:* A critical piece for predicting human toxicity from high  
16 throughput test results for a chemical exposure will be an understanding of other  
17 exogeneous and endogenous exposures that perturb the same toxicological process,  
18 the degree of human exposures to them, and the variable human responses to such  
19 exposures. Research is needed to support the development of human surveillance  
20 strategies to provide the needed human data to interpret high throughput findings.  
21

22 The NAS (2007) *Toxicity Testing* report notes these and a variety of other research areas  
23 that require attention in order to support the development of toxicity test batteries for  
24 wide use - to address the large number of environmental chemicals that are not now  
25 tested for lack of resources and rapid methods. The NAS envisioned a large scale  
26 research venture over many years to bring the testing vision to fruition, involving an  
27 NTP-like effort in terms of scale. The Agency's impressive but necessarily modest effort  
28 to move forward and gain experience and capacity in the area is noted. As the Agency by  
29 itself and in collaboration with other Federal agencies and institutions makes progress in  
30 its research, it is encouraged to turn frequently to the scientific community through the  
31 SAB and other scientific expert groups to optimize its research effort in this area.  
32

33 **b) Research to Development of Numerical (IRIS) Guidance Levels for Chemicals**  
34 **with Limited Apical Endpoint Test Data.** Chemicals go uncharacterized because data  
35 from classical toxicity test results (e.g., long term bioassays) are not available. In some  
36 cases, in vitro and metabolic studies and other data would enable the prediction of  
37 toxicity endpoints and levels. One example where the Agency does make quantitative  
38 activity estimates and estimates risk in the absence of full bioassay data is dioxin-like  
39 compounds based on toxic equivalency factors. Research is needed to support the  
40 application of this approach to other chemical classes. In the long term approaches will  
41 be needed to develop guidance levels based on data emerging from the toxicity testing  
42 vision discussed above. Nearer term, research can enable the Agency to move forward  
43 on chemicals using short term in vivo and in vitro data and structure activity

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1 relationships. This kind of information can be quite valuable in supporting green  
2 chemistry and other initiatives aimed at moving toward using less toxic materials.  
3

4 **c) Evolving Agency Hazard Identification and Dose Response Practice and**  
5 **Guidance as New Test Data Emerge.** Clearly there is a need to evolve risk assessment  
6 techniques and practice as the practice of toxicity testing changes. With the exception of  
7 pesticides, there are significantly fewer chronic studies being performed today than  
8 twenty years ago. REACH promises to produce large volumes of toxicity data, but many  
9 chemicals are likely to have non-classical toxicity tests, particularly given the REACH  
10 guidance to where possible minimize the use of animals. Agency guidance and practice  
11 needs to evolve to take advantage of the available toxicity data, particular in cases where  
12 chemicals go uncharacterized. While the *Carcinogen Guidelines* and *Supplemental*  
13 *Guidance* did advance over previous versions, they were long in coming, and the  
14 International Agency for Research in Cancer has now developed guidance that is  
15 considered by some to be more up to date. There is a research component to develop new  
16 practice – new methods need to be developed to capitalize on findings, and sensitivity  
17 and specificity of the new approaches need to be understood in a general sense. It is  
18 recognized that development and incorporation of new approaches to chemical hazard  
19 and dose response prediction are challenges for a variety of practical reasons.  
20 Predictability of agency response to particular types of test data, consistency across  
21 chemicals in methods of analysis, and the need for researchers to have the skill set and  
22 understanding to replicate analyses all come into play in maintaining the status quo. On  
23 the other hand when there are exposures to apparently toxic agents that go  
24 uncharacterized and are not included in risk assessments, or better replacement chemicals  
25 are harder to identify, or agency assessments appear out of step with the science,  
26 opportunities for better decision-making are lost and agency credibility suffers.  
27

28 **d) Epidemiological Research: Surveillance, Understanding Gene-Lifestyle-**  
29 **Environment Interactions.** The Board saw in-house capacity in the area of  
30 epidemiologic research limited to a few specialized areas. Most of the long term research  
31 is “bottom up” in nature, with the long term goal of inferring risks and effects in  
32 individuals from mechanistic understanding and data. “Top down” look at exposures and  
33 disease can be used to quantitatively generate as well as check hypotheses. It can also  
34 help to develop more scientifically rigorous basis for individual variability assumptions  
35 used in dose response analyses. Also, as in the first bullet above, epidemiologic  
36 understanding of endogenous and exogenous exposures and health status should prove  
37 critical in applying the results of high throughput screening to individuals and  
38 populations. Molecular epidemiology is key to identifying relationships between specific  
39 diseases and genes. Disease pathways can be discovered through associations between  
40 genes in susceptible individuals and diseases. An understanding of background processes  
41 and exposures is also critical to understanding the potential for linear dose response  
42 relationships due to “background additivity. The Board supports the partnerships EPA  
43 has developed with agencies such as CDC in health tracking and biomonitoring, as well

