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



OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

1

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

7

8 Subject: SAB Advisory on EPA's Draft *Report on the Environment 2007: Science Report*

9

10

11 Dear Administrator Johnson:

12

13 EPA's Office of Research and Development requested that the Science Advisory
14 Board (SAB) review the Agency's draft *Report on the Environment 2007: Science Report*
15 (ROE). The ROE is an update of EPA's draft 2003 Report on the Environment which
16 was reviewed by the SAB in 2004. The ROE compiles and reports on scientific
17 indicators of status and trends in human health and ecological condition in the United
18 States. In response to the Agency's advisory request, an SAB panel conducted a peer
19 review of the draft 2007 ROE. The enclosed advisory report provides the advice and
20 recommendations of the Panel.

21

22 The SAB commends the Agency for its initiative in preparing this unique but ambitious
23 report. The current draft represents an evolutionary advancement over the earlier 2003
24 version; however, the SAB still finds opportunity for improvement. Our primary
25 overarching recommendation is to strengthen the science of the report. This can be
26 accomplished through stronger conceptualization, integration across the chapters and
27 with the published literature, and application of appropriate statistical analysis.

28

29 The value and importance of the ROE will continue to increase as environmental
30 pressures of population, energy use, and urbanization grow. The SAB therefore strongly
31 urges EPA to fully support and permanently embed the ROE into its core mission-
32 directed activities. This will require an investment of resources beyond those currently
33 devoted to the ROE.

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

3
4 Sincerely,

5
6
7
8
9 Dr. M. Granger Morgan, Chair
10 Science Advisory Board

Dr. Deborah Swackhamer, Chair
Panel for the Review of EPA's
2007 Report on the Environment

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NOTICE

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

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1 **U.S. Environmental Protection Agency**
2 **Science Advisory Board**
3 **Panel for the Review of EPA's 2007 Report on the Environment**
4

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8 Environment, University of Minnesota, St. Paul, MN
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32 Agency, Washington, DC

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1
2 **1.0 EXECUTIVE SUMMARY**
3

4 The Science Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on
5 the Environment has reviewed the Agency's draft *Report on the Environment 2007:*
6 *Science Report* (ROE 2007 Science Report or Report). The ROE 2007 Science Report
7 compiles and reports on scientific indicators of status and trends in human health and
8 ecological condition in the United States. EPA initially presented this information in a
9 draft *Report on the Environment Technical Document* released in 2003 and reviewed by
10 the SAB. Since then, EPA has revised the Report in response to feedback from the SAB
11 and stakeholders. The ROE 2007 Science Report will be used by EPA to inform strategic
12 planning, priority setting, and decision making across the Agency, and to communicate
13 with the general public.
14

15 In developing the ROE 2007 Science Report, EPA compiled indicators to help answer
16 twenty-six policy-relevant questions deemed to be critically important to the Agency's
17 mission and national interest. EPA sought the SAB's review of: the adequacy of the
18 formulation and scope of the questions posed in the Report; the appropriateness of the
19 indicators in answering the questions; the accuracy of the characterization of indicator
20 data gaps and limitations; the degree to which the data gaps and limitations of the
21 indicators limit ability to answer the questions; the appropriateness of regionalization of
22 national indicators; the utility of regional indicators in the Report; and the overall quality
23 of the Report with respect to technical accuracy, clarity, and appropriateness of the level
24 of communication. In this advisory report, the SAB provides specific comments and
25 recommendations in response to the charge questions.
26

27 The Panel emphasizes the tremendous value of the ROE 2007 Science Report and
28 concurs with the statement in the previous SAB review of the 2003 Report that there is an
29 urgent need for this kind of assessment. The Report is unique in providing a
30 comprehensive assessment of the time-varying quality of the environment including air,
31 land, and water in relation to human and ecological health. Such an assessment becomes
32 increasingly important as environmental pressures of population, urbanization, climate
33 change, and energy use grow. The Panel therefore strongly urges EPA to fully support
34 and permanently embed the Report on the Environment into its core mission-directed
35 activities. This will require an investment in resources well beyond those currently
36 devoted to the ROE 2007 Science Report.
37

38 The Panel finds that the ROE 2007 Science Report is a valuable collection of data,
39 trends, and impact indicators. The Panel commends EPA for incorporating many of the
40 SAB's recommendations from the 2004 review to improve the organization and scope of
41 the Report. EPA has structured the ROE 2007 around questions central to the Agency's
42 mission to protect environmental and ecological health. Generally, the SAB finds that
43 the formulation and scope of the questions are well developed; EPA has effectively
44 identified many of the key indicator data gaps and limitations; and regional analyses have

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1 made the Report more meaningful. However, as discussed below, the Panel has
2 identified shortcomings in the document that limit its usefulness in fulfilling its stated
3 purposes. **While the Report may help inform strategic planning and priority setting,**
4 **it should not be used as the sole basis for decision making as it contains little data**
5 **interpretation and no conclusions supported by statistical analysis.**

6 Recommendations for improvements in the Report are provided in response to EPA's
7 specific charge questions and to generally strengthen the document. The Panel provides
8 recommendations at two levels, i.e., those to be considered before finalization of the 2007
9 Report, and longer-term recommendations to be considered in subsequent reports.

10 These recommendations are listed as bullets throughout this report and presented in
11 summary tables in Appendix E. Additional comments and suggestions are also provided
12 in the text of this report, and detailed comments pertaining to specific indicators and
13 technical issues are included in Appendix A.

14
15 *Overarching "higher level" findings and recommendations that pertain to all chapters of*
16 *the ROE 2007 Science Report*
17

- 18 • **Strengthened scientific underpinnings:** The Panel finds that the scientific
19 underpinnings of the final 2007 Report should be strengthened to make it a "science
20 report," as indicated by its title, rather than simply a data report. As discussed below,
21 this can be accomplished by including greater synthesis, interpretation, statistical
22 analysis, and discussion related to the literature. An alternative would be to remove
23 "science" from the title of the final 2007 Report so it is characterized as a status and
24 trends report. When work is completed to strengthen the scientific underpinnings of
25 future Reports, "science" could be included in the title.
26
- 27 • **Better integration and discussion of indicators:** The organization of the Report
28 into individual media chapters (air, water, and land) and synthesis chapters on human
29 health and ecosystem condition makes sense, and the approach of asking key
30 scientific questions about the environment is a highly effective framework for
31 organization and presentation. However, the Panel recommends that the final 2007
32 Report contain a greater degree of integrated discussion across the indicators and
33 chapters than currently exists. **A conceptual framework that illustrates the**
34 **connectedness between the media chapters and the human health and ecological**
35 **condition chapters should be added to the introduction of the final 2007 Report.**
36 **In addition we recommend that a final synthesis chapter be added to future**
37 **Reports. The synthesis chapter should fully integrate the entire Report and**
38 **discuss health and ecosystem status, trends and effects from a holistic**
39 **perspective.** The synthesis chapter should include a discussion that interprets and
40 discusses the observed trends, connects the trends seen in the various indicators with
41 cause/effect, and also connects the indicators with each other. EPA should add a brief
42 section to the final 2007 Report outlining how a synthesis chapter could be developed
43 in future Reports. The Panel also notes that the Report provides a large amount of
44 valuable data and information that can be interpreted by readers, but it contains few

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1 clear conclusions and statements of significance of the findings. **Future Reports on**
2 **the Environment should provide such conclusions and statements.**

- 3
- 4 • **Statistics and uncertainties:** The ROE 2007 Science Report states that, due to time
5 and resource limitations, statistical analyses of uncertainty and trends in indicators
6 were not included. The Panel finds that this has limited the usefulness of the Report,
7 and that a statistical approach to analysis and presentation of the data is needed to add
8 rigor to the Report. **The Panel therefore recommends that EPA incorporate into**
9 **future Reports on the Environment an approach to statistical analysis and**
10 **reporting across all indicators.** This should be part of the results presentation for
11 each indicator. In some cases, this may involve formal statistical analyses, whereas in
12 other cases it may involve the inclusion of additional information such as error bars
13 around mean values. When there are insufficient data available for robust
14 quantitative analyses, such statistical limitations can be reported. Without such
15 information, the ROE cannot fully meet its intended purpose of reporting
16 scientifically established trends in human health and environmental condition.
17
 - 18 • **All questions in the final 2007 Report should address status and trends:** The
19 Panel was asked to comment on the adequacy of the formulation and scope of
20 questions posed in the ROE 2007 Science Report. Although the scope of the
21 questions posed in the Report is generally appropriate, questions are asked only about
22 trends. Most of the information presented in the Report reflects indicator status rather
23 than trends. **The Panel recommends that all questions in the final 2007 Report**
24 **address both status and trends.** The discussions of “what the data show” should
25 clearly reflect cases where trends cannot be presented because only status information
26 is available. In addition, it is recommended that EPA explicitly state how each
27 question is related to the conceptual framework of the Report.
28
 - 29 • **Indicator selection criteria:** The Panel was asked to comment on whether the
30 indicators presented were used appropriately to answer questions contained in the
31 Report. Indicators were selected against a set of specified criteria. The Panel finds
32 that, with some exceptions, appropriate indicators were selected. However, for some
33 indicators, the criterion of national representation results in the exclusion of valuable
34 and relevant information. **As discussed in various sections of this advisory report,**
35 **the Report on the Environment can be strengthened by adjusting the criteria to**
36 **include additional indicators that inform the stated questions. In addition, the**
37 **Panel recommends that for each indicator in the final 2007 Report, EPA provide**
38 **a clear description of why the indicator is important, what it tells, and the**
39 **documented relationship between the indicator and human health and ecological**
40 **condition.**
41
 - 42 • **Indicator discussion:** Each question contained in the Report is accompanied by a
43 discussion of the most critical indicator gaps, limitations, and challenges that prevent
44 the question from being fully answered. The Panel was asked to comment on the

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1 accuracy with which the indicator gaps were characterized and limitations in the
2 degree to which questions were addressed. In general, the Panel finds that most of
3 the indicator data gaps and limitations have been identified. However, to improve the
4 final 2007 Report, **additional clarification is required to differentiate indicator**
5 **limitations from data gaps. The Panel recommends that in future Reports on the**
6 **Environment, the discussion of indicator limitations and data gaps be**
7 **distinguished. For example, the limitations could be grouped based on**
8 **geographic limitations; statistical limitations; and data coverage limitations.** The
9 Panel also recommends that the indicator gaps discussion in the final 2007 Report be
10 expanded to identify some of the more prominent available data sets that were
11 excluded, and the reasons for their exclusion.
12

- 13 • **Regional indicators:** The Report has broken out national-level data for some of the
14 indicators by EPA region, and provided ten regional indicators. The Panel was asked
15 to comment on the utility of these approaches. The Panel finds that regional analysis
16 of data makes the Report more meaningful, and recognizes the pragmatic appeal of
17 using EPA administrative regions for this purpose. However, the use of EPA
18 administrative regions to scale national data has little ecological justification and does
19 not provide particularly informative geographic descriptors of human health.
20 **Therefore, the Panel recommends that in future Reports on the Environment,**
21 **indicator data be presented by relevant geographic units such as ecoregions,**
22 **airsheds, and watersheds.** This would be a useful approach for presenting both
23 ecological and human health data. The Panel supports the use of regional indicators
24 that can reflect important information for gauging the state of the U.S. environment.
25 Key regional issues such as the ecological health of the Great Lakes or the Everglades
26 should also be addressed in a national report on the environment, and the use of state
27 and county data could increase the resolution for reporting the health indicators in
28 future Reports.
29
- 30 • **Use of regional indicators and case studies to illustrate trends:** It is disappointing
31 that the lack of available long-term data for many indicators precludes trend analysis
32 and limits the usefulness of the Report. Regional data are not a substitute for national
33 or even representative national data. However, the Panel notes that with appropriate
34 caveats, **more regional indicators and case studies with long-term, well-**
35 **supported data sets could be used in future Reports on the Environment to**
36 **illustrate trends when national data sets are not available.** Some regional case
37 studies are included in the Report, and it should be clearly stated that the specific case
38 studies presented may not be representative of a general or national situation when
39 they represent a picture of success or failure. However, this concern should not
40 constrain the use of additional regional studies to demonstrate important examples of
41 national importance or particular significance to local populations. In section 5 of
42 this advisory report, the Panel suggests criteria that might be applied to identify useful
43 regional indicators and case studies.
44

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1 In addition to overarching findings and recommendations pertaining to all chapters of
2 the ROE 2007 Science Report, the Panel has provided specific recommendations
3 pertinent to individual chapters of the Report.
4

5 *Air chapter findings and recommendations*
6

7 Although the questions in the air chapter of the Report are generally appropriate, a
8 science framework is needed to show interaction within, between and among media, as
9 well as between and among indicators. The Panel also notes that a short historical section
10 should be included in the air chapter of the final 2007 Report to provide background
11 information on the criteria pollutants. This information is needed to provide an
12 understanding of the importance of these pollutants as indicators, how they have been
13 tracked, and their relationship to other indicators in the Report. As discussed in section
14 6.0 below, the Panel has identified a number of missing air indicators that should be
15 added to the final 2007 Report because they represent important trends in air quality, or
16 present a more holistic picture of atmospheric chemistry. These include SO₂
17 concentration and air toxics information. The Report should also discuss key trends in
18 the understanding of the atmosphere, such as the clear reduction of primary pollutants
19 (CO, SO₂, and Pb) and much flatter trends in secondary pollutants (O₃ and PM_{2.5}).
20

21 Most of the gaps and limitations of air indicators have been appropriately identified in
22 the Report. However, the Panel finds that the pollutant-by-pollutant recounting approach
23 used in the air chapter does not show the interplay of the various criteria and toxic
24 pollutants with one another or the role of stratospheric ozone depletion and climate
25 change on air quality. In addition, the pollutant information does not demonstrate the
26 relationship to human health. An integrative description of these pollutants is needed in
27 the final 2007 Report to provide public or other policy makers a full picture of the state of
28 the atmospheric environment.
29

30 *Water chapter findings and recommendations*
31

32 The Panel finds that some of the questions in the water chapter inappropriately call for
33 information on trends in both the extent and condition of certain indicators. Therefore, it
34 is recommended that in the final 2007 Report, EPA refine the differentiation between
35 extent and condition for indicators where inclusion of both extent and condition measures
36 does not make sense. For example, it is not meaningful to refer to the extent of coastal
37 waters because the issue of importance is condition. In addition, questions should be
38 incorporated in the water chapter of future Reports on the Environment to provide
39 information on critical habitats and missing thematic elements such as trends in water
40 availability and usage of water for human activities.
41

42 The Panel finds a lack of acceptable water indicators in the Report to answer some of
43 the questions posed. Additional indicators have been recommended to answer questions
44 in future Reports on the Environment. For example: 1) The freshwater indicators in the

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1 Report have a strong lotic bias and equal attention should be devoted to indicators
2 relevant to lentic systems. 2) EPA should identify and use indicators that have relevance
3 to human health as well as to ecology. 3) EPA should identify indicators of important
4 ecosystem processes such as denitrification, decomposition, and primary production. In
5 this regard, data on biogeochemical processes in wetlands such as organic matter
6 decomposition and accretion, denitrification, and sulfate reduction can provide early
7 indications of impending ecological changes. 4) EPA should identify indicators that will
8 aid in evaluating the impact of emerging issues such as biofuel feedstock production on
9 the quality and quantity of water. 5) Some chemical indicators, such as pesticides in
10 agricultural streams, should be based on measured concentrations in sediments and biota
11 rather than the water column, where concentrations may be low but biota may be
12 impacted by elevated levels in sediments. The Panel also notes that in the Report,
13 concentrations of chemical indicators have been inappropriately compared to drinking
14 water maximum contaminant levels.

15
16 *Land chapter findings and recommendations*

17
18 The questions in the land chapter address land resource management and land
19 contamination. Although the questions are relevant to EPA's mission, it is recommended
20 that in future Reports on the Environment EPA consider adding a question that addresses
21 soil quality and conservation. In future Reports on the Environment EPA should also: 1)
22 consider a range of available land cover classification schemes with different levels of
23 resolution (this is necessary because the resolution of the data in the current draft of the
24 Report is too coarse to completely answer the questions); 2) extend land cover
25 characterization to all major ecosystem types, not just the forest land characterized in the
26 current draft of the Report; and 3) adopt standard approaches for land use and land cover
27 analysis to evaluate information and document trends across a range of available data
28 sets. Moreover, as further discussed in section 8.0 of this advisory report, the Panel finds
29 that the questions in the land chapter are not completely answered by the indicators
30 presented, and that the range of indicators in the land chapter is not at the same overall
31 level of development as in the water and air chapters. For example, few land indicators
32 provide direct measures of effects on human health. Some additional resources and an
33 expanded set of disciplines are needed to bring the land chapter to the level of evaluation
34 provided in other chapters. To more completely answer the questions posed in the land
35 chapter, the Panel recommends that EPA include the following additional indicators in
36 the final 2007 Report: 1) a pesticide use indicator (this would be particularly important
37 from the standpoint of human exposure); and 2) indicator data for persistent
38 bioaccumulative toxics (PBTs) and mining wastes (e.g., Toxics Release Inventory derived
39 information), radioactive wastes, and wastes applied on agricultural land (biosolids,
40 compost, etc.).

41
42 *Human health chapter findings and recommendations*

43

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1 The questions in the human health chapter are comprehensive, appropriate, and well-
2 developed. However, the Panel notes that they encompass both human health and
3 exposure. It is therefore recommended that in the final 2007 Report, the chapter be more
4 descriptively renamed "Human Exposures and Health." The indicators used in the
5 human health chapter are appropriate, but the Panel recommends that, in future Reports
6 on the Environment, EPA consider using an expanded suite of human health indicators
7 that include National Health Interview Survey (NHIS) Behavioral Risk Factor Survey
8 (BRFS) information, hospital and emergency room admission data (if publicly available),
9 and reports of infectious disease maintained by the Centers for Disease Control. These
10 indicators would more effectively capture such important health concerns as effects
11 related to indoor air quality, use of pesticides, and exposure to pathogens.
12

13 In addition, the Panel finds that there is a critical need to expand the indicator
14 discussion in the final 2007 Report to address indicator relevance to the stated questions.
15 Such discussion is needed because the relevance of the indicators to the questions can be
16 wide ranging and it is important that the Report provide a characterization of the value or
17 importance of the indicator to the question. Strong epidemiologic evidence is available in
18 the literature to support many of the indicators EPA has chosen (i.e., cancer incidence,
19 childhood cancer incidence, cardiovascular disease, chronic obstructive pulmonary
20 disease, asthma, infectious disease, birth defects, low birth weight, and preterm delivery)
21 and it is recommended that a qualitative or quantitative description of such information
22 be provided in the final 2007 Report. To further strengthen the scientific credibility of
23 the Report, the Panel recommends that the discussion of indicator gaps and limitations
24 also be expanded in the final 2007 Report to include a more quantitative description of
25 indicator relevance by relying on the epidemiologic literature. The discussion might be
26 further expanded to address how the limitations and gaps affect the interpretations of the
27 indicators.
28

29 *Ecological condition chapter findings and recommendations*

30

31 The questions posed in the ecological condition chapter of the Report are generally
32 appropriate but the Panel recommends that in the final 2007 Report, the chapter be
33 reorganized to reflect an integrated focus on ecosystem health. To meet this objective, it
34 is recommended that the chapter be organized hierarchically according to: 1) major
35 ecosystem type, 2) ecosystem processes and services, and 3) ecosystem components
36 (physical, chemical, biological). In addition, the Panel finds that the scope of indicators
37 in the ecological condition chapter needs considerable broadening to cover all ecosystem
38 types and fill specific gaps (i.e., missing ecosystems, missing populations, and missing
39 processes) in the indicator coverage. Specific indicators and indicator types have been
40 suggested in section 10.0 and Appendix A of this advisory report to broaden the coverage
41 and fill gaps. Easily accessible data may be available for some of these indicators and
42 they could be included in the final 2007 Report, while others should be included in future
43 Reports on the Environment. It is recognized that EPA cannot develop an unlimited set
44 of indicators but should select those that address key ecological issues.

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1 **2.0 INTRODUCTION**
2

3 This report transmits the advice of the U.S. Environmental Protection Agency Science
4 Advisory Board (SAB) Panel for the Review of EPA's 2007 Report on the Environment.
5 The Panel conducted a peer review of EPA's draft *Report on the Environment 2007:*
6 *Science Report* (ROE 2007 Science Report or Report). The draft ROE 2007 Science
7 Report compiles and updates scientific indicators of status and trends in human health
8 and ecological condition in the United States. EPA released its first draft Report on the
9 Environment in 2003. That report was reviewed by the SAB (U.S. EPA Science
10 Advisory Board, 2004) and the SAB's advice was used to develop the improved and
11 updated ROE 2007 Science Report. A second SAB Panel was formed to review the 2007
12 Report. EPA intends to use the ROE 2007 Science Report to inform strategic planning,
13 priority setting, and decision making across the Agency. The ROE 2007 Science Report
14 is also intended to provide information that will enable the public to assess whether EPA
15 is succeeding in its overall mission to protect human health and the environment.
16

17 In developing the ROE 2007 Science Report, EPA identified twenty-six policy-
18 relevant questions about environmental and human health deemed to be critically
19 important to the Agency's mission and national interest. The Agency selected a suite of
20 indicators to answer these questions. The ROE 2007 Science Report consists of chapters
21 developed to answer status and trend questions concerning air, water, land, human health,
22 and ecological condition. In each of these five chapters, EPA: described the scope of the
23 priority questions to be answered; provided a set of indicators to answer the questions;
24 and discussed indicator data gaps, limitations, and challenges that prevented questions
25 from being fully answered. In the ROE 2007 Science Report, EPA established an explicit
26 indicator definition and six indicator criteria. Information was presented to show trends
27 and national baseline information for some of the indicators in the Report. EPA stated
28 that the ROE 2007 Science Report was written for a target audience of environmental
29 professionals. The Agency developed a less detailed ROE 2007 "Highlights Document"
30 for the more general audience of concerned citizens, and a web-based "e-ROE" to
31 facilitate electronic access to materials in the Report and provide timely updates in the
32 future. The SAB Panel was asked to review only the ROE 2007 Science Report.
33

34 The Panel emphasizes the tremendous value of EPA's Report on the Environment.
35 This is a unique report with the objective of providing an assessment of changes in
36 environmental quality over time as related to human and ecological health. We concur
37 with the statement in the SAB's review of EPA's draft 2003 Report that there is an urgent
38 need for this kind of assessment. It can have an important impact on improving the state
39 of the environment by synthesizing relevant information from many sources for the
40 development of effective environmental monitoring, policy, and protection programs.
41 EPA's Report on the Environment can also provide the public with essential information
42 about environmental status and trends and their relevance to public health and ecological
43 condition. **The Panel therefore strongly urges EPA to fully support and**
44 **permanently embed the Report on the Environment in its core mission-directed**

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1 **activities.** This will require an investment in resources beyond those currently devoted to
2 the ROE 2007 Science Report. The EPA staff that produced the ROE 2007 Science
3 Report are commended for their remarkable productivity and output; however, a
4 sustained and increased investment in staff and expertise for the Report on the
5 Environment is essential and strongly recommended. The Panel offers recommendations
6 for improvements in the ROE 2007 Science Report to make it more useful to EPA and
7 other intended audiences.
8

9 **3.0 CHARGE TO THE REVIEW PANEL**

10
11 EPA gave the following six charge questions to the SAB Panel for its review of the
12 ROE 2007 Science Report.
13

14 **Charge Question 1.** Please comment on the adequacy of the formulation and scope of
15 the questions in the Chapters of the *Report on the Environment 2007: Science Report*.
16 Does the SAB have any specific recommendations on how to improve or clarify the
17 formulation of the questions? Does the SAB have recommendations on changing the
18 scope of the questions to better reflect EPA's mission?
19

20 **Charge Question 2.** Please comment on whether all of the relevant indicators in the
21 Report have been used appropriately to answer the questions. Please comment on
22 whether the integrity of the material in the indicator write-up is preserved in the chapter
23 narrative.
24

25 **Charge Question 3.** Please comment on the adequacy, objectivity, and transparency of
26 the identification and communication of gaps and limitations of the indicators in
27 answering the Report on the Environment questions.
28

29 **Charge Question 4.** Please comment on the utility, comparability, and objectivity of the
30 regionalization of the national Report on the Environment indicators. Does the use of
31 EPA Regions to scale national data accurately reflect, or does it inappropriately distort,
32 the problem domain?
33

34 **Charge Question 5.** Please comment on the utility of the regional indicators in *Report*
35 *on the Environment 2007: Science Report* in answering the questions. Does the SAB
36 have recommendations for whether and how to build on this base in future versions of the
37 report?
38

39 **Charge Question 6.** Please comment on the overall quality of the *Report on the*
40 *Environment 2007: Science Report* with respect to technical accuracy, clarity, and
41 appropriateness of the level of communication.
42

43 **4.0 REVIEW PROCESS**

44

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1 The Panel's review of EPA's ROE 2007 Science Report was structured to develop
2 responses to all of the charge questions for each chapter of the Report. Panel subgroups
3 were assigned lead responsibility for reviewing individual chapters of the Agency's draft
4 Report. The Panel then discussed the subgroup responses and developed specific
5 findings and recommendations concerning the air, water, land, human health, and
6 ecological condition chapters. The Panel has also provided "higher level" overarching
7 recommendations that pertain to all chapters of the ROE 2007 Science Report. The
8 overarching findings and recommendations address EPA's specific charge questions as
9 well as general improvements needed to make the Report a more effective assessment of
10 status and trends in human health and ecological condition. The Panel has recommended
11 revisions that should be incorporated into the final 2007 Report as well as improvements
12 that will require a much longer time frame to implement, and thus should be incorporated
13 in future Reports on the Environment. These recommendations listed as bullets
14 throughout this report and presented in summary tables in Appendix E. Additional
15 comments and suggestions are also provided in the text of this report, and detailed
16 comments pertaining to specific indicators and technical issues are included in Appendix
17 A. The Panel strongly recommends that EPA make the suggested near-term changes
18 prior to releasing the final 2007 Report. Italicized subheadings within the following
19 sections correspond to the Panel's charge questions listed above.

20 21 **5.0 OVERARCHING RECOMMENDATIONS**

22
23 The Panel finds that the ROE 2007 Science Report is a valuable collection of data,
24 trends, and impact indicators, and strongly endorses continued development and
25 dissemination of the Report. The Panel finds that the Report is an improvement over
26 EPA's draft 2003 Report on the Environment, and commends the Agency for addressing
27 many of the SAB's comments and recommendations on the 2003 Report. As
28 recommended by the 2004 SAB Review Panel, the ROE 2007 is free from conclusions
29 about the impacts of specific policies or government initiatives, regional indicators have
30 been incorporated into the Report, and other key missing indicators have been added.
31 The 2007 SAB Review Panel notes, however, that some recommendations of the
32 previous SAB review panel were not addressed. Additional funds and personnel have not
33 been allocated to sustain development of the Report on a continuing basis, and analyses
34 of greater statistical rigor have not been included in the Report. Generally, the
35 formulation and scope of the questions in the ROE 2007 Science Report are adequate,
36 narratives in the text have captured information about the indicators presented in the
37 document, EPA has effectively identified many of the key indicator data gaps and
38 limitations, and regional analyses have made the Report more meaningful. However, as
39 discussed below, the Panel has identified numerous shortcomings in the document that
40 limit its usefulness in fulfilling its stated purposes. While the Report may help inform
41 strategic planning and priority setting, it should not be used as the sole basis for decision
42 making because it contains data with little interpretation and no conclusions supported by
43 statistical analysis. Recommendations for improvements in the Report are provided to
44 make it more useful to EPA and other intended audiences.

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1
2 *Organization of the ROE 2007 Science Report*

3
4 The organization of the Report into individual media chapters (air, water, and land)
5 and synthesis chapters on human health and ecological condition makes sense, and the
6 approach of asking key scientific questions is a highly effective framework for presenting
7 the information in the Report. However, the Panel finds that the introduction of the
8 Report should be revised to clearly articulate EPA's objectives in developing the report
9 and to more fully describe the report structure. To accomplish this, the Panel
10 recommends the following:

- 11
12 • **In the final 2007 Report the introduction should be revised to clearly indicate**
13 **that the first three chapters address status and trends using specific indicators**
14 **for the individual “media” of air, water, and land, and that the next two**
15 **chapters are syntheses that provide integrated assessments of status and trends**
16 **in human health and ecosystem condition. The introduction should also identify**
17 **how EPA plans to use the Report and its analyses, and how the Agency wants**
18 **the Report to be used by the broader public.**
19
20 • **In the final 2007 Report the introduction should also clearly state its purpose for**
21 **intended audiences and EPA.**

22
23 *Strengthened scientific underpinnings*

24
25 The Panel finds that the scientific underpinnings of the final 2007 Report should to be
26 strengthened to make it a “science report,” as indicated by its title, rather than simply a
27 data report. As discussed below, this can be accomplished by including greater synthesis,
28 interpretation, statistical analysis, and discussion related to the literature. An alternative
29 would be to remove “science” from the title so that the report is characterized as a status
30 and trends report. If work is completed to strengthen the scientific underpinnings of
31 subsequent versions of the Report, “science” could again be included in the title.

32
33 *Incorporation of a conceptual framework and synthesis chapter*

34
35 The Panel finds that the final 2007 Report needs a greater degree of integrated
36 discussion across the indicators and chapters. Each chapter of the Report is currently
37 designed to be a stand-alone document for readers interested in the particular subject
38 areas of land, water, air, health, and ecology. Consequently, the interconnections among
39 these areas are not well established or discussed. For example, the relationship between
40 waste management and chemical uses (addressed in chapter 4) and water quality
41 (addressed in chapter 3) is mentioned in the introduction of the water chapter, but this
42 relationship is not obvious from the presentations of the individual indicator data. In
43 addition, the possible link between greenhouse gas emissions (in Chapter 2) and global
44 sea level and temperature changes (in Chapter 6) are not discussed. The Report currently

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1 contains a discussion section after each question and related series of indicators, but there
2 is not a corresponding synthesis discussion across the questions to tie the document
3 together and make the whole greater than the sum of its parts. The Panel also notes that,
4 although the Report provides a large amount of valuable data and information that can be
5 interpreted by readers, it contains few clear conclusions and statements of significance of
6 the findings. In future Reports on the Environment, EPA should provide such
7 conclusions and statements. The Panel specifically recommends that:

- 8
9 • **In the final 2007 Report, EPA should incorporate a conceptual framework into**
10 **the introduction to illustrate the connectedness between the media, human**
11 **health, and ecological condition chapters.** The conceptual framework could be a
12 short but comprehensive description and figure that demonstrates scientific
13 understanding of the relationships between the stressors (drivers), responses and
14 outcomes to human health and ecosystem condition. An example conceptual
15 framework figure is provided in Appendix C of this advisory report. The conceptual
16 framework should address relationships between source, transport, and fate of human
17 and environmental health hazards, as well as exposure to receptors, dose, and impact.
18 The description of the conceptual framework might discuss efforts underway to
19 develop so-called linked indicators of environmental hazards and human health such
20 as the Environmental Public Health Tracking Project (National Association of County
21 and City Health Officials, 2007). The figure could be included in the introduction
22 and at the beginning of each chapter to provide overall context for the chapter and
23 illustrate how the chapters are connected. For example, in each chapter the relevant
24 parts of the figure that show the role and importance of a given chapter could be
25 highlighted in the graphic. This would provide the clear basis for the use and
26 prioritization of specific indicators, the choice of scale and boundaries in regional
27 indicators, and selection of metrics (i.e., thresholds, benchmarks, etc.). The choice in
28 scale and metrics would provide the appropriate context for future monitoring and
29 assessment of status and trends.
30
- 31 • **In Future Reports on the Environment a synthesis chapter should be included to**
32 **fully integrate the Reports and provide an overall assessment of health and**
33 **ecosystem status, trends and effects.** The synthesis chapter in future reports could
34 also analyze and discuss in more detail the connections among various related
35 indicators. For example, the relationship between nitrogen and phosphorus in
36 agricultural watersheds (in chapter 3) and fertilizer use (in chapter 4) could be
37 discussed. In this regard, a number of questions could be addressed, such as: Is there
38 any evidence that indicators are correlated? Is it possible to use the indicator data for
39 such an analysis? EPA should add a brief section to the final 2007 Report outlining
40 how a synthesis chapter could be developed in future Reports.
41
- 42 • **In appropriate places of the final 2007 Report, interconnections between the**
43 **indicators should be established by cross-referencing the discussion of indicators**
44 **in different chapters.** EPA should elaborate wherever possible on the relationships

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1 between indicators and the outcomes with respect to human health and ecological
2 condition.

- 3
4 • **In future Reports on the Environment, a summary section should be included**
5 **after each media chapter to summarize information presented in the chapter**
6 **and identify relevant emerging issues that could potentially affect human health**
7 **and the environment.**

8
9 *Statistical analysis*

10
11 The ROE 2007 Science Report states that, due to time and resource limitations,
12 statistical analysis of uncertainty and trends in indicators was not included. The Panel
13 finds that this has limited the usefulness of the Report, and that a statistical approach to
14 analysis and presentation of the data is needed. Without such information, the Report on
15 the Environment cannot fully meet its intended purpose of reporting scientifically
16 established trends in human health and environmental condition. The Panel understands
17 that EPA has begun this work for some indicators and that the analysis for those
18 indicators will be included in the final 2007 Report. It is our further understanding that
19 this work will eventually be completed for all indicators. The Panel understands that
20 some of the most important indicators are not well developed and few high quality data
21 sets may be available for these indicators. The Panel suggests that these indicators could
22 be used with the explanation that a higher level of statistical analysis and reporting will
23 be developed in the future. We encourage the effort to develop statistically established
24 trends and recommend that:

- 25
26 • **In future Reports on the Environment, EPA should incorporate statistical**
27 **analysis and interpretation in the reporting of all indicators.** This should be part
28 of the results presentation for each indicator. In some cases, this may involve formal
29 statistical analyses, whereas in other cases it may involve the inclusion of additional
30 information such as error bars around mean values. The Panel notes that this
31 approach should be developed taking into consideration the need for statistical
32 accuracy as well as the importance of using available information to report on
33 indicators of human health and environmental condition.