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1 as the extramural research conducted to support the assessment of the criteria air  
2 pollutants and cumulative risk assessment. Still, greater in-house capacity including at a  
3 senior level could provide a public health and epidemiologic perspective to the research  
4 program and potentially synergize activities in the toxicity testing initiative.  
5  
6  
7  
8

**ATTACHMENT J**  
**Compilation of SAB Comments on the Strategic Research Directions**  
**Draft**  
(July 28, 2008)

**1. Dr. Granger Morgan**

In the May 12 letter to the Administrator on the R&D budget various of you asked me to expand the 6 points that we had developed to nine. In the letter they read:

- 1) broaden the interpretation of "land preservation" to include systems analysis pertaining to future land-use decision making and managing the consequences of complex issues such as bio-fuels, urban-sprawl, green-field development, and the pressures of unconstrained coastal development;
- 2) expand the focus on the environmental consequences of new technologies to include a broader consideration of the life-cycle of new products and their globalization;
- 3) in light of changing socio-economic pressures and the growing stresses that will result from climate change (reduced snow pack, more intermittent precipitation and stream flows, more frequent drought, etc.), expand the analysis of water infrastructures, supply, demand and quality;
- 4) expand and strengthen work on multi-pollutant health impacts and environmental control;
- 5) reinvigorate and modernize research on sensitive human and ecological populations;
- 6) improve the science foundation needed to respond to unexpected and emerging problems and environmental disasters;
- 7) expand policy relevant research on developing, testing and evaluating new and innovative alternatives to conventional command and control regulation;
- 8) dramatically improve the integration of economics and the decision and behavioral sciences into research and policy development across the Agency; and
- 9) continue to work on improving the effective communication of research results to potential users both inside and outside the Agency.

However, I note that the text on strategic research direction that we are reviewing [on July 28] only has the original six.

The letter can be found at:

[http://yosemite.epa.gov/sab/sabproduct.nsf/C657C9653FE5398D85257448004E92F5/\\$File/EPA-SAB-08-008-unsigned.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/C657C9653FE5398D85257448004E92F5/$File/EPA-SAB-08-008-unsigned.pdf)

I can't seem to find on the SAB web site the letter we got back from the Administrator that basically says EPA is doing a fine job and is doing all the fundamental research they need. Tom, can you either get us the URL for that response, or if it is not up on the SAB web site, distribute a cc of the Administrator's letter to all the members of the board so that every one has a chance to read it before our discussion tomorrow.

2. **Jill Lipoti**

I'm reading the document and on page 38 there is a comment from ORD saying that ORD has developed over 80 provisional advisory levels (PAL) for selected toxic industrial chemicals and warfare agents for acute, short-term, and chronic exposure conditions. I was curious, so I did a search on the EPA website for these PALs. I could not find them. I couldn't find them on the Department of Homeland Security website. So I tried Google. Nothing.

What is ORD talking about? If they developed these PALs, why don't they tell people about them? I would even be interested in the list of 80 chemicals - why did they choose this group?

3. **Dr. Rebecca Parkin**

Attachment D2

- P. 13, line 42: There are no "above examples." Either insert examples or revise this paragraph.
- P. 49, lines 2-3: An issue for co-authors' attention has not been addressed.
- P. 52, line 35: What does "first bullet above" refer to? Revision is needed here.

Edits

- There are a number of typos in the text that need attention.
- P. 11, line 1: This heading is incomplete.
- P. 37, line 5: "Public health" is misspelled.

4. **Dr. Rogene Henderson:**

Tom, I reviewed the two advisories for our conference call next Monday and have only one concern. In the document on strategic research directions, on page 39, lines 40-42, I noted that a suggestion to conduct research on alternative policy approaches was recommended. I did not know that a science advisory group got into policy. I suppose the idea is to inform the choices made by others on policy.