34
35 *Charge Question 1. Adequacy of formulation and scope of questions in the ROE 2007*
36 *Science Report*

37
38 The Panel was asked to comment on the adequacy of the formulation and scope of
39 questions posed in the ROE 2007 Science Report. Although the scope of the questions
40 posed in the Report is generally appropriate, questions are asked only about trends. The
41 scope of the questions should be broadened in the final 2007 Report to focus on status as
42 well as trends. This will reflect the importance of capturing information to represent a
43 baseline established as an initial step to evaluate trends when more data become
44 available. To help readers understand the importance of the questions and associated

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1 indicators, it is also important to explain the relationship between the questions and the
2 conceptual framework in the final 2007 Report. The Panel therefore recommends that:

- 3
- 4 • **In the final 2007 Report all questions should be broadened to ask “What are the**
5 **status and trends...” rather than focusing only on trends.** In some chapters of the
6 Report a few long term data sets are presented. However, the information in the
7 Report is focused more on status than trends. The questions should therefore address
8 both status and trends. In cases where a trend cannot be presented because only status
9 information is available, this should be clearly reflected in the discussion of what the
10 data show.
 - 11
 - 12 • **In the final 2007 Report, EPA should explicitly state how each question in the**
13 **Report is related to a conceptual framework.** The Panel recognizes that in the
14 Report EPA has included “policy relevant” questions that are important to the
15 Agency’s program offices. However, the conceptual framework should be
16 constructed and from the framework appropriate questions should follow.
 - 17

18 *Charge Question 2. Use of indicators to answer questions in the ROE 2007 Science*
19 *Report and presentation of indicator data in the chapter narratives*

20

21 The Panel was asked to comment on whether the indicators presented in the ROE
22 2007 Science Report were used appropriately to answer questions in the Report, and
23 whether narratives in the text accurately captured indicator information. EPA established
24 a set of criteria that were used to drive the process of selecting the indicators in the
25 Report. The criteria included rigorous data requirements for selection of indicators. The
26 Panel finds that, with some exceptions, the narratives in the text of the Report have
27 accurately captured the indicator data. However, the high data standards established by
28 the indicator selection criteria are restrictive and this has resulted in the exclusion of
29 many important indicators of status and trends in human and ecological health. As
30 further discussed in other sections of this advisory report, future Reports on the
31 Environment can be strengthened by including additional indicators and data sets that
32 may not meet the current selection criteria. Some additional indicators have also been
33 recommended for inclusion in the final 2007 Report. In particular, as discussed in
34 Section 10.0 below, indicators should be included in the final 2007 Report to represent
35 the status of and trends in ecosystem services. In addition, the Panel finds that the final
36 2007 Report should contain further discussion of the relationships between the indicators
37 and human health and ecological condition. The Panel specifically recommends the
38 following:

- 39
- 40 • **In the final 2007 Report, EPA should provide a clear description of why each**
41 **indicator is important, the rationale for selecting the indicator, what it tells, and**
42 **the documented relationship between the indicator and human health and**
43 **ecological condition. An example indicator description is provided in Appendix**
44 **C of this advisory report.** The description could be provided in an introductory

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1 section for each indicator that refers to the conceptual model or framework. This is
2 critical in order to enable the reader to interpret the meaning of the indicator relative
3 to the question. The primary stressors (e.g., air emissions data) are important
4 indicators but the Report should more fully explain how these stressors contribute to
5 answering questions in the Report.
6

- 7 • **In the final 2007 Report additional indicators should be included to capture the**
8 **status of and trends in ecosystem services.** For information on this topic, EPA is
9 referred to Meyerson et al., 2005. Ecosystem services classification and indicators
10 are further discussed in section 10.0 of this advisory report.
11
- 12 • **In future Reports on the Environment, the indicators selected should be clearly**
13 **related to the “big picture” fundamental questions, and not chosen just because**
14 **of data availability or compliance with indicator criteria (i.e., they are the only**
15 **indicators left after others have been eliminated).**
16
- 17 • **In future Reports on the Environment, EPA should consider relaxing the**
18 **restrictive indicator selection criteria so that additional indicators can be**
19 **included.** This will enable EPA to better evaluate trends and answer questions in the
20 Report. In this regard, regional indicators supported by long-term data sets may be
21 particularly useful. The Panel appreciates that this selectivity is in response to the
22 2004 review, but the Panel feels the selection criteria have been made too restrictive
23 and rigid such that useful data have been excluded. One way to revise the selection
24 criteria in order to identify useful regional indicators and data sets would be to
25 classify indicators according to completeness or rigor. This could supplement the
26 current approach of classifying the data as national or regional. For example,
27 indicators could be classified as high, medium, or low with respect to confidence in
28 the ability to detect trends based on data continuity. Although this is recommended
29 as a revision for future Reports on the Environment, some regional trend data may
30 currently be available and easily obtained. In these cases, revision of the final 2007
31 Report is recommended to use the available data. Additional specific indicators that
32 should be considered are identified in various sections of this advisory report. For
33 example, a coral reef indicator and National Oceanographic and Atmospheric
34 Administration status and trends data could be included if restrictive selection criteria
35 were relaxed.
36

37 The Panel recognizes that it is not a simple task to change the indicator selection
38 criteria to take into account the importance of additional long-term data sets and key
39 indicators in various media and systems. However, the conceptual framework of the
40 Report should drive the design of criteria that will enable selection of the best
41 indicators to answer questions posed in the Report.
42

- 43 • **In the final 2007 Report, additional trend data (classified as either qualitative or**
44 **quantitative) should be included for as many indicators as possible.** This is

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1 recommended as a revision for the final 2007 Report if data are available and
2 certainly as a revision for future Reports on the Environment.

- 3
- 4 • **In the final 2007 Report, EPA should identify the status of the monitoring**
5 **programs (e.g., extant, “on hold,” or expired) that have provided indicator data**
6 **used in the Report.** This will enable readers to determine whether additional trend
7 information will be available in the future.

8

9 *Charge Question 3. Discussion of indicator data gaps and limitations in the ROE 2007*
10 *Science Report*

11

12 Each question in the ROE 2007 Science Report is accompanied by a discussion of the
13 most critical indicator gaps, limitations, and challenges that prevent the question from
14 being fully answered. The Panel was asked to comment on the accuracy of
15 characterization of the indicator gaps and limitations, and the degree to which they limit
16 the ability to answer questions in the Report. In general, the Panel finds that most of the
17 indicator data gaps and limitations have been identified and clearly explained in the
18 Report. However, the Panel is troubled by the frequency of statements indicating that
19 long-term data were not available for many indicators, and that this precluded trend
20 analysis. The Panel appreciates this transparency but finds that there are too many
21 indicators in the ROE 2007 Science Report that use “snapshot” data. The Panel
22 acknowledges that baseline data are essential, but as noted above, in future Reports on the
23 Environment EPA should consider relaxing the indicator criteria, especially on a regional
24 basis, to allow the use of data sets that are amenable to trend analysis.

25

26 It is somewhat problematic that many of the indicators in the Report aggregate data
27 over a prolonged period of time. While this may be the result of the sampling
28 methodology, it should be mentioned and discussed as a weakness. For example, in the
29 presentation of the indicator “nitrogen and phosphorus in streams in agricultural
30 watersheds,” the data are aggregated over nearly 10 years, but it is safe to assume that
31 agricultural practices and land cover in each of the watersheds have changed over that
32 time. The Panel notes that these changes in agricultural practice may be a confounding
33 effect.

34

35 The Panel also notes that it is not always clear which bullets in the Report refer to
36 “indicator limitations” or to “data gaps.” This should be clarified in the final 2007
37 Report, and in future Reports on the Environment it may be useful to subdivide the data
38 gaps and limitations section into different types of limitations, instead of providing a
39 laundry list after each indicator. For example, the limitations could be grouped based on:
40 1) geographic limitations; 2) statistical limitations; 3) data coverage limitations; etc. The
41 following specific recommendations are provided to amplify and clarify the discussion of
42 indicator data gaps and limitations in the Report:

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- 1 • **In the final 2007 Report, EPA should clarify whether specific bullets in the**
2 **indicator limitations sections refer to indicator limitations or data gaps.**
3
- 4 • **In future Reports on the Environment, each of the sections that address data**
5 **gaps and limitations should be separated into clear discussions of types of**
6 **limitations (e.g., geographic, statistical, data coverage, etc.)**
7
- 8 • **In the final 2007 Report, the discussion of gaps and limitations should be**
9 **expanded to identify some of the more prominent available data sets that were**
10 **excluded and the reasons for their exclusion (e.g., technical concerns, lack of**
11 **statistical power, or other specific reasons).** This discussion should refer to the
12 indicator selection criteria and might identify indicators that could effectively narrow
13 data gaps but may not meet specific stringent criteria (e.g., older data sets that can be
14 used to show trends in important indicators, regional data sets that are of national
15 interest or case studies demonstrating a framework for discussion or national
16 applicability). This would help address questions about some omissions, such as fish
17 advisories issued by states and birth defect data.
18
- 19 • **In the final 2007 Report the discussion of data gaps and limitations should be**
20 **strengthened by adding or expanding existing information in several areas.**
21 These include: 1) Discussion of the need for a transparent set of indicator metrics that
22 can be well justified. The current choices of metrics and benchmarks are not well
23 justified. 2) The need to provide additional information on emerging issues such as
24 chemicals of emerging concern, exotic wildlife diseases or invasive species (the
25 emerging issues should be discussed at the end of each individual chapter). The
26 Panel specifically notes that perfluorinated chemicals should be added to the list of
27 emerging contaminants of importance in Chapter 7 of the ROE 2007. 3) Further
28 justification and discussion of limitations associated with the intervals of time used to
29 establish trends. To understand and account for such potential confounding effects,
30 the description of each indicator should include a discussion of the relevant time
31 periods that can be aggregated without losing integrity.
32
- 33 • **In the final 2007 Report, the implications of each indicator limitation should be**
34 **discussed, and the uncertainties associated with each limitation should be**
35 **quantified to the extent feasible.** One possible approach to address uncertainty
36 would be to assign a level of confidence to the inferences that can be drawn from the
37 data sets. Even a subjective evaluation would provide helpful information.
38

39 *Charge Question 4. Regionalization of national indicators in the ROE 2007 Science*
40 *Report*
41

42 The ROE 2007 Science Report has broken out national-level data for some of the
43 indicators by EPA region, and the Panel was asked to comment on the utility of this
44 approach. The panel notes that national-level indicators are by themselves insufficient

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1 for gauging the state of the U.S. environment. Nationally aggregated data cannot reflect
2 local and regional environmental trends that are important to the quality of life and health
3 of the residents living in these areas. Exposures to environmental contaminants may be
4 relevant at three scales: national (e.g., mercury emissions), regional (e.g., contaminants in
5 lake fish), and local (e.g., contaminated land sites). Moreover, disasters such as
6 Hurricane Katrina and “9/11” taught us that while the immediate direct effects of such
7 events are regional or local in scale, the overall long-term effects reverberate through the
8 nation. Similarly, a decline in the health of one region’s environment could affect the
9 entire nation. Therefore, national indicator data should be presented at the finest spatial
10 resolution that can be scientifically supported. For example, it would be valuable to
11 examine national trends in air quality as well as regional, state, and/or county trends.
12

13 The disaggregation of the national indicator data in the Report by EPA administrative
14 regions is useful for some purposes. For example, indicator data for individual EPA
15 regions could be used for goal setting and performance evaluation. However, this should
16 be done independently from the primary environmental assessments because the use of
17 EPA administrative regions to scale national data has little ecological justification and
18 does not provide particularly informative geographic descriptors of human health.
19 Appendix D of this advisory report provides further discussion of how ecoregionally
20 derived indicator information could be used for action and decision making by EPA
21 regional offices. The Panel finds that a preferable approach would be to analyze the air,
22 water, land, human health, and ecological condition indicators using appropriate airshed,
23 watershed, and ecoregional units. A useful approach to regionalization of indicators may
24 be to include two subcomponents for each indicator: 1) a national metric of some kind,
25 with the obvious caveat that data aggregation can lead to masking of local trends; and 2)
26 a consistent (whenever possible) approach to showing regional data, preferably based on
27 ecologically justifiable regions, not EPA administrative regions. The following specific
28 recommendations are provided regarding this approach.
29

- 30 • **In future Reports on the Environment EPA should analyze the air, water, land,**
31 **human health, and ecological condition indicators using appropriate airshed,**
32 **watershed, and ecoregional units.** However, the appropriate scaling for indicator
33 analysis and reporting must be considered on an indicator-by-indicator basis. This is
34 true also for temporal scaling issues and the appropriateness of data aggregation over
35 time and space.
36
- 37 • **In the final 2007 Report, if EPA administrative regions continue to be used as**
38 **the basis for regionalizing data, the Panel recommends that this process be**
39 **better explained.** For example, it is unclear why the data are not presented
40 consistently for each Region. Presenting these data consistently for each EPA Region
41 would at least provide more comparability, although it will not address the bigger
42 issue of ecological validity. The strengths and limitations of using EPA
43 administrative regions to regionalize data should also be discussed.
44

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1 *Charge Question 5. Utility of regional indicators in the ROE 2007 Science Report*
2

3 EPA has included ten regional indicators in the ROE 2007 Science Report. The Panel
4 was asked to comment on the utility of regional indicators in answering the questions in
5 the Report. The Panel finds that regional indicators and case studies should be used in
6 future Reports on the Environment when they may be of particular value for use in trend
7 analysis, or provide information that is vital to the nation's interest (e.g., topsoil
8 preservation in the central Midwest). Examples will be most valuable if they can be
9 replicated across the U.S. In addition, important regional issues, such as the ecological
10 health of the Great Lakes or the Everglades, should be addressed in a national report on
11 the environment. The Panel notes, however, that the justification for the inclusion of
12 particular regional indicators is not clear in the current draft of the Report on the
13 Environment and therefore appears somewhat arbitrary. It is difficult to understand why
14 the current regional indicators have been chosen, as they do not appear to provide value
15 for replication elsewhere.

16
17 The Panel finds that the use of regional examples is particularly useful in cases where:
18

- 19 - They present the successful application of an approach, model or tool that may
20 have wider application. For example, the conceptual approach used for Biscayne
21 Bay may have application to a wide range of problems in quite different
22 environments, and the connectivity done for EPA Region 4 may have broader
23 applications.
- 24
25 - They serve to explain the functioning of the ecosystem and help build
26 understanding of a conceptual framework of wider application. Diagrams of
27 conceptual models or frameworks might be linked (especially in the web version
28 of the "e-ROE") to regional examples that demonstrate processes or cause and
29 effect relationships.
- 30
31 - They have wider applicability to areas within the same ecologically relevant
32 region or type. Case examples can be very effective if the Report is built around
33 natural systems (for example, tidal wetlands, dunes, tundra).
- 34
35 - They have long-term data sets that permit explanation of trends. This would be
36 especially useful where nationwide data sets have limited time series.
- 37
38 - They represent an issue of national importance and deserve illumination even if it
39 fails to meet the other criteria. Significance may stem from its natural resource
40 value (e.g., Great Lakes), or from its importance as an emerging issue
41 (nanotechnology, pharmaceuticals).
- 42
43 - They provide a higher resolution example of a nationwide indicator.
44

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1 The following specific recommendations are provided concerning the use of regional
2 data sets and indicators:

- 3
4 • **In future Reports on the Environment, it is recommended that EPA identify
5 and use, with appropriate caveats, more regional indicators and data bases to
6 illustrate trends when national data sets are not available.** The Panel notes,
7 however, that such regional data are not a substitute for national or even
8 representative national data and can be misleading if not carefully presented.
9 Regional indicators should also be used in future Reports on the Environment when
10 they have national importance or are of particular significance to local populations.
11 Long-term, well-supported data sets are available for such regional indicators.
12 Examples include data available from: the National Science Foundation's Long
13 Term Ecological Research Program sites, USGS groundwater basins, state agencies,
14 and data collected on Lake Tahoe, Lake Mendota, and the Great Lakes.
15
- 16 • **In future Reports on the Environment, it is recommended that EPA develop
17 clear and transparent criteria that are uniformly used for the selection of
18 regional indicators and case studies, with the recognition that not all data will
19 meet the criteria for these regional indicators.** For example, regional indicators
20 should have long-term well supported data sets, be of particular national or local
21 significance, or represent an assessment approach that that could be replicated.
22

23 **6.0 AIR CHAPTER COMMENTS**

24 *Charge Question 1. Adequacy of formulation and scope of questions in the air chapter*

25
26
27 In general, the Panel finds that the scope of questions in the air chapter of the Report
28 is appropriate. However, it is problematic that the indicator data in the chapter are
29 presented in isolation. A science framework consisting of a process model and
30 discussion is needed in the final 2007 Report to provide context for the components by
31 showing the interaction within, between, and among media and indicators as well as the
32 effects on human health and ecosystem condition. The lack of such a framework is a
33 significant problem. It is critically important for EPA to understand that data presented
34 in isolation are not science. It is only when the data are explained as well as
35 appropriately interrelated across factors and chapters that one gains the scientific
36 understanding of what the data mean. The following recommendations are provided to
37 improve the formulation and scope of the questions in the air chapter.
38

- 39 • **In future Reports on the Environment, the discussion provided in the response
40 to the indoor air quality question should be expanded.** The Panel finds that the
41 discussion of indoor air and related indicators is too limited considering the
42 importance of the indoor environment and the amount of time spent by the population
43 indoors. While indoor environments do not fall within the statutory mandate of EPA,
44 exclusion of available and relevant data makes the Report incomplete. Because of the

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1 importance of consumer products (e.g. solvents, paints, glues, and building materials)
2 as a determinant of indoor air quality and exposure, we encourage EPA to consider
3 whether there are appropriate consumer product data available that satisfy the criteria
4 for uses as an indicator. For example, data regarding changes in the benzene content
5 of gasoline, paints, and varnishes with time would provide a powerful indicator of
6 human exposure. Similarly, data concerning changes in formaldehyde content of
7 particle board and other building materials would be relevant and informative of
8 indoor air quality and human exposure.

9
10
11 *Charge Question 2. Use of indicators to answer questions in the air chapter of the ROE*
12 *2007 Science Report and presentation of indicator data in the chapter narrative*
13

14 Overall, the Panel finds that the integrity of the indicator information is maintained in
15 the air chapter narrative, but as noted above, the indicators are not adequately linked to
16 information across the various other Report chapters. A short historical section
17 containing background information on the criteria pollutants is needed in the final 2007
18 Report to provide an understanding of the importance of these pollutants as indicators,
19 how they have been tracked, and their relationship to other indicators in the Report.
20 Because the Report contains no history of the air indicators, there is no indication of how
21 long the air monitoring networks have been in place. This knowledge would give the
22 reader a sense of the importance that EPA places on the air monitoring networks.
23 Further, it would provide the opportunity for the reader to learn about the various types of
24 air monitoring networks. The air chapter then can have a discussion of questions that
25 integrate across the pollutants. In addition, it is important to discuss issues such as trends
26 in climate (such as increased radiation from stratospheric ozone depletion) that likely lead
27 to secondary pollutant problems. There is a clear need to look at the air chapter from the
28 whole atmosphere perspective instead of simply isolated atmospheric components.
29

30 The most significant shortcoming in the air chapter is the fact that the pollutant-by-
31 pollutant recounting approach does not show the interplay of the various criteria and
32 toxic pollutants with one another or the role of stratospheric ozone depletion and climate
33 change on air quality. Put another way, a holistic picture of the chemistry of the
34 atmosphere is missing. The Panel notes that substantial gains have been made in limiting
35 the emissions of specific primary pollutants and it is increasingly recognized that the
36 interplay among multiple air pollutants (i.e., air pollutant mixtures) is largely responsible
37 for the human health impacts of air pollution. Human activities have made the
38 atmosphere more oxidizing through increases in NO_x emissions. This leads to greater
39 ozone, more rapid conversion of SO₂ to SO₄⁻², NO_x to NO₃⁻, and biogenic and
40 anthropogenic volatile organic compounds (VOCs) to secondary organic aerosols. Thus,
41 one cannot really look at the problem of ozone and fine particulate matter without
42 considering SO₂ and NO_x emissions all together. NO_x has been controlled to the point
43 where it does not have direct health impacts (the basis for the level in the NO₂ primary
44 national ambient air quality standards [NAAQS]), but that approach fails to achieve

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1 control of O₃ and PM_{2.5} (Particulate Matter less than 2.5 micrometers in diameter). The
2 discussion of VOCs in the air chapter is almost entirely focused on anthropogenic VOCs,
3 but it is now recognized that for many parts of the U.S., biogenic VOCs dominate and it
4 is necessary to think very differently about how to bring about continuing improvements
5 in air quality. Thus, the pollutant-by-pollutant evaluation or “stove piping” within the air
6 chapter does not really provide a clear picture of the current status of air quality and what
7 must be done in the future to continue the gains made over the past 35 years. Local
8 sources no longer contribute to local concentrations that can be dealt with locally. Those
9 sources have been or are being controlled through either air quality state implementation
10 plan (SIPs) processes or maximum achievable control technology (MACT) and residual
11 risk. New conceptualization of the problems is needed. Recitation of pollutant-by-
12 pollutant gains without a truly integrative description of their interplay fails to provide
13 the public or other policy makers of the full picture of the state of the atmospheric
14 environment.

15
16 The Panel notes that the Report contains some discussion of trends in air indicators,
17 but it is unfortunate that there is neither mention nor discussion of the direction of trends
18 in air indicators 10 to 20 years into the future. The Agency should discuss ongoing
19 efforts, activities and/or programs that can be qualitatively described to make the point
20 that future trends are not static, and that processes are in place that will lead to ever-
21 improving air quality. This would provide the reader with the rationale for the suggestion
22 that improving air indicator trends will continue into the future. It must be made clear to
23 the reader that EPA views air quality management as an ongoing process. The Panel also
24 notes that EPA used data from sites going back to 1990 to demonstrate declining trends,
25 but it is not clear that the same data for these sites during the past 5 years would provide
26 the same understanding of trends. The issue of base year and site selection bias must be
27 considered and a transparent description of the analysis must be provided. In addition,
28 the Panel notes that when regional indicators are considered the picture of air quality may
29 change. It is important for EPA to consider whether all of the available relevant
30 information is being used in the Report.

31
32 A number of missing air indicators have been identified below and in Appendix A of
33 this advisory report. These indicators should be added to the future Reports on the
34 Environment because they represent important trends in air quality, or present a more
35 holistic picture of atmospheric chemistry. The Panel also notes that the reference to acid
36 deposition in the air chapter seems out of place as presented. It would appear to be more
37 appropriate to refer to this in the water and land chapters. That being said, the Panel
38 recognizes that this may be a contradictory suggestion because EPA is being advised to
39 provide greater integration while at the same time being advised to remove the reference
40 to acid deposition (an integrating indicator) from the air chapter. However, it is not
41 unreasonable for given indicators to appear in different chapters as long as there is a clear
42 cross reference across the chapters and the reason for the cross reference clearly
43 explained.
44

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1 The following specific recommendations are provided to improve the air indicators in
2 the Report.

- 3
- 4 • **As stated in the overarching recommendations, a science framework is should be**
5 **incorporated into the air chapter of the final 2007 Report to show the interaction**
6 **within, between and among media as well as between and among indicators.** The
7 data presented must be explained because data presented in isolation are not science.
8 In addition, the health/environmental relevance of the air indicators should be better
9 documented with more extensive reference to the epidemiologic evidence as well as
10 the environmental evidence.
 - 11
 - 12 • **In the final 2007 Report, a short historical section should be added to the air**
13 **chapter to provide background information on the criteria pollutants.**
 - 14
 - 15 • **In the final 2007 Report, SO₂ concentration should be added to the air chapter**
16 **as an indicator.** The Panel notes that this is a “good news” story for both EPA and
17 the environment. SO₂ emissions controls have resulted in significant reductions in
18 ambient SO₂ concentrations. This has also resulted in a reduction in the amount of
19 acidic deposition attributable to SO₂ emissions.
 - 20
 - 21 • **In the final 2007 Report, an air toxics indicator should be added to the air**
22 **chapter.** This is an important and rapidly emerging human and environmental health
23 issue and it should be expanded. Currently the air chapter presents an air toxics
24 emissions indicator as an aggregate of 188 compounds. A more informative
25 description could be presented to provide additional information concerning specific
26 toxics (see also the following recommendation concerning the National Emissions
27 Inventory). The Panel also notes a disconnect in data between 1990 and 1999 and
28 suggests that the Agency could look at the possibility of using estimates to determine
29 trends. Trends in ambient concentrations of toxics could be developed by looking
30 beyond the regional scale to the local level where additional monitoring data are
31 available. While it is true that in the current network the benzene data are the most
32 robust, it should be anticipated by EPA that in the future the network will be more
33 robust for additional chemicals of concern.

34

35 Further, it is not clear in the text what the difference is between Persistent Organic
36 Pollutants (POPS), Persistent Bioaccumulative and Toxic chemicals (PBTs), and
37 Hazardous Atmospheric Pollutants (HAPS). Sometimes the terms air toxics and
38 HAPS are used as synonyms. Since the ROE 2007 Science Report is to be read by
39 the general public, it is essential that all of the terms used in the text be clearly and
40 unambiguously defined and used consistently. This becomes an important integration
41 issue when chemicals and the responses to those chemicals appear in different media
42 chapters. Reference is made in the water chapter, for example, to compounds also
43 found in the air chapter but no cross-referencing is evident. Clearly, EPA needs to do
44 more with the air toxics. .

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- 1
2 • **In the final 2007 Report, a broader explanation of what is in the National**
3 **Emissions Inventory (NEI) should be added to the air chapter.** This is important
4 because there is reference in the text to the Toxic Release Inventory (TRI) and
5 Persistent Bioaccumulative and Toxic (PBT) chemicals.
6
7 • **In the final 2007 Report, further analysis of the trends in air indicators should**
8 **be added to the air chapter.** While it is important to know whether air indicator
9 trends are increasing or not, it is important for the reader to understand the reason for
10 the direction of indicator trends. The Report should state where have we been, where
11 we now, and where we are going. As it stands, there is no history provided on how
12 the air indicators were developed or evolved, or what may have influenced a certain
13 trend (e.g. banning lead from gasoline resulted in a precipitous decline in atmospheric
14 lead concentrations).
15
16 • **In the final 2007 Report, an indicator should be added to the air chapter to focus**
17 **on the clear reduction of primary pollutants (CO, SO₂, and Pb) but much flatter**
18 **trends in secondary pollutants (O₃ and PM_{2.5}), reflecting the growing importance**
19 **of secondary air pollutants.** These pollutants are becoming increasingly important
20 as regulatory efforts have resulted in reductions of major primary pollutants. Such an
21 indicator would allow EPA to show the interaction of the atmospheric components
22 and would help to pull the pieces together conceptually. It also allows one to bring in
23 the more complex issues such as climate and ozone.
24
25 • **In the final 2007 Report, a small piece should be added to the air chapter to**
26 **discuss how climate is affecting aerosols.** A paragraph would be appropriate. This
27 paragraph would create the opportunities in the text to emphasize the interactions
28 among pollutants, the importance of secondary pollutants, and the complexity of the
29 atmospheric chemistry.
30

31 *Charge Question 3. Identification of gaps and limitations of the air chapter indicators*
32

33 Overall, the Panel finds that most of the gaps and limitations of air chapter indicators
34 have been identified. That being said, the Panel provides a number of suggestions for
35 informational improvements to the gaps and limitations to provide a better understanding
36 of the meaning and relevance of the indicators. The Panel finds that indicator limitations
37 are presented in a generally pro forma and mechanical fashion. There is virtually no
38 discussion of whether, and how, these limitations should affect the reader's interpretation
39 of the estimates with regard to magnitude of point estimates or shape of trends. With the
40 exception of the ambient concentration indicators for criteria pollutants, benzene, and
41 manganese in Region 5, quantitative estimates of uncertainty are lacking, leaving
42 unanswered questions concerning the robustness of the majority of the indicators.
43

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1 The Panel also finds that in the discussion of gaps and limitations of the air indicators,
2 more emphasis should be placed on how limitations fit into the “big picture,” or how
3 changes in outdoor concentrations may have increased or decreased the importance of
4 other contributors to exposure and health risk. For example, given what is known,
5 information should be provided to indicate how decreases or increases in ambient
6 contaminant concentrations are reflected in total exposure and human and ecosystem
7 health. It is important to know whether the trends in decreasing ambient concentrations
8 for certain contaminants are reflected to the same extent in bio-measurements (human
9 and other organisms) beyond Lead (Pb). These are questions that require thinking more
10 comprehensively than the media-by-media presentation. The Panel also notes that in the
11 air chapter, as well as other chapters, the final 2007 Report should offer approaches
12 and/or solutions to filling gaps and limitations. The following specific recommendations
13 are provided to improve the discussion of indicator limitations in the air chapter.

- 14
- 15 • **In the final 2007 Report, EPA should acknowledge and discuss the limitations of**
16 **a single pollutant, local source approach to pollution control in the context of the**
17 **marked reductions in individual pollutants documented by the indicators, and as**
18 **exemplified by continuing challenges with regard to ozone and PM_{2.5}.** The
19 significance of temporal trends viewed in the light of the importance of primary vs.
20 secondary pollutants (specifically with respect to PM and ozone) should be discussed.
21
- 22 • **For the final 2007 Report, EPA should view the PM speciation network as the**
23 **vehicle to provide the needed information on PM composition.**
24
- 25 • **In the final 2007 Report, the bias that may result from the choice of base year**
26 **for trends for a given air indicator should be discussed, as this has implications**
27 **in the interpretation of the air indicator data.**
28
- 29 • **In the final 2007 Report, the effects of trends in ambient concentrations of air**
30 **pollutant indicators on exposure and dose should be discussed.**
31

32 *Charge Question 4. Regionalization of the national Report on the Environment*
33 *indicators in the air chapter*
34

35 The Panel finds that the concept of having “national” as well as “regional” air
36 indicators would be very informative if an appropriate approach were used. The main
37 problem with the approach currently used in the air chapter is that the EPA regions are
38 artificial administrative units that do not reflect airsheds. In addition, the national air
39 quality data are dominated by data from urban air quality monitoring stations. The
40 extrapolation of air indicator data from national to regional to subregional levels (e.g.,
41 states, cities) could be extremely misleading unless the inherent limitations of the data are
42 clearly understood.
43

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1 *Charge Question 5. Utility of the regional indicators in answering the questions in the*
2 *air chapter*

3
4 The Panel finds that regional air indicators would be very useful as long as their
5 application has a sound scientific basis. Unfortunately, this is generally not the case in
6 the air chapter. As noted above, the EPA regions do not correspond to airsheds but rather
7 artificial administrative units. That being said, the Agency could get around this dilemma
8 by carefully defining the “region” according to an air issue. While two examples of
9 regional indicators are provided in the chapter (Manganese within Region 5 and PM
10 along the U.S.-Mexico border), the basis for the selection of these indicators is not
11 evident. This illustrates the need for EPA to consider developing and providing air
12 indicators for ‘hot-spot’ locations/areas. For future Reports on the Environment, more
13 conceptual development is required by EPA with respect to applying regional and sub-
14 regional (i.e., hot spot) air indicators.

15
16 *Charge Question 6. Overall quality of the air chapter with respect to technical accuracy,*
17 *clarity, and level of communication*

18
19 The Panel finds that the air chapter fails to provide the critical links between the
20 observed changes in concentrations of pollutants and the understanding of the functioning
21 of the atmospheric environment. The air chapter benefits from a long record of
22 atmospheric monitoring that provides a wealth of data. Data are an essential part of
23 science because they provide the basis for developing an understanding of the sources,
24 processes and fate of the measured constituents. However, the final 2007 Report should
25 do more than report data. The pollutant-by-pollutant presentation does not adequately
26 reflect the understanding of the interrelationships among the measured species. As
27 mentioned above, there are key trends in the understanding of the atmosphere that should
28 be addressed in the final 2007 Report, such as the clear reduction of primary pollutants
29 (CO, SO₂, lead) but much flatter trends in secondary pollutants (O₃, PM_{2.5}). NO_x has
30 been controlled to the point where it does not have direct health impacts (the basis for the
31 level in the NO₂ Primary NAAQS), but leaves concentrations that permit formation of O₃
32 and PM_{2.5} that lead to air quality violations. As mentioned above, the discussion of
33 VOCs in the air chapter is almost entirely focused on anthropogenic VOCs. However, it
34 is now recognized that for many parts of the U.S., biogenic VOCs dominate. In addition,
35 the relationships between climate change and stratospheric ozone depletion, and
36 tropospheric chemistry that enhances key pollutants (O₃ and PM_{2.5}), provide an important
37 link between these currently isolated aspects of the chapter and other air pollutants which
38 the EPA monitors. Thus, to improve understanding of atmospheric processes and achieve
39 continuing improvements in air quality, indicator data such as those currently presented
40 in the air chapter must be treated as a valuable resource but not an end in themselves.
41 More attention needs to be paid to the “one atmosphere” concept that EPA has been
42 trying to implement, and to using the data to demonstrate how they have improved our
43 understanding of the atmospheric system in the U.S.

44

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1 **7.0 WATER CHAPTER COMMENTS**
2

3 *Charge Question 1. Adequacy of formulation and scope of questions in the water chapter*
4

5 The Panel finds that the overall broadness and consistency of the questions in the
6 water chapter of the ROE 2007 Science Report are appropriate given EPA's mission and
7 the scope of the Report. However, the questions in the water chapter do not adequately
8 address the interconnectedness of different water systems and both land-water and air-
9 water interactions. The Panel also finds that additional questions are needed to
10 incorporate missing information on critical habitats and thematic elements. The
11 following specific recommendations are provided to improve the formulation and scope
12 of the questions.
13

- 14 • **In the final 2007 Report, the questions in the water chapter should be expanded**
15 **to focus on the interconnectedness of different systems (both within the different**
16 **water types and across media).**
17
- 18 • **In the final 2007 Report, additional questions should be included in the water**
19 **chapter to incorporate missing information on availability and usage of water**
20 **for human activities, especially with respect to both ground water and surface**
21 **water withdrawals (see data in Roy. et al., 2005 and Solley et al., 1995).**
22
- 23 • **In future Reports on the Environment, additional questions should be included**
24 **in the water chapter to incorporate missing information on critical habitats or**
25 **thematic elements such as:**
26
 - 27 - Extent and condition of coral reefs;
 - 28 - Wastewater management information (it is recommended that EPA review
29 available National Pollution Discharge Elimination System data for possible
30 useful indicators);
 - 31 - Extent and condition of, and trends in, riparian zones and lake shoreline (i.e.,
32 land-water interface, where much of the biological activity occurs), and their
33 effects on human health and the environment; and
 - 34 - More national indicators and analyses providing data and information on non-
35 indigenous invasive species.
- 36
- 37 • **In future Reports on the Environment, some key model aquatic systems should**
38 **be identified in several ecoregions of the U.S. and data collected from these**
39 **systems should be mined and analyzed in the context of questions presented in**
40 **the Report.**
41
- 42 • **For future Reports on the Environment, EPA should examine the 2004 National**
43 **Research Council Report on national and global water resources and water**
44 **infrastructure problems, and the importance of research in addressing them**

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1 **(National Research Council, 2004)**. In this regard, relevant questions to be
2 considered include: (1) Will drinking water be safe? (2) Will there be sufficient water
3 to support both the environment and future economic growth? (3) Can effective
4 water policy be made? (4) Can water quality be maintained and enhanced? (5) Will
5 our water management systems adapt to climate change? While the Panel recognizes
6 that some, if not most, of these questions are outside the narrowly defined scope of
7 the ROE 2007 Science Report, EPA should consider addressing these questions
8 because they help place the water media chapter into context .
9

- 10 • **In the final 2007 Report, EPA should examine the relevance of measures of**
11 **“Extent and Condition” across all aquatic ecosystem types.** In this regard, the
12 Panel finds that the question on the “extent” of coastal waters is not meaningful
13 because for coastal waters, the issue of importance is their condition not their extent.
14

15 *Charge Question 2. Use of indicators to answer questions in the water chapter of the*
16 *ROE 2007 Science Report and presentation of indicator data in the chapter narrative*
17

18 In general, the Panel finds that the narratives in the water chapter of the ROE 2007
19 Science Report have accurately captured the indicator data. However, there is a lack of
20 acceptable water indicators to provide answers to the questions in the chapter. In this
21 regard, the following concerns are noted.
22

- 23 - The indicators selected to address freshwater issues are all based on streams and
24 rivers. It is problematic that there is no mention of any indicators for lakes, ponds,
25 and reservoirs.
26 - The section in the water chapter on wetlands provides minimal analysis of available
27 data. The Panel finds that addressing only loss or gain in wetland acreage as an
28 indicator is not adequate.
29 - Only total nitrogen and phosphorus are used as nutrient indicators in the water
30 chapter. Other nutrient indicators mentioned below should be considered.
31 - The drinking water section of the water chapter needs additional critical analysis to
32 consider the implications of drinking water quality to human health. For example, the
33 water chapter indicator dealing with "drinking water" covers only the number of
34 systems that have not reported exceedances of maximum contaminant levels (MCLs).
35 The Panel finds that it would be more informative to report this indicator in the final
36 2007 Report as the number of systems that have had exceedances, and include data on
37 which contaminants were present and the degree to which they exceeded the MCL.
38 - The lack of microbial indicators in the water chapter makes it difficult if not
39 impossible to ascertain human health implications and impairment of water resources
40 due to fecal pathogen contamination, regulated contaminants, or EPA Contaminant
41 Candidate List elements. In the case of pathogens, this is an unfortunate void (as
42 implied in the water chapter limitations and gap analysis) given that there is a non-
43 ambiguous (etiological) link between pathogen exposure and disease, albeit an
44 unclear dose-dependent relationship. In earlier U.S. EPA Water Quality Inventory

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1 Reports to Congress (U.S. EPA, 2000), pathogen data were evaluated and used to
2 classify contributions to pollution of water resources. It was noted that pathogens
3 were either the first or second primary pollutant contributing to non-attainment of
4 water quality standards for estuaries, coastal shoreline, and rivers and stream. These
5 data, once obtainable from the states, are apparently no longer accessible or have
6 been judged statistically or probabilistically unreliable for accurate trend analysis.
7 EPA should look for ways to obtain these data again (perhaps collaboratively with
8 states).