**5. Dr. Valerie Thomas**  
Strategic Direction Comments

Comments on the letter to the administrator:

p. 3, lines 15-25. Point 2. "...consideration of the lifecycle..." The text doesn't include any material on lifecycle. I suggest replacing the text after the heading (lines 17-25) with "The environmental impacts of products include effects from their production, use, and their consumption, dissipation, or disposal. A lifecycle approach in a global context is needed to assess nanotechnologies and other new technologies." (See also my comments below on the treatment of this topic in the body of the report.)

p. 3, lines 27-33. Point 3. "Expand analysis of water infrastructures..." The description in the body of the report didn't quite fit Atlanta's situation (one of the examples). I suggest replacing the first sentence after the heading ("Increased water demand..."), lines 28-30, with: "Water management agencies in a number of water-short areas of the U.S. are seeking to access water from other regions."

p. 4, lines 7-13. Point 6. "Expand policy-relevant research on ... alternatives to conventional command and control regulation." The text does not match the heading. The heading refers to command and control regulation; the text refers to a more systems oriented research. We did also have this Point in the Budget Commentary. But did we ever develop a couple of sentences about it: I suggest either writing those sentences to keep our advice consistent, or changing the bullet to read something like: "Develop a broader and more systems-oriented approach to research that transcends traditional EPA stove-piped programs." With this change, the text in lines 9-13 works fine.

Comments on the body of the report:

p. 10. The sections in the report that cover points (1) "broaden interpretation of land preservation" doesn't yet reflect the work of the "technology team" from the February SAB meeting. I think page 10 is older, unrevised text. To bring page 10 somewhat more into alignment with our February discussions, I suggest:

lines 16-18: Cut these lines entirely and replace with "There are", which fits nicely into the beginning of line 19.

lines 29-41: Cut entirely.

pp. 11-12. The section in the report that covers (2) "expand the focus on the environmental consequences of new technologies to include a broader consideration of the lifecycle of new products and their globalization" needs to be replaced. Am I correct in thinking that this section is meant to reflect the technology team's conclusions? If so, it doesn't reflect the technology team's

discussion from the February meeting. The lifecycle intention of the heading needs to be supported by the text; this text doesn't match the topic. I suggest the technology team, or some other small group, be tasked to provide alternative text.

Here is some placeholder replacement text for the entire section (2)  
(pp. 11-12)

“Expand the focus on the environmental consequences of new technologies to include a broader consideration of the lifecycle of new products and their globalization: The environmental impacts of products include effects from their production, use, and their consumption, dissipation, or disposal. ORD is beginning to consider the full lifecycle impacts of nanotechnology, recognizing that potential impacts can arise from any aspect of the lifecycle. The ongoing growth in capability to assess full lifecycle impacts of products will provide a stronger basis for identifying key environmental impacts. For a number of product categories, manufacturing occurs outside the U.S., and the main environmental impacts relate to the use and disposal of the products. For other product categories, such as electronics, recycled paper, and recycled metals, much of the recycling or disposal also occurs outside the US. With outsourcing of both manufacturing and some disposal or recycling, it is essential that EPA have a strong capability to assess the environmental impacts of products during use, as this is the main activity that occurs entirely within the U.S. In addition, however, EPA assessment of the environmental impacts of products should also include the activities carried out beyond U.S. borders, to ensure that lifecycle management of products consumed in the US is environmentally sound.

p. 12. Lines 19-30. Expand the analysis of water infrastructures....The paragraph doesn't correctly characterize the Atlanta water situation. I suggest replacing the first two sentences (lines 22-25) with: “Water management agencies in a number of water-short areas of the U.S. (e.g. Atlanta, Las Vegas, and Phoenix) are seeking to divert or access water from other regions.”

p. 13, line 39-p. 14 line 15. “(6) Expand policy relevant research... on alternatives to command and control...” Here again the text does not match the heading. I suggest, as in the letter to the administrator, that the bullet point be changed to something like: “Develop a broader and more systems-oriented approach to research that transcends traditional EPA stove-piped programs.”

p.13, lines 42-43: Clearly these should be cut.

p. 14, lines 1-2: Clearly these should be cut.

p. 14, lines 12-15: Is this old text? Should it be cut, or are we providing additional advice in the coming months?

p. 17, lines 39-41 – remove the question marks. These are statements, not questions.

p. 18. Here is the recommendation for expanding behavioral and decision science – Granger noted it was in the Budget Commentary but not in our list of 6 points for research directions. It is here, just down in the research effectiveness section.

p. 20. Remove question mark from line 6.