- 9 - It appears that many of the indicators used in the water chapter are composite or
10 multi-metric in nature. These indicators are useful, but the Panel recommends that
11 they be complemented with single metric indicators that are easier to understand and
12 require fewer caveats and assumptions.
- 13 - In the water chapter there is very limited inclusion of data on specific toxic industrial
14 chemicals and contaminants, of either a regulated or unregulated nature, for which
15 EPA has statutory responsibility under the Clean Water Act. Analysis of specific
16 toxic and bioaccumulating chemicals, other than pesticides, is largely confined to fish
17 tissue contaminant concentration. The lack of such information for streams, rivers,
18 and sediments makes it difficult to discriminate sources of contamination and
19 impairment (e.g., urban/industrial vs. agricultural).
- 20 - The water chapter data on “pesticides in agricultural streams” are comprised of
21 measurements of concentrations in the water only. However, the Panel notes that
22 many of these chemicals are hydrophobic and are better analyzed in the sediments
23 and biota rather than in the water column, where they may appear low even in
24 situations where biota may be impacted by their elevated levels in the sediments. It is
25 also unclear why these concentrations were compared with EPA’s MCLs for drinking
26 water. People are not generally drinking water out of agricultural streams, so the
27 focus on pesticide concentration should be their toxicity to biota living in the streams,
28 not to human consumers of drinking water.
- 29 - The section of the water chapter on “coastal fish tissue contaminants” includes
30 analyses of many species of fish, and indicates that 22% of the sites showed high
31 contamination. However, the contaminant data are pooled from many different
32 species of fish and shellfish from different habitats, trophic levels, and age classes.
33 The Panel notes that these factors strongly influence the degree to which a particular
34 species bioaccumulates various contaminants.

35
36 It is suggested that in the water chapter of future Reports on the Environment it should
37 be possible to develop internally consistent local or regional indicators (covering
38 individual environmental units or ecological provinces) in those cases where data for
39 national indicators are not available or do not meet the criteria for inclusion in the ROE
40 2007 Science Report. Indicator data from different watersheds or hydrological basins
41 may not be directly comparable with each other, but the local or regional sets of data can
42 provide meaningful temporal trends.
43

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1 The Panel also finds that the final 2007 Report should contain better justification for
2 some of the schemes used to grade indicators in the water chapter. In some instances
3 (e.g., trophic state of coastal waters) the grading of “high, medium and low” quality are
4 quite understandable. On the other hand, the low, medium, and high grading of “nitrogen
5 and phosphorus in wadeable streams” presented on pages 3-22 and 3-23 is confusing. It
6 is hard to understand why the grading is “low” when it is below the 75th percentile for the
7 reference. It appears this system was used because of statistical analyses that are not
8 discussed in the Report. Providing only qualitative indication (such as low nitrogen,
9 medium nitrogen, and high nitrogen or low flow and high flow) is not adequate for those
10 who would like to use this report as a guide to determine the state of these systems. The
11 Panel suggests that it might be better to provide a range of values in the final 2007 Report
12 for each of these parameters presented. The following specific recommendations are
13 provided to address the concerns noted above.

- 14
- 15 • **In future Reports on the Environment, EPA should include appropriate**
16 **indicators of condition of lakes, ponds, and reservoirs.**
- 17
- 18 • **In future Reports on the Environment, EPA should consider including the**
19 **following important specific indicators:**
 - 20 - **Snow pack (extent, condition, and volume)**
 - 21 - **Pathogens (coliforms, enteric viruses, toxins, etc.)**
 - 22 - **Storm water and wastewater (contaminant effects)**
 - 23 - **Drinking water primary contaminants (e.g., microbial indicators and**
24 **pathogens: bacterial, viral or protozoan)**
 - 25 - **Contaminants of emerging concern such as pharmaceutical and personal**
26 **care products, perfluorinated chemicals, brominated flame retardants,**
27 **nanoparticles, and others.**
- 28
- 29 • **In future Reports on the Environment additional wetland data should be used.**
30 In many areas, wetlands will indicate more efficiently the ecological integrity of the
31 entire watershed than will any other portion of the landscape. New data on basic
32 wetland soil, vegetation, and periphyton characteristics are now emerging in various
33 ecoregions. These data can provide important information. In addition, some of the
34 possible complementary or alternative wetland indicators may include
35 biogeochemical processes, such as organic matter decomposition and accretion,
36 denitrification, phosphorus saturation, sulfate reduction, and indices of biotic integrity
37 (IBIs) which can provide early indications of impending ecological changes.
- 38
- 39 • **For future Reports on the Environment, EPA should evaluate whether nutrient**
40 **indicators based on bioavailable nitrogen and phosphorus or**
41 **nitrogen:phosphorus ratios may be more useful.**
- 42
- 43 • **For future Reports on the Environment, EPA should develop drinking water**
44 **indicators based on the available data from the Agency’s own databases and the**

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1 **consumer confidence reports released to the public annually by community**
2 **water systems.** Based on these data, EPA could formulate indicators that can
3 delineate trends in drinking water quality. The water chapter should include source
4 water monitoring data in addition to treated water quality data.
5

- 6 • **For future Reports on the Environment, pathogen monitoring should be**
7 **investigated as a primary indicator for water quality trends and human health**
8 **effects across various water sources.** This recommendation would encourage more
9 cooperation with states in providing data for analysis for longer term trends.
10
- 11 • **In future Reports on the Environment, composite or multi-metric indicators**
12 **should be complemented with single metric indicators that are easier to**
13 **understand and require fewer caveats and assumptions.** For example, the coastal
14 benthic communities indicator could be supplemented with data on the abundance of
15 key reference organisms that are particularly important to ecosystem function in each
16 region (i.e., keystone species), or species that have special value to the stakeholders
17 of the region (e.g., manatees in Florida or coho salmon in Pacific Northwest).
18
- 19 • **In the final 2007 Report, data for the indicator “pesticides in agricultural**
20 **streams” should not be compared to human health benchmarks.** In future
21 Reports on the Environment, data should reflect pesticide toxicity to stream biota
22 (e.g., sediment concentrations of pesticides could be considered).
23
- 24 • **In future Reports on the Environment, EPA should incorporate more**
25 **information on specific toxic industrial chemicals for which the Agency has**
26 **statutory responsibility under the Clean Water Act.**
27
- 28 • **In future Reports on the Environment, EPA should analyze fish tissue**
29 **contaminant data by different species, or at least conduct separate analyses of**
30 **fish from different trophic levels or different habitats (as was done for the “lake**
31 **fish tissue” indicator) to see which species (e.g., piscivores) are more likely to**
32 **have higher levels of contaminants than others.**
33

34 Additional technical comments and recommendations concerning the specific
35 indicators in the water chapter are provided in Appendices A and B of this report.
36

37 *Charge Question 3. Identification of gaps and limitations of the water chapter indicators*
38

39 In general, the Panel finds that EPA has effectively identified and communicated the
40 gaps and limitations of the indicators in answering questions posed in the water chapter
41 of the ROE 2007 Science Report. However, it is disappointing that many of the
42 indicators used in the chapter are recent and do not include many years of prior
43 monitoring to show trends, so this gap/limitation is cited frequently. This is in striking
44 contrast to the air chapter of the Report in which numerous graphs with downward trends

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1 are presented showing the overall improvement in release and ambient concentrations of
2 various air pollutants (with the exception of greenhouse gases which are going up). The
3 Panel finds it hard to understand why the data collected for the last three decades on
4 various water systems are not adequate to determine status of and trends in the ecological
5 condition of water systems. The gaps identified in the water chapter (e.g., on page 3-40)
6 for freshwater systems highlight the need for more data. The Panel notes that more data
7 will not necessarily answer the questions presented in Report, but it may be helpful to use
8 additional data from well-planned and consistent monitoring of representative systems.
9

10 In several instances the "indicator limitations" discussion in the water chapter
11 addresses or provides recommendations on how to interpret indicators. In these instances
12 the discussion is most often focused on interpretation of indicators to show human health
13 effects. The Panel finds that the discussion of how to interpret indicators or, show what
14 they mean, would fit better in the section of the water chapter titled, "what the data
15 show." Alternatively, to address the need for cross-media linkages, it is suggested that
16 EPA could add a separate section titled, "what does this mean for human health." An
17 example of such a limitation is on page 3-27 in the discussion of the nitrate in streams
18 indicator. The text states that, "Drinking water treatment can significantly reduce
19 concentrations of nitrate, so the level of contaminants reported in this indicator is not
20 necessarily representative of exposures to people when these waters are used as public
21 water supplies." The Panel notes that this is a separate issue from the sample design and
22 temporal limitations of the data set, concerns that most commonly appear in the indicator
23 limitations list. The interpretation statement included on page 3-27 raises important
24 human health questions that could well be addressed by providing additional information.
25 These include questions such as: How many communities rely on these streams for their
26 water supply? How many communities rely on the streams that had nitrates above the
27 MCL? How many communities treat their water for nitrate? The Panel notes that while
28 treatment can reduce nitrate levels, it is often cost prohibitive and communities must find
29 an alternate water supply. In addition, a high percentage of residents in rural areas
30 depend on private water wells which have no treatment capability. Because surface water
31 contamination in streams often has a direct bearing on ground water quality, how are the
32 exposures of these people affected? A similar issue is apparent in the limitations
33 discussion of the "pesticide in streams" indicator on page 3-32. Important human health
34 questions that could be addressed include: How practical is it to treat a community water
35 supply for pesticides? and How many communities do this?
36

37 The Panel recognizes that the "Survey of the Nation's Lakes" will provide a valuable
38 database in the future for assessing conditions of ponds and reservoirs that are
39 representative of all lakes in the United States. However, in the interim, usable data that
40 already exist should not be overlooked. For example, there is wealth of information (and
41 associated data) available on nutrients, especially for rivers, lakes, and coastal waters.
42 The Panel recommends that staff visit (or revisit) EPA guidance manuals for lakes, rivers,
43 coastal waters, and wetlands for potential data sets, if they have not already done so. In
44 addition, long-term monitoring programs of EPA (e.g., Environmental Monitoring and

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1 Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S. Geological
2 Survey's National Water Quality Assessment Program, the National Oceanic and
3 Atmospheric Administration's Status and Trends and Mussel Watch Programs, and the
4 National Science Foundation's Long Term Ecological Research and Long Term Research
5 in Environmental Biology sites), and of states or universities should be examined.
6 Indicator criteria should be relaxed (within reason) to enable the use of important trend
7 data. It is important to be able to see the trends with appropriate caveats about
8 methodologies used. This was done for the "SAV in the Chesapeake" indicator discussed
9 on pages 3-74 to 3-75. In this case, data were adjusted to account for methodological
10 inconsistencies. A similar approach should be adopted for other parameters (e.g.,
11 sediment contamination, tissue contaminants, benthic communities, etc.), if feasible. The
12 following specific recommendations are recommended to address indicator gaps and
13 limitations in the water chapter.

- 14
- 15 • **For future Reports on the Environment, EPA should visit (or revisit) the**
16 **Agency's guidance manuals for lakes, rivers, coastal waters, and wetlands for**
17 **potential data sets to fill identified data gaps.**
- 18
- 19 • **For future Reports on the Environment, long-term monitoring programs of**
20 **EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and**
21 **other Federal Agencies (e.g., the U.S. Geological Survey's National Water**
22 **Quality Assessment Program, and the National Oceanic and Atmospheric**
23 **Administration's Status and Trends and Mussel Watch Programs), and of states**
24 **or universities should be examined. Indicator criteria should be relaxed (within**
25 **reason) to enable use of important trend data.**
- 26

27 *Charge Question 4. Regionalization of the national Report on the Environment*
28 *indicators in the water chapter*

29

30 The Panel finds that regionalization of national indicators is an important component
31 of the water chapter of the ROE 2007 Science Report. However, as noted previously, the
32 Panel is concerned that the use of EPA administrative regions will distort true ecological
33 patterns or gradients. If possible, in future Reports on the Environment the data should
34 be analyzed at more appropriate scales. For surface water, a more appropriate approach
35 may be to use watersheds or established hydrologic units that also account for altitudinal
36 gradients. For groundwater, EPA should evaluate the validity of using U.S. Geological
37 Survey (USGS) groundwater basins as regional units. Contributing watersheds may be
38 used as a scaling unit for estuaries.

39

40 The Panel notes that a regional approach will also aid in evaluating indicators for
41 various water systems during extreme events such as hurricanes, drought, and possibly
42 bioterrorism. As noted previously, it is important for EPA to mine existing data and find
43 ways to use these data to develop indicators for different ecoregions. For example, an
44 enormous amount of data is collected by the five Water Management Districts in Florida

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1 on various water systems. Similar data sets exist for various ecoregions. For future
2 Reports on the Environment, these data can be used to identify indicators.

3
4 *Charge Question 5. Utility of the regional indicators in answering the questions in the*
5 *water chapter*

6
7 The Panel finds that there is considerable utility in using regional indicators to answer
8 questions in the water chapter of the ROE 2007 Science Report. The regional indicators
9 used in the water chapter answer parts of the questions to one degree or another but
10 certainly do not address all aspects of the questions. The Panel suggests that additional
11 regional indicators could be used to answer questions in the water chapter. One indicator
12 used to respond to the question of the condition and extent of coastal waters and their
13 effects on human health and the environment is the occurrence of dinoflagellate blooms
14 on the west coast of Florida. The Panel notes that dinoflagellate blooms (*Pfiesteria*) have
15 been strongly linked to nutrient input in the bays of North Carolina and Virginia and
16 could be possible regional indicators. In addition, recurrent harmful algal blooms
17 (HABs) of *Alexandrium* off the coast of New England, brown tide (*Aureococcus*) in the
18 middle Atlantic, and *Pseudonitzschia* off the coast of the Pacific Northwest are being
19 monitored, among others. The Panel questions why harmful algal blooms in fresh waters
20 and invasive species have not been included as indicators in the discussion of extent and
21 condition of fresh surface waters. The Panel notes that a regional indicator would seem
22 to make sense here, either based on Great Lakes or Everglades long-term data (National
23 Oceanic and Atmospheric Administration, 2007; South Florida Water Management
24 District, 2007). Occurrences of freshwater HABs such as *Microcystis* could also be used
25 as indicators. In future Reports on the Environment, EPA should consider incorporating
26 these and other monitored blooms into the HAB indicator in the water chapter. In the
27 water chapter, there are seven other indicators listed in response to the question of the
28 condition and extent of coastal waters and their effects on human health and the
29 environment. Even taken collectively, these indicators do not answer all aspects of the
30 question, although each indicator illuminates some facet of the problem posed. If EPA
31 continues to use regional indicators in answering this question in future Reports on the
32 Environment, it would be helpful to explicitly identify the benefits and limitations
33 associated with each regional indicator vis-à-vis national indicators.

34
35 The Panel finds that for future Reports on the Environment, development of regional
36 indicators focusing on individual water systems would be a useful way to identify
37 common indicators across regions. For example, separate water systems could be divided
38 into groups: lakes and reservoirs, streams and rivers, ground water aquifers, wetlands,
39 estuaries, and coastal waters. Indicators used in each of these groups could be evaluated
40 across ecoregions and climatic gradients. Regional EPA offices, in collaboration with
41 USGS and state agencies in the region, could identify data sources and transform data
42 into useable information for the Report on the Environment.

43

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1 The Panel notes that as indicators are developed, there are a multitude of processes
2 that must be integrated, some of which can be described in deterministic/mechanistic
3 equations (e.g., water flux, sediment and contaminant transport) or stochastic models
4 (e.g., climate change). In contrast, other processes that affect water resources are more
5 complex and “fuzzy” and thus more difficult to incorporate into quantitative models (e.g.,
6 irrational behavior of population groups rooted in cultural and social belief systems). The
7 process of indicator development will require transdisciplinary research and education to
8 synergize expertise from various domains and develop holistic approaches or models that
9 are modular, scalable and flexible linking land and water resources to internal and
10 external forcing functions. The following specific recommendations are provided to
11 strengthen the use of regional indicators in the water chapter of the Report:
12

- 13 • **In future Reports on the Environment, EPA should utilize and build on existing**
14 **databases that have been collected and existing local expertise that has been**
15 **developed at benchmark sites in various ecoregions.** Some specific examples are
16 provided in the discussion above and in the following recommendations. This effort
17 should focus on addressing water quality and quantity issues that could potentially
18 affect human, economic, and ecological health. The specific proposed goals of such
19 an effort should be to:
20
 - 21 - Identify attributes of land and water resources that can serve as indices of
22 sustainability, and develop field and laboratory methodologies to determine these
23 attributes in space and time within different benchmark water systems;
 - 24 - Investigate the sensitivity and dependence of basin factors to internal and external
25 forcing functions such as climate change, extreme events, water law, land use
26 policies, and social customs;
 - 27 - Develop predictive tools that will aid in determining the interactions and linkages
28 between hydrologic processes, biogeochemical processes and socio-economic
29 factors; and
 - 30 - Expand institutional collaborations through partners and maximize the utilization
31 of available resources to promote interdisciplinary research and educational
32 activities in benchmark water systems.
- 33
34 • **In future Reports on the Environment, EPA should give state data sets much**
35 **closer scrutiny for possible inclusion.** Some states have a wealth of area-specific
36 data. For example, private well testing data are available in states with a high
37 proportion of private wells (cf. the “Wellologic: system in Michigan:
38 http://www.michigan.gov/deq/0,1607,7-135-6132_6828-16124--,00.html) and local
39 sport fish testing in states with strong recreational fisheries may mesh well with the
40 existing national indicators. Highlighting what some states have done might help
41 advance interest in expanding the efforts to a national surveillance system.
42
- 43 • **For future Reports on the Environment, the Panel recommends that EPA**
44 **consider the following example potential local/regional indicator for use in the**

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1 **water chapter.** The State Water Resources Control Board of California is funding
2 USGS to lead and conduct a Ground-Water Ambient Monitoring and Assessment
3 (G.A.M.A.) program (<http://ca.water.usgs.gov/gama/>) under which groundwater
4 samples from public and private water supply wells from California are analyzed for
5 water quality. The data collected will be integrated with existing water quality data
6 (such as the public supply well water quality data of the California Department of
7 Health Services). The monitoring program is scheduled to repeat the collection and
8 analyses once every ten years and therefore it will provide the badly needed
9 information for temporal trends. Although this type of data set may not be useful in
10 developing a national water quality indicator, it is nevertheless meaningful and very
11 useful in answering many of the questions in the regional context.

- 12
- 13 • **In future Reports on the Environment, the Panel recommends that, in addition**
14 **to the Gulf of Mexico and Long Island Sound, other places where hypoxic**
15 **conditions tend to occur and are well monitored (such as Chesapeake Bay, the**
16 **coastal waters off Oregon, and parts of Lake Erie) should be added to the**
17 **hypoxia indicator.**
 - 18
 - 19 • **For future Reports on the Environment, EPA should develop indicators for arid**
20 **regions.** In this regard the Agency should draw upon the numerous studies and data
21 collection efforts conducted by various federal and state agencies in the western states
22 where the climate is arid. Most areas in these states (EPA Region 9: California,
23 Arizona, Nevada) can be classified as desert or semi-desert, and water resources
24 issues, both in terms of quality and quantity, are highly contentious.

25

26 *Charge Question 6. Overall quality of the water chapter with respect to technical*
27 *accuracy, clarity, and level of communication*

28

29 The Panel generally finds that the water chapter is technically accurate and that the
30 level of communication is appropriate. As noted above, additional indicators are needed
31 to answer the questions in the water chapter. The following recommendation is provided
32 to strengthen the overall quality of the water chapter and other parts of the document.

- 33
- 34 • **In future Reports on the Environment, a summary section should be included**
35 **after each media chapter. In addition to summarizing information presented in**
36 **the chapter, this section should also identify relevant emerging issues. In the**
37 **water chapter such issues might include:**
 - 38
 - 39 - **Effect of climate change on water quantity and quality**
 - 40 - **Emerging pathogens associated with climate change**
 - 41 - **Chemicals of emerging concern**
 - 42 - **Nanoparticle waste products**
 - 43 - **Water availability and sustainability**
 - 44 - **Invasive species**

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- 1 - **Algal toxins.**
2
3

4 **8.0 LAND CHAPTER COMMENTS**

5

6 *Charge Question 1. Adequacy of formulation and scope of questions in the land chapter*

7

8 In the land chapter of the ROE 2007 Science Report, indicators are presented to
9 address fundamental questions about the state of the nation's land and its effect on human
10 health and the environment. The five questions in the chapter focus on trends in: the
11 extent of land cover, land use, wastes, chemicals used on land, and contaminated land.
12 The questions in the land chapter are appropriate to the mission of the EPA. The first two
13 questions (addressing land cover and land use) relate to land resource management, while
14 the last three questions relate to land contamination. However, the Panel finds that an
15 additional question is needed to address the important issue of soil quality and
16 conservation. In addition, the Panel finds that, while the inclusion of the phrase "and
17 their effects on human health and the environment" in each question is understandable
18 given the mission of EPA, there are few land indicators in the Report that directly
19 measure effects on human health. The following specific recommendations are provided
20 to improve the overall formulation and scope of the questions in the land chapter.

- 21
- 22 • **In future Reports on the Environment, EPA should consider adding a**
23 **fundamental question on soil quality and conservation to the land chapter.** The
24 structure of the question could be parallel to the others in the chapter. While it could
25 be argued that soil quality is covered conceptually under one of the existing
26 questions, it is not obvious which one, and the Panel believes that soil quality and
27 conservation is at the same level of importance as land cover, land use, etc. A variety
28 of indicators could be established in relation to this fundamental question, including
29 soil properties such as ability to hold nutrients (as measured by cation exchange
30 capacity [CEC] or organic matter content), soil nutrient inventory (e.g., to assess
31 loadings of nutrients and legacy phosphorus inventory), soil salinity (e.g., to assess
32 long-term effects of irrigated agriculture), and others.
33
 - 34 • **In the final 2007 Report, EPA should consider the following suggested revisions**
35 **of the land chapter questions in order to improve their clarity.**
36
 - 37 - The word "trend" (used in the questions) has a specific meaning in statistical
38 science. It needs to be made clear whether qualitative or quantitative trends (or
39 both) are used in the land chapter (and other chapters) of the Report (i.e., "trend"
40 as used here needs to be defined). The definition of trend used in the Report can
41 cover both statistical and qualitative assessment of change over time, as long as
42 the intended meaning in a particular situation is indicated. The Panel suggests
43 that trend information be developed wherever possible, and that EPA use both

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- 1 qualitative as well as quantitative data to generate trend information for all
2 indicators.
3
- 4 - The waste deposition addressed in Question 3 (wastes) could be considered a
5 “land use” issue and included as a subtopic of Question 2 (land use). The
6 separation of waste management is understandable, however, as it is recognized
7 that the hazardous and solid waste management programs run by EPA are large
8 and important land media activities for the agency.
9
 - 10 - Waste deposition on land has impacts on groundwater that are likely of equal or
11 greater significance than the direct impacts on land. Thus, the topic encompassed
12 by Question 3 has overlap with the fundamental question regarding groundwater
13 in Chapter 3, and there is a need for an explanation of integration among
14 components of the Report in the introduction.
15
 - 16 - The indicators presented in relation to Question 4 (addressing chemicals used on
17 land) focus on agriculture. The agency may wish to list agriculture explicitly as
18 the focus in Question 4. An alternative would be to include agricultural land
19 indicators under Question 2 (addressing land use), considering agriculture as a
20 specific land use.
21
 - 22 - Question 5 (addressing contaminated land) has some overlap with Questions 3
23 and 4. The “contaminated land” issue that is addressed by Question 5 (e.g., from
24 pesticide use, industrial waste disposal, etc.) can be viewed as subsidiary to
25 Questions 3 and 4. The factors distinguishing Question 5 (addressing
26 contaminated land) from Questions 3 and 4 should be explained more fully.
27

28 *Charge Question 2. Use of indicators to answer questions in the land chapter of the ROE*
29 *2007 Science Report and presentation of indicator data in the chapter narrative*
30

31 The Panel finds that the five fundamental land chapter questions are not completely
32 answered by the indicators presented, and in some cases are answered only in very small
33 part. Further, most of the indicators do not represent by themselves a direct causal
34 relationship to human and environmental health. However, the Panel recognizes that
35 presently it may not be possible define land indicators that are directly linked to health
36 effects.
37

38 In Appendix A of this report the Panel has provided specific technical comments and
39 suggested improvements to individual indicators used in the land chapter. These
40 improvements are recommended to answer the questions in the chapter more completely.
41 The following more general recommendations and suggestions for additional indicators
42 are provided to improve the indicators in the land chapter:
43

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- **In future Reports on the Environment, with respect to the land chapter indicators the Panel recommends that EPA should: 1) consider a range of land cover classification schemes with different levels of resolution. This is necessary because the resolution of the data in the current Report is too coarse to completely answer the questions; 2) characterize land cover of all major ecosystem types, not just the forest land cover characterized the current draft of the Report; 3) adopt standard, established approaches for land use and land cover analysis to evaluate information and document trends across a range of available data sets.**
 - **In the final 2007 Report EPA should include more direct indicators of effects in the land chapter.** For example, stream water quality associated with particular land uses could be used as an indicator. In addition, as in other chapters, a better explanation of the reasons for choosing the indicators used should be provided.
 - **In the final 2007 Report, EPA should consider adding indicators for mining wastes, and wastes applied on agricultural land (biosolids, compost, etc.).** The Panel finds that the two waste indicators in the land chapter are appropriate, but adding these additional indicators would provide important information about waste on land.
 - **In the final 2007 Report, EPA should add an indicator based on the generation and disposal of civilian radioactive waste.** This will fill an important data gap. The Panel recognizes that some data on defense radioactive waste may not be publicly available. However, it is recommended that EPA staff work with the U.S. Nuclear Regulatory Commission to obtain statistical information on status and trends concerning civilian radioactive waste generation, disposal, and management (U.S. Nuclear Regulatory Commission, 2007).
 - **In the final 2007 Report, a pesticide use indicator should be added to the land chapter.** This could be done by renaming the existing indicator, “fertilizer applied for agricultural purposes,” as “fertilizer and pesticide applied” and adjusting the type of data used to populate the indicator. In this regard, one possible indicator that could be used is pesticide sales, which could likely be parsed into agricultural and residential/commercial landscape applications. The latter would provide a suburban/urban indicator, which is important from the standpoint of human exposure.
 - **In the final 2007 Report, the reported pesticide incident indicator should be moved to the human health chapter.** The Panel finds that the decline in reported pesticide incidents has a direct relationship with human health. However, the link between reported pesticide incidents and the human health impacts of land management practices is tenuous. Reported pesticide incidents cover all sorts of uses of pesticides, and are based on calls to poison control centers. Many of these

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1 incidents are related to misuse of household products and activities far removed from
2 land management.

3
4 *Charge Question 3. Identification of gaps and limitations of the land chapter indicators*

5
6 The Panel finds that the discussions of indicator information gaps and limitations in
7 the land chapter are objective, honest and insightful. In many cases, these sections point
8 out why particular indicators do not provide the comprehensive picture that is needed or
9 are “not ready for prime time.” However, with respect to data gaps, much more could be
10 said for each question. The data gap topics chosen for discussion seem somewhat
11 arbitrary, though the data gaps discussions do uniformly address the lack of measures
12 needed to directly assess the relationship of the indicator values to human health.

13 Therefore the Panel recommends that:

- 14
15 • **In the final 2007 Report, the discussions of the data gaps in the land chapter**
16 **should be modified to make it clear that the gaps mentioned are the highest**
17 **priority gaps determined by the agency, and that the list is not intended to be**
18 **comprehensive.**

19
20 *Charge Question 4. Regionalization of the national Report on the Environment*
21 *indicators in the land chapter*

22
23 Concerns about the use of EPA administrative regions to regionalize national data have
24 been noted previously. The Panel also notes that for future Reports on the Environment,
25 the Agency may wish to consider the utility of the land chapter for cross-media
26 evaluations if EPA regions were keyed to important environmental factors. The Panel
27 notes that no single regionalization approach fits all evaluation needs. In the age of
28 geographic information systems (GIS), there is no need to oversimplify. Therefore, in
29 evaluating the condition of land, for example, EPA could select a particular level of
30 USGS Hydrologic Units and overlay an ecoregionalization scheme. Bailey’s U.S. Forest
31 Service (USFS) Ecoregions of the U.S. (Bailey, 1995) or Omernik’s Ecoregional schema
32 (Omernik, 1987) would be appropriate because these combine soil, elevation, moisture,
33 vegetation, and other factors.

34
35 In future Reports, different types of regional groupings could be used to show the
36 location and extent of many features in the various chapters of the ROE. For example, as
37 further discussed in Section 10 of this advisory report, ecologically relevant units such as
38 watersheds, climatic provinces, and major coastal realms could be used to regionalize
39 data. It would be useful to mention at the beginning of future Reports how the indicators
40 will be regionalized (i.e., an ecologically relevant regionalization scheme will be selected
41 based on the type of indicator).

42
43 *Charge Question 5. Utility of the regional indicators in answering the questions in the*
44 *land chapter*

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1
2 As further discussed in Appendix A of this advisory report, the Panel did not find the
3 one regional example included in the land chapter (the Puget Sound/Georgia Basin
4 example given in the Land Cover subsection) to be very useful. It is sufficiently unique
5 that it was not seen as providing much value as a national model or case study. The
6 Panel could not determine why this example was included, nor was clear how this
7 example could be standardized for use in other regional analyses. However the Puget
8 Sound case study exemplifies how an indicator (impervious cover) in one medium (land)
9 has clear implications in another medium (water). Unfortunately, there is no explicit
10 linkage to the water chapter of the ROE. As discussed above, a conceptual model could
11 be used to illustrate such linkages. It would also be useful to include examples from
12 more than one region in the. Examples and case studies of significant national
13 importance (e.g., from the Great Lakes region) should be given preference.

14
15 *Charge Question 6. Overall quality of the land chapter with respect to technical*
16 *accuracy, clarity, and level of communication*

17
18 The Panel finds that the land chapter is generally clearly written and technically
19 accurate. The data presented are interesting and will be useful for multiple purposes.
20 However, in most cases, the fundamental questions in the land chapter are far from
21 completely answered by the indicators and indicator data available, and the big picture
22 understanding that the public may expect is not achieved. The data gap discussions are
23 brief and the Panel recommends that they be reviewed and expanded where appropriate.
24 In addition, while the Report writers clearly made strong efforts to avoid interpretations
25 regarding influence of programs, some interpretation statements have made their way into
26 the Report and should be removed. For example, the Report states that recycling efforts
27 related to municipal solid waste have increased “most likely due to the increased
28 awareness about the benefits of recycling and the implementation of policies by state and
29 local governments tying waste generation directly to the cost of waste services”.

30
31 The Panel also finds that the range of indicators in the land chapter is not at the same
32 level of development as indicators the water and air chapters. This is understandable
33 given that EPA does not have a land program comparable to its water and air programs.
34 The modest level of development of the land chapter must ultimately be addressed
35 through direction of additional resources and an expanded set of disciplines in the
36 Agency.

37 38 **9.0 HUMAN HEALTH CHAPTER COMMENTS**

39
40 *Charge Question 1. Adequacy of formulation and scope of questions in the human health*
41 *chapter*

42
43 The panel generally finds the questions within the human health chapter of the ROE
44 2007 Science Report to be comprehensive, appropriate, and well developed. There is

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1 strength in the questions in their simplicity and clarity. However, the Panel recommends
2 the following specific revisions to improve the scope and clarity of the questions.

- 3
- 4 • **In the final 2007 Report the questions within the human health chapter should**
5 **be reordered to be consistent with event sequence in the environmental health**
6 **paradigm as depicted in Figure 5.1 of the Report (i.e., exposure precedes the**
7 **health effect).**
 - 8
 - 9 • **In the final 2007 Report the human health chapter should be more descriptively**
10 **renamed as “Human Exposures and Health.” This change is needed because the**
11 **questions contained within the chapter encompass both human health and**
12 **exposure.** In addition to being more descriptive, the inclusion of “exposure”
13 within the chapter title offers the following advantages:
 - 14
 - 15 - It appropriately elevates exposure assessment within the ROE as a central and
 - 16 critical domain within EPA;
 - 17 - It is a key tenet of the ROE to link environmental change to human and ecological
 - 18 change; and
 - 19 - It provides a more appropriate place to include National Health and Nutrition
 - 20 Examination Survey (NHANES) pesticide body burden measurements that are
 - 21 currently out of place within the land use chapter.
 - 22

23 There were differing opinions among panelists regarding the adequacy and scope of
24 the first question within the chapter “What are the trends in health status in the United
25 States?” Some panelists thought that because the environmental factors considered in the
26 Report play relatively small roles in the epidemiology of major U.S. health trends (i.e.,
27 general mortality, life expectancy, and infant mortality), such broad health-related
28 conditions would have limited utility as environmental health indicators *per se*. Others
29 felt that this question was appropriate in highlighting EPA’s health mission. There was
30 some consensus around a compromise suggestion for eliminating this question in the final
31 2007 Report but retaining the content as introductory text to the subsequent, more
32 specific health question “What are the trends in human disease and conditions for which
33 environmental contaminants may be a risk factor, including across population subgroups,
34 and geographic regions?” In contrast to the previous more general question, there is
35 strong justification for the inclusion of this question in the final 2007 Report.

36
37 *Charge Question 2. Use of indicators to answer questions in the human health chapter of*
38 *the ROE 2007 Science Report and presentation of indicator data in the chapter narrative*
39

40 The Panel finds that the indicators used in the human health chapter of the ROE 2007
41 Science Report are appropriate. However, as discussed below, additional indicators are
42 recommended to more completely answer the questions. In addition, there is a critical
43 need to expand the discussion of the health indicators’ relevance to the questions. This

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1 discussion can appropriately stem from the following indicator criterion on page 1-7 of
2 the Report.