**ATTACHMENT K**  
**US EPA SCIENCE ADVISORY BOARD**  
**STRATEGIC RESEARCH DIRECTIONS REVIEW TEAM ASSIGNMENTS**

**SAB Chair:** Dr. M. Granger Morgan

<b>TEAM</b>	<b>RESEARCH PROGRAM AREA (NPD)</b>
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<p><b><u>AIR &amp; GLOBAL CHANGE TEAM</u></b>            Dr. Rogene Henderson (Air) Lead Writer            Dr. Jerry Schnoor (Global Change) Lead Writer            Dr. James Galloway            Dr. Jill Lipoti</p>	<p>-Clean Air (PTR) Dan Costa            -Global Change (CPR) Joel Scheraga</p>
<p><b><u>TECHNOLOGY TEAM</u></b>            Dr. James Johnson, Lead Writer            Dr. David Dzombak            Dr. Bernd Kahn            Dr. Mike McFarland            Dr. Valerie Thomas</p>	<p>-Land Preservation (PTR) Randy Wentsel            -Nanotechnology (CPR) Nora Savage            -GEOSS/Advanced Monitoring (CPR) Ed Washburn</p>

<sup>1</sup> CPR = Cross-Programs Research

<sup>2</sup> PTR = Program-targeted Research



# ATTACHMENT L

## D R A F T

### Background

On October 27-28, 2008, the EPA Science Advisory Board will hold a one-and-a half-day meeting entitled *Future Science and Research: Next Steps for Integrated Science*. The meeting will focus on two topics:

- Biofuels: What are the net environmental implications?
- Epigenomic research: What are the implications for environmental health sciences and human health risk assessment?

This seminar-style meeting will be followed by a half-day advisory meeting on October 28th, when the chartered SAB will discuss possible implications of the October 27th meeting for ongoing SAB advice on EPA research.

Exploration of "next steps for integrated science" for biofuels and epigenomic research is intended to provide the chartered SAB with an inter-disciplinary introduction to these topics. It is also intended to stimulate SAB thinking generally about future advice to strengthen EPA's response to emerging science issues, especially how EPA might implement inter-disciplinary approaches that incorporate significant emerging research.

In 2007, the chartered SAB committed to provide ongoing advice on strategic research directions for EPA and how they can be implemented. This activity complements the SAB's traditional review of EPA's annual research budget. Exploration of emerging science on biofuels and genomics from different disciplines may stimulate SAB advice encouraging EPA to address inherent complexities and interconnections among human and ecological systems through integrated, multi-disciplinary approaches.

**EPA Science Advisory Board (SAB) Meeting**  
**Future Science and Research: Next Steps for Integrated Science**  
**October 27, 2008**  
**Draft Agenda**

**Purpose:** To stimulate SAB thinking about priorities for meeting critical environmental problems with an integrated approach to interdisciplinary science and research.

<b>8:00 - 8:10</b>	<b>Welcome</b>	<b>SAB Chair</b>
<b>8:10 – 12:00</b>	<b>Biofuels: What are the net environmental implications?</b>	
	Introduction	Dr. M. Granger Morgan, SAB
8:10 – 10:00	Sustainable Paths to a Biofuel-Powered Transportation Sector	Dr. Bruce Dale, Michigan State University (present) and Dr. Lee Lynd, Dartmouth College
	Biofuels and ecosystem services	Dr. David Tilman, University of Minnesota
	Biofuels potential: The climate protective domain	Dr. Christopher Field, Carnegie Institution
	Why biofuels do not make any sense	Dr. Vclav Smil, University of Manitoba
10:30 – 12:00	SAB discussion with invited speakers	
12:00 – 1:15	Lunch	
<b>1:15 – 4:45</b>	<b>Epigenomics research: What are the implications for environmental health sciences and human health risk assessment?</b>	
	Introduction	Dr. Deborah Cory-Slechta, SAB
1:15 – 3:45	Epigenetics and human health - New challenges and new approaches	Dr. Mark Hanson, University of Southampton
	Epigenetics: The new genetics of disease susceptibility	Dr. Randy Jirtle, Duke University
	Transgenerational epigenetic actions of environmental factors on disease	Dr. Michael Skinner, Washington State University
3:45 – 4:45	SAB discussion with invited speakers	
<b>4:45 – 5:00</b>	<b>Final Remarks and Adjourn</b>	<b>SAB Chair</b>