3
4 “The indicator is useful. It answers (or makes an important contribution to
5 answering) a question in the Report on the Environment.”
6

7 Although there is strong epidemiologic evidence that supports the indicators chosen
8 (cancer incidence, childhood cancer incidence, cardiovascular disease, chronic
9 obstructive pulmonary disease, asthma, infectious disease, birth defects, low birth weight,
10 preterm delivery) the Panel finds that the Report fails to take advantage of this literature
11 to provide either a qualitative or quantitative description of the environmental
12 contribution. For example, what is the estimated fraction of cardiovascular disease that
13 can be attributed to air pollution? Although the Report acknowledges that the health
14 questions are complex and have multiple causes, it fails to provide a quantitative or even
15 qualitative assessment of the relevance of the indicator to the question. This is an
16 important consideration in providing the reader with the necessary context for
17 understanding the meaningfulness of the indicator in the context of the health question.
18 For example, there are scientifically credible estimates for the contribution of the
19 environment to various cancers (Doll and Peto, 1981; Lichtenstien et al., 2000). There
20 are similar estimates of air pollution contributions to asthma and cardiovascular
21 morbidity and mortality (U.S. Environmental Protection Agency, 2005). The Panel
22 therefore recommends that:

- 23
- 24 • **For the final 2007 Report, if credible quantitative impact estimates are available**
25 **(e.g., estimates of the mortality impacts of particulate air pollution in selected**
26 **locations in the U.S.), they should be included.** Establishing the relevance of the
27 indicator grounded in the literature will go a long way toward strengthening the
28 science of the Report.
29
 - 30 • **In future Reports on the Environment, EPA should consider using an expanded**
31 **suite of human health indicators** that would include the following:
32
 - 33 - The National Health Interview Survey (NHIS) Behavioral Risk Factor Survey
34 (BRFS). This is a population-base survey administered by states and includes the
35 relevant domains of Secondhand Smoke Policy (Module 10), Indoor Air Quality
36 (Module 11), and the Home Environment (Module 12). These modules include
37 salient indicators for indoor air quality: 1) the use of gas appliances, 2) use of a
38 coal stove, fireplace, or kerosene heater; 3) use of pesticides; 4) whether smoking
39 is allowed indoors at home and at work. Because these data are collected at a
40 state level, there is sufficient resolution to the data for use as a regional as well as
41 a national indicator. (This recommendation also is relevant to the Air Chapter)
 - 42 - Hospital and emergency room discharge data (if publicly available);
 - 43 - Reports of infectious disease maintained by CDC (Centers for Disease Control,
44 2007).

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- 1 • **In future Reports on the Environment, EPA needs to adopt the suites of**
2 **indicators that other agencies have developed, but present them in relation to**
3 **environmental factors.**
4

5 *Charge Question 3. Identification of gaps and limitations of the human health chapter*
6 *indicators*
7

8 The Panel finds that the identification and communication of gaps and limitations of
9 the indicators in the health chapter are adequately addressed with some potential areas for
10 improvement. The following recommendations are provided to improve the
11 identification of gaps and limitations. The Panel recommends that:
12

- 13 • **In the final 2007 Report, the discussion of gaps and limitations should be**
14 **expanded to include a more quantitative description of the indicator’s relevance**
15 **by relying on the epidemiologic literature (this is also addressed in the indicator**
16 **discussion above).** The discussion might be further expanded to address how the
17 limitations and gaps affect the interpretations of the Report on the Environment
18 indicators, or the larger framework of the disease state or indicator.
19
- 20 • **In the final 2007 Report, the concept statements in the indicator limitations**
21 **sections such as “the measurement of mercury or any other environmental**
22 **chemical in a person’s blood or urine does not by itself mean that the chemical**
23 **has caused or will cause harmful effects in that person” should be removed from**
24 **each discussion of indicator gap and instead placed in the conceptual framework**
25 **section of the chapter.**
26

27 *Charge Questions 4 and 5. Regionalization of the national indicators and utility of the*
28 *regional indicators in answering the questions in the human health chapter*
29

30 As noted previously, the Panel finds that regional analysis will make the Report on the
31 Environment richer and more meaningful. Nationally aggregated data cannot reflect
32 local and regional environmental or health trends that are important to the quality of life
33 and health of the residents living in these areas. Regional indicators as presented by EPA
34 administrative regions are not particularly informative geographic descriptors of health.
35 The Panel notes that ecosystems, watersheds etc. are far more useful, as presented in
36 some of the other chapters, and would be a novel approach to presenting health data that
37 would set the Report on the Environment apart from the already existing health data
38 presentations. The finer the spatial scale of this analysis, the more valuable it becomes.
39 The finest spatial resolution contained with the Report is at the regional level and trend
40 analysis is shown simplistically as line graphs. The Panel notes that even for this
41 relatively simple analysis, and certainly as the Report on the Environment is developed to
42 include indicators with greater spatial resolution, more sophisticated and innovative
43 means of analysis and presentation will be required.
44

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1 For some of the indicators, resolution can go down to the state and even the county
2 level (indicators derived from birth and death certificates) thus making it possible to
3 aggregate the data in many geographic patterns. The NHIS survey data and the Survey
4 Epidemiology and End Results (SEER) cancer data only have national resolution.
5 However, state-based surveys such as the Behavioral Risk Factor Surveillance System
6 (BRFSS) can provide much of the same disease prevalence data as the NHIS with
7 resolution at the state level. State cancer reporting registries are in nearly all states and,
8 while not as rigorous as the SEER program, provide credible cancer incidence data
9 widely used by states without SEER registries. It would be helpful for EPA to provide
10 “regional” reports that were integrative and coherent. The current approach does not
11 provide much benefit. Therefore the Panel specifically recommends that:

- 12
- 13 • **In the final 2007 Report, EPA should build on the higher geographic resolution**
14 **theme by presenting individual or multiple state data which could inform the**
15 **gross national estimates presented and point toward the future. This should be**
16 **done if possible, given the time constraints of revising this version of the ROE.**
17
- 18 • **For future Reports on the Environment (if time does not permit inclusion of the**
19 **state data in the final ROE 2007 Science Report as recommended immediately**
20 **above) EPA should consider making use of county-level data available from the**
21 **states.** All of the vital statistic data presented and used for the EPA Regional
22 indicators can and have been scaled to the county level and excellent maps have been
23 generated and already published in books. Geographic differences in disease have
24 been identified. Virtually every state provides tables and maps of their vital statistics
25 by county and they are used to identify local priorities to allocate targeted
26 interventions and funding, yet on page 5-68 of the ROE 2007 Science Report it is
27 stated that “underlying data for most ROE indicators ...do not enable extensive
28 analysis of disease trends within or across geographic regions.” The Panel notes that
29 this statement only pertains to the NHIS survey data. Certainly cardiovascular
30 disease, stroke, and chronic obstructive pulmonary disease mortality can be presented
31 at the county level or certainly the state level.
32

33 *Charge Question 6. Overall quality of the human health chapter with respect to*
34 *technical accuracy, clarity, and level of communication*
35

36 The Panel finds that the human health chapter is generally technically accurate
37 although limited in its assessment and synthesis. As with the Report in general, there is a
38 need to further develop the chapter from its current form, which can be characterized as a
39 data report, to a more sophisticated scientific document that includes assessment based on
40 the primary literature and appropriate statistical analysis. The following specific
41 additional recommendations are provided to improve the overall quality of the human
42 health chapter.
43

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- 1 • **In the final 2007 Report, Bullet #2 on page 5-5 should be rewritten to include**
2 **biological agents.** The following sentence should be added: “Infectious diseases
3 associated with environmental exposures or conditions are also addressed.”
4
- 5 • **In the final 2007 Report, the discussion of sensitive populations should be**
6 **expanded because these populations are important in considerations of**
7 **environmental health.**
8

9 **10.0 ECOLOGICAL CONDITION CHAPTER COMMENTS**

10
11 The ecological condition chapter of the ROE 2007 Science Report tackles an
12 extremely complex topic. The Panel recognizes that developing the chapter has been a
13 difficult task, as it covers millions of species as well as populations, biological
14 communities, and ecosystems, all of which interact with each other and are differentially
15 affected by environmental factors. EPA is to be commended for tackling this important
16 task. Compiling this information and pointing out the gaps and limitations is a very
17 useful project for the agency, the scientific community, and the general public. However,
18 the Panel finds that reorganization of the chapter is needed to reflect an integrated focus
19 on ecosystem health. The ecological condition chapter should be reorganized
20 hierarchically according to: 1) major ecosystem type, 2) ecosystem processes and
21 services, and 3) ecosystem components (physical, chemical, biological). This is
22 discussed in more detail below.
23

24 Structuring the chapter as recommended above will involve reorganization of material
25 presently covered in the chapter and the inclusion of additional indicators discussed
26 below. The Panel recognizes that many of the comments and recommendations provided
27 below in response to the specific charge questions probably cannot be addressed in the
28 final 2007 Report, but should be considered for future Reports on the Environment.
29 However, the Panel recommends that EPA complete as much of the reorganization as
30 possible for the final 2007 Report. The Panel also suggests that in the final 2007 Report,
31 the ecological condition chapter include a synthesis of the independent indicators, and
32 that it emphasize the connections between ecosystems and stressors.
33

34 *Charge Question 1. Adequacy of formulation and scope of questions in the ecological* 35 *condition chapter* 36

37 In general, the Panel finds that the questions in the ecological condition chapter are
38 formulated appropriately, although some revision of the questions may be needed as the
39 chapter is reorganized as recommended below. An exception is the biomarker question
40 addressing the level of exposure of specific plant and animal species to different forms of
41 pollution and toxic chemicals. The Panel suggests that in the final 2007 Report, rather
42 than focusing on trends in biomarkers, the question should refer to trends in exposure and
43 effects of contaminants in organisms. Biomarkers are the data collected to analyze the
44 trends. In addition, the Panel notes that it is important to show the linkages between the

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1 effects seen in the ecological condition chapter and the indicators discussed in the media
2 chapters; for example, EPA should strengthen the link between sea temperature and sea
3 level rise discussed in this chapter and greenhouse gases in the air chapter. The Panel
4 therefore recommends that:

- 5
- 6 • **In the final 2007 Report, the climate indicator trends in the ecological condition**
7 **chapter should be placed in a paleoclimatic context in order to distinguish**
8 **between human induced changes and other long-term changes. References to**
9 **the Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a,b)**
10 **Report should be included.**
- 11
- 12 • **The Panel recommends that in the final 2007 Report, rather than focusing on**
13 **trends in biomarkers, a question should refer to trends in exposure and effects of**
14 **contaminants in organisms.**
- 15

16 Although most of the questions in the ecological condition chapter appear to be
17 germane, the associated indicators in the chapter seem to have been chosen because of
18 the availability of data, not always because of their appropriateness to answer the
19 questions. In some cases there are significant gaps between the questions and the
20 corresponding indicators. As recommended previously for other chapters of the final
21 2007 Report, EPA should provide the rationale for selection of these particular indicators.
22 This rationale may be that for many desired indicators of ecological condition the needed
23 data simply are not available. If a desired indicator has no data, the final 2007 Report
24 should contain a statement of the need for data.

25

26 As further discussed below, the Panel also notes that the scope of indicators used to
27 answer questions in the chapter needs considerable broadening to cover more ecosystem
28 types, with the recognition that EPA cannot develop an unlimited set of indicators but
29 should select those that address key ecological issues. **Easily accessible data may be**
30 **available for some of these indicators and could be included in the final 2007**
31 **Report, while others will have to wait for future Reports on the Environment.** A
32 critical issue to be considered is whether data must meet some test that many ecological
33 studies may not achieve. The final 2007 Report will be more useful if it includes more
34 information, and then discusses caveats about the methodology. Specific gaps in
35 coverage (missing ecosystems, missing populations, and missing processes) in the
36 ecological condition chapter of the ROE 2007 Science Report are presented below in
37 Appendix A.

38

39 *Charge Question 2. Use of indicators to answer questions in the ecological condition*
40 *chapter of the ROE 2007 Science Report and presentation of indicator data in the*
41 *chapter narrative*

42

43 In reviewing indicators used in the ecological condition chapter, the Panel considered
44 the charge question in two parts: “Are the current indicators appropriately used to answer

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1 the questions?” and “Are these the correct indicators to answer the questions?” The
2 Panel finds that the indicators in the ecological condition chapter provide relevant and
3 useful information as an initial attempt to answer the general questions posed, but many
4 of the indicators are not transparent. Ideally, they should be intuitive to readers and
5 require little explanation. The limited number of acceptable indicators in the ecological
6 condition chapter can offer only a narrow perspective or a snapshot, and many do not
7 show temporal trends. They are hardly adequate. This argues for an introductory
8 discussion of each indicator along with a conceptual process diagram so that the reader
9 can better understand the role of each indicator and its importance relative to the
10 questions asked. The Panel’s specific recommendations to address these concerns are as
11 follows:

- 12
13 • **In the final 2007 Report, EPA should reorganize the ecological condition chapter**
14 **to focus on three major indicator categories: Ecosystems, Ecological Processes**
15 **and Services, and Ecosystem Components.**
- 16
17 • **In the final 2007 Report, appropriate indicators should be included in the**
18 **ecological condition chapter to provide information on the ecosystem extent (e.g.,**
19 **land cover, land use, urbanization) and quality /condition (e.g., landscape**
20 **integrity, connectedness, fragmentation, and contamination) of major ecosystem**
21 **types.** Examples of major ecosystem types include: forests, grasslands, shrublands,
22 arid lands, wetlands, farmlands, freshwater, and coastal, marine, and urban
23 ecosystems.
- 24
25 • **In the final 2007 Report, indicators should be included in the ecological**
26 **condition chapter to represent important ecosystem processes and services such**
27 **as: provisioning (e.g., timber, fuel, minerals, and other services); regulating (e.g.,**
28 **disease, climate, and flood processes); cultural (e.g., spiritual and aesthetic**
29 **services); and supporting (e.g., soil formation, primary productivity, pollination,**
30 **decomposition, disturbance, nutrient cycling, hydrological/chemical cycling,**
31 **carbon sequestration processes, and services such as clean air, clean water, and**
32 **net production).** These ecosystem services classifications were developed by the
33 Millennium Ecosystem Assessment (2005). Potential indicators relevant to the
34 ecosystem processes listed above include: fire frequency, floods, drought, algal
35 blooms, invasive species, carbon storage, soil salinity, nutrients, and erosion.
- 36
37 • **In the final 2007 Report, indicators should be included in the ecological**
38 **condition chapter to represent physico-chemical components of ecosystems (e.g.,**
39 **soils, water, chemicals, snow pack, and physical habitats).** Some physico-
40 chemical indicators are already included in the Report (e.g., mean temperature and
41 precipitation, sea surface temperature, sea level, stream flows, and nitrogen and
42 phosphorus discharge into rivers and streams).
- 43

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- 1 • **In the final 2007 Report, indicators should be included in the ecological**
2 **condition chapter to represent biological components of ecosystems ranging**
3 **from the genome to the community level of organization.** Such components
4 include biodiversity, endangered species, invasive species, keystone species, and
5 communities. Specific examples of biological component indicators include: the
6 extent and range of communities (e.g., land cover, coastal benthic communities, and
7 coral reefs) and particular taxa (e.g., birds, fish, macroinvertebrates, and submerged
8 aquatic vegetation); the protection status of biological components (e.g., management
9 policy and zoning information relevant to understanding status and future
10 vulnerability); and threats. The Panel finds that the current indicators in the
11 ecological condition chapter have too much reliance on vertebrates and not enough
12 emphasis on small organisms (e.g., microbes, invertebrates, and flora).
13

14 In Appendix A the Panel has provided specific technical comments and suggested
15 improvements concerning individual indicators currently used in the ecological condition
16 chapter.
17

18 *Charge Question 3. Identification of gaps and limitations of the ecological condition*
19 *chapter indicators*
20

21 The Panel finds that, in general, the limitations and gaps are assessed fairly and
22 objectively, and are presented in a clear and transparent way in the ecological condition
23 chapter. As in other chapters of the Report it may be useful to subdivide this section into
24 different types of limitations, such as geographic limitations, statistical limitations, data
25 coverage limitations, etc. Often gaps or limitations are discussed with an inadequate
26 understanding of relationships between the indicator and the environment. Also,
27 limitations are often based on inadequate data, or inability to interpret data because they
28 are “incomplete.” This concern can be addressed by including a conceptual model in the
29 chapter as recommended above. The conceptual model should indicate how stressors
30 (drivers), responses and outcomes are perceived by the scientific community. As
31 previously discussed, this will improve interpretation and discussion and help the reader
32 understand the importance of the indicators.
33

34 As in other chapters of the Report, it is disappointing that so many of the indicator
35 data are recent and prior monitoring data are not available data to see temporal trends.
36 As noted previously, there are many monitoring programs of EPA, other Federal
37 Agencies, and states that have long-term data sets. These data sets may not be based on
38 probabilistic surveys and the statistical approaches that meet the indicator selection
39 criteria. However, they may provide good long-term data could should be incorporated
40 into future Reports on the Environment. The sampling deficiencies associated with the
41 data should be discussed in the section on gaps and limitations. Ignoring decades of prior
42 monitoring information because methodologies were not “up to” current standards results
43 in the inability to see trends in many important parameters. The Panel finds that it is
44 important to show trends and include caveats about methodology. As methods, indices,

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1 and statistical design continue to improve, EPA should not discard the present
2 measurements in favor of the new and improved indices. When methods are changed,
3 there should be a time when both the old and new methods are used in order to establish
4 their comparability.

5
6 The Panel provides the following specific recommendations to improve the discussion of
7 indicator limitations in the Report.

- 8
9 • **In the final 2007 Report, the discussion of “trends in diversity and biological**
10 **balance of the nation’s ecological systems,” (on page 6-29) should acknowledge**
11 **that some systems inherently have different numbers and variety of species,**
12 **making it inappropriate to make comparisons between systems.**
13
14 • **In the final 2007 Report, the discussion of “fish faunal intactness,” should**
15 **explain why 1970 is chosen as the reference.**
16
17 • **In the final 2007 Report, trend data should be adjusted to account for**
18 **methodological inconsistencies.** For example, in the discussion of “SAV in the
19 Chesapeake” which shows trends since 1978, the Report on the Environment states
20 that “methods changed over the course of this study. However, data have been
21 adjusted to account for any methodological inconsistencies.” The same should have
22 been done with other parameters that are presented as a snapshot at one time that
23 could have shown trends. The Panel recognizes that not all data sets will lend
24 themselves to this type of adjustment, but when possible, EPA should calibrate or
25 adjust data from different periods that use different methodologies to allow
26 comparability over time.
27
28 • **In future Reports on the Environment EPA should use available information**
29 **from the Agency’s water quality criteria guidance manuals.** The Panel notes that
30 EPA has previously conducted a detailed review of current information and
31 developed water quality criteria guidance manuals for lakes, rivers, coastal waters. It
32 is not clear whether this information was used in addressing some of the questions
33 raised in the Report.

34
35 *Charge Question 4. Regionalization of the national Report on the Environment*
36 *indicators in the ecological condition chapter*
37

38 As discussed previously, regionalization is an important element in the Report on the
39 Environment. However, the EPA regions, while important for administrative purposes,
40 are not relevant for representation of regional indicators in the ecological condition
41 chapter. The separation of data into the ten EPA regions may inadvertently convey
42 inaccurate ecological information to readers. For example, Exhibit 6-2 shows the
43 changes in acreage in the extent of forested land in the U.S. broken down by EPA
44 regions. However, the Report fails to recognize the differences in climate, biomes, and

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1 the amount of total area among these ecologically distinct units. The Panel finds the
2 basis of the division to be misleading. Ecologically relevant units, such as watersheds,
3 climatic provinces, major coastal realms, forests, etc. provide a scientifically sound basis
4 for conceptual and statistical analyses. Results from ecoregional analysis could easily be
5 reported in the final 2007 Report for EPA administrative units by using current GIS
6 technology. It could be mentioned early in the final 2007 Report that some indicators
7 will be regionalized based on the type of indicator (e.g., one that relates to large
8 watersheds such as nutrient discharge to oceans), or to major climatic zones (e.g., forest
9 indicators). In this way objectivity of regionalization is addressed. Because there is little
10 comparison across indicators in the Report, comparability across regions is limited. This
11 suggests a future need for some kind of cross-reference table or section in the final 2007
12 Report that addresses the issue of comparability of indicators, questions and regions.

13
14 *Charge Question 5. Utility of the regional indicators in answering the questions in the*
15 *ecological condition chapter*

16
17 The Panel finds that regional indicators in the ecological condition chapter have
18 considerable value and should be retained but with qualifications. Although regional
19 examples have value for the national report, caution should be used in applying
20 interpretation of regional examples on a national basis. As discussed above, the shortage
21 of acceptable national large-scale indicators can be remedied by developing regional or
22 local indicators. However, the justification of the inclusion of these particular indicators
23 in the chapter is not clear. The use of a region to demonstrate some trend or change is
24 useful if it represents scaling of similar national data. Some of the data sets are
25 sufficiently complete to support useful regional subdivision, while others are not. Scaling
26 decisions should be made on an indicator-by-indicator basis. If a regional indicator has
27 been included in the Report only because a particular EPA region developed the
28 methodology and collected the data, the indicator should be tested in another region that
29 is not geographically or physiognomically equivalent (e.g., ecological connectivity in
30 EPA Region 4). If the indicator represents an “interesting” region (e.g., Puget Sound
31 area) where analysis of changes has been completed, it should be pointed out that the
32 complexity of the study may make it difficult to duplicate across the nation.

33
34 The following recommendations are provided to improve the use of regional indicators in
35 the ecological condition chapter.

- 36
37 • **In the final 2007 Report, it should be clearly stated that specific case studies in**
38 **the Report may not be representative of a general or national situation when**
39 **they represent either a picture of success or one of failure.** These concerns should
40 not constrain the use of regional examples if developed in a fashion similar to other
41 indicators with emphasis on the importance and applicability of the example.
42
43 • **In future Reports on the Environment, specific case studies using regional**
44 **indicators should be selected for their ability to demonstrate the long-term**

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1 **trends that cannot be accomplished at the national level. It would be useful to**
2 **pick well-studied sites (e.g., Lake Mendota, Lake Tahoe) where there are long-**
3 **term data sets available for each region.**

- 4
5 • **For future Reports on the Environment, some of the regional indicators should**
6 **be expanded to become national indicators (e.g., SAV, invasive species, harmful**
7 **algal blooms).**

8
9 *Charge Question 6. Overall quality of the ecological condition chapter with respect to*
10 *technical accuracy, clarity, and level of communication*

11
12 As noted above, the ecological condition chapter provides relevant, accurate, and
13 useful information, but it is far too limited in scope. The nation's ecosystems and key
14 ecosystem processes are far more extensive than represented in the Report. One problem
15 is the immense difference between the objectives and base questions for the Report and
16 the availability of applicable information to meet these objectives. The ecological
17 condition chapter of the final 2007 Report would benefit from improved organization, as
18 mentioned previously. The general introduction of the final 2007 Report should include a
19 description of how all the themes are or can be integrated. To improve integration it
20 would be possible to take a regional approach (e.g., large watershed) and show how each
21 theme can be integrated within the region. This is something that should be considered
22 for future Reports on the Environment. The Report also makes scaling difficult.
23 Regional data need to be scaleable to a larger region or nationally, and national data need
24 to be scaled to regional levels for application and understanding of the data. A more
25 consistent and defensible approach is needed in future Reports on the Environment to
26 deal with regionalization of indicators.

27
28 There is no easy way to develop ecological condition indicators, populate them with
29 data, and then interpret the results. One approach requires use of conceptual models that
30 show how indicator selection was achieved and how the indicator actually "indicates" the
31 consequences of changing stressors, processes and outcomes. The authors should be
32 commended for their ecological condition paradigm diagram Exhibit 6-1. A conceptual
33 model of flows between stressors and outcomes will look quite different from this general
34 interactive model but, as discussed previously, this type of diagram showing interactions
35 among many processes and attributes should be placed at the beginning of the document.
36 The ecological condition paradigm is an excellent conceptual framework, but not well
37 used in discussions of the indicators. The interconnections of human health and
38 ecological condition with each other and with the media chapters should be discussed and
39 expanded. This approach would greatly improve the level of communication. For
40 example, the schematic that the SAB provided in its prior advisory report to demonstrate
41 interconnections should be referred to because it is still germane and would improve the
42 Report on the Environment. The inclusion of a statistical approach to the data, and
43 consistent use of metric measures would also add rigor and are needed in a scientific
44 document.

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1 **Appendix A: Specific Technical Comments and Corrections**

2 3 **General**

- 4 - In the final 2007 Report, EPA should identify, perhaps by using a letter (e.g.,
5 “H”), those indicators that explicitly relate to human health. Such identification
6 will help differentiate those indicators from others that relate more to ecological
7 health. For example, indicators presented on pages 3-32 (pesticides in
8 agricultural watersheds), 3-44 (nitrate and pesticides in shallow ground water in
9 agricultural watersheds), 3-90 (population served by community water systems
10 with no reported violations of health-based standards), and 3-103 (coastal fish
11 tissue contaminants) include a health component because of health based
12 standards.
- 13 - In some cases, data are presented for each of the 9 ecoregions (e.g., Exhibit 3-3).
14 The type of panel in Exhibit 3-3, showing a map of the 9 ecoregions, with stacked
15 bars emanating from each region, should be more frequently used in the Report
16 because it is much more informative than aggregated data. This is recommended
17 as a revision for future Reports on the Environment.

18 19 **Air chapter**

20 21 **Ambient Concentrations of Lead (Figure B on page 2-22)**

- 22 - The caveat regarding the lead trend sites above the NAAQS is not really useful
23 since the last year with a concentration above the NAAQS was 1982. The
24 description in the narrative is sufficient for describing this event and the Figure is
25 not necessary. It is not clear if excluded sites could be useful for establishing
26 trends in more recent years. In the final 2007 Report, perhaps the X axis in Figure
27 B could be modified in a manner similar to the NO_x or other NAAQS emission
28 trends as presented in Figure A on page 2-24 or SO₂ on page 2-54.

29 30 **Particulate Matter (PM)**

- 31 - With regard to PM, a significant fraction of the 2.5 size range results from
32 secondary formation. The Report on the Environment does not mention the
33 potential use of the PM characterization sites (which also provide data on
34 elemental composition and elemental carbon/organic carbon [EC/OC]). These
35 sites have been operational for several years and it would be worth considering in
36 future Reports on the Environment. At a minimum, there is probably enough data
37 to provide a snapshot of regional differences in broad ranges of composition
38 (North American Consortium for Atmospheric research in Support of Air Quality
39 Management – NARSTO data, for example).

40 41 **Acid Deposition Data**

- 42 - The presentation of acid deposition data is visually attractive but the format is
43 discordant with how data are presented for other pollutants (i.e., charts). The
44 graphical format on pages 2-59 and 2-60 is difficult to follow in its detail as

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1 compared with the chart (bar graph, pie chart). Thus it would seem for added
2 clarity in understanding national and regional trends, in the final 2007 Report it
3 would be advisable to follow the format used for the other pollutants in the air
4 chapter.

5

6 ***Water Chapter***

7

8 **Presentation of Data**

- 9 - On rare occasions, the discussion text in the water chapter is not consistent with
10 the data being presented. For example, in the discussion of “coastal benthic
11 communities” on pages 3-71 to 3-73 it is shown that 17% of area of all the U.S.
12 coastal waters have low index values, and that 27% of the area in U.S. EPA
13 Region 3 has a low index value. The Panel notes that a substantial portion the
14 area of U.S. coastal waters (20 to 25% of the area) has a low index, and in
15 addition there are extensive areas with “moderate” rather than “high” condition.
16 However, in the discussion on page 3-85 of the water chapter, the Report states
17 that, “Benthic communities in the nation’s estuaries are largely intact in terms of
18 species diversity... which is critical because these organisms are a fundamental
19 link in the coastal food web.” While the second part of the sentence is true, the
20 first part is the statement is not supported by the data. The Panel recommends
21 that in the final 2007 Report this misrepresentation of the data be corrected.

22

23 **High and Low Stream Flows**

- 24 - “High and low stream flows” is not an accurate characterization of this indicator.
25 The data also address timing, but this is not intuitive from this heading. A more
26 accurate title is recommended for the final 2007 Report.
- 27 - Page 3-15 lines 5-11: The text is confusing in this section. First, the word
28 “substantially” is vague, perhaps intentionally, and lacks rigor. Second, what
29 does substantially “larger low flows” mean? Is this an increase in volume for low
30 flows? A greater number of streams experiencing low flows? Or does it mean
31 something else? This should be clarified in the final 2007 Report.
- 32 - 3-15/24-32: it might be instructive to know if the change in timing showed any
33 type of pattern. Was there more often a delay or an acceleration, or was there no
34 distinct pattern? Distinct patterns may be useful to identify, as they may be
35 related to withdrawal patterns or climate change influences.
- 36 - Since this indicator comes directly from the Heinz Center Report, EPA should
37 look into how Heinz has modified its data.

38

39 **Nitrogen and Phosphorus in Wadeable Streams**

- 40 - 3-22/1: This indicator should be labeled Total N and P, not just N and P, to be
41 accurate.
- 42 - Although there are geographic limits to the data, much of the land cover that
43 sends waters to the oceans is covered. Limitations on what is not included are
44 explained. It might be mentioned in the final 2007 Report that many if not most

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1 of the rivers in the Southwest do not discharge into the ocean, or if they do, much
2 of the river has already been diverted for other purposes.
3

4 **Nitrogen and Phosphorus in Agricultural Watersheds**

- 5 - 3-25/10: The important point is not that nitrite and ammonium are not *present*—
6 rather, they are present but in low concentrations.
- 7 - 3-25/20: Clarify in the final 2007 Report that it is the decomposition of the excess
8 algae that can deplete oxygen in water. Also, include internal P loading from
9 sediments as a potential P source, especially in shallow lakes.
- 10 - 3-26/3: The low range for phosphorus is still quite high, and indicates eutrophic
11 conditions for most systems. It is unclear why such a high threshold was chosen
12 for the low end of this indicator. It is not surprising that such a high percentage
13 fell into this low category, but its significance is debatable. Clarify this in the
14 final 2007 Report.
- 15 - 3-26/10: Flow-weighting makes considerable sense, given the aggregation of data.
16 However, it would be very instructive if the data were analyzed for base flow and
17 storm event periods, assuming the data set allows this type of analysis.
18

19 **Nitrogen and Phosphorus Discharge from Large Rivers**

- 20 - 3-28/1: In the final 2007 Report replace “Discharge” with “Load”
- 21 - Exhibit 3-9: As noted in the text, load is a function of both discharge and
22 concentration—in the final 2007 Report it would be instructive to have discharge
23 data also included in this figure, to see how much of the change in load is a
24 function of discharge vs. concentration. While both drive load, changes driven by
25 the former are more climate related, while changes driven by the latter are more a
26 function of land use practices, and therefore more related to human activities.
27 This is an important distinction.
- 28 - In future Reports on the Environment statistical analysis (trend analysis) is
29 recommended for these data to determine if these trends are significant or not.
30

31 **Pesticides in Streams in Ag Watersheds**

- 32 - Exhibit 3-11: There is considerable value in disaggregating the data into at least a
33 few key pesticides. In the present format, there may be considerable
34 improvement or declines in a key pesticide, but the trend would be masked.
35 While there is presentation value in aggregated data, it also can lead to
36 misinterpretations—if the aggregated data need to be retained, they should be
37 enhanced in the final 2007 Report by adding trends on a few key pesticides.
- 38 - 3-33/25: Include a map of the watersheds in the final 2007 Report to show explicit
39 geographic distribution of the data collection.
40

41 **Benthic Macroinvertebrates in Wadeable Streams**

- 42 - 3-36: The explanation of the O/E model will be difficult for many readers to
43 follow. This may be an acceptable limitation, especially if the intended audience

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- 1 of the Report on the Environment is scientists, but others will balk at the non-
2 intuitive narrative. .
- 3 - What is the justification for the inclusion of these 3 ecoregions? Why not more,
4 less, others?
 - 5 - Exhibit 3-13: Why are the O/E data not shown in a geographic context, as well?
 - 6 - Data from the wadeable stream sampling are suspect, not because of the sampling
7 technique but rather the timing. Samples are taken from April to November and
8 then treated equally. Certainly streams change considerably over this time, both
9 in physical and chemical characteristics.

10 11 **3.2.3 Discussion**

- 12 - 3-39/30: These indicators do not reveal the role of precipitation—the load
13 indicators don't provide any precipitation information, and in fact, as currently
14 presented, mask the role of precipitation.
- 15 - 3-39/33: This should be rephrased in the final 2007 Report—the chemical and
16 physical indicators are proxies, at best, for the biological condition of the fresh
17 surface waters. The Report on the Environment provides a very limited picture,
18 not a mixed picture, of biological conditions, simply because there are so few
19 biological indicators to this point. The only trophic level discussed for surface
20 fresh waters in the entire U.S. is benthic invertebrates—nothing about bacteria,
21 algae, macrophytes, fish, or waterfowl. Hence, it is misleading to state the
22 biological condition index is mixed—there simply are insufficient data to draw
23 any conclusions about the overall state of the nation's surface fresh water biology.
- 24 - The final 2007 Report should include something on waterborne pathogens in this
25 section; even if it is not an indicator, perhaps there can be cross-references to
26 other sections where this indicator is discussed.

27 28 **Nitrate and Pesticides in Shallow Ground Water in Ag Watersheds**

- 29 - The indicator “nitrate and pesticides in shallow groundwater in agricultural
30 watersheds” does not match well with the question it addresses in the Report
31 because as it fails to inform on “extent.” The Panel therefore suggests that it may
32 be appropriate to restrict the question in the final 2007 Report to just “condition of
33 groundwater”
- 34 - See comments on the pesticides in streams indicator—they apply here, as well.

35 36 **3.3.3 Discussion**

- 37 - There is a dire need for a national monitoring program to address groundwater
38 extent; this is within the domain of the USGS and hopefully funding can be
39 obtained to start this work. In the interim, why not use groundwater contribution
40 to stream base flow as a measure? Gauging stage data from appropriate streams
41 across the nation might serve this purpose.
- 42 - 3-48/15: Changes in water table elevations are available in many groundwater
43 basins. For example, California Department of Water Resources maintains the
44 water table data. Over-drafting groundwater resources is a major concern and

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1 pressing environmental issue in the central and western states. Regional
2 indicators should be developed to address the question of “extent.”
3

4 **Wetland Extent, Change, and Sources of Change**

- 5 - 3-54/19: An important limitation of these data, which is not stated, is that extent
6 does not equate to quality—the increase in freshwater ponds results in a very
7 different quality of habitat than an increase in wetlands.
- 8 - If possible, the data should also be shown in the final 2007 Report by region
9 within the U.S.
- 10 - Exhibit 3-19: More attention should be paid in the final 2007 Report to the
11 “other” category; relative to the identified land use categories, this change in very
12 large and cries out for better classification.
13

14 **Trophic State of Coastal Waters**

- 15 - The Panel recommends that in the final 2007 Report the water chapter indicator
16 called “trophic state of coastal waters” be renamed “nutrients” or “eutrophication”
17 in coastal waters. Trophic state is a larger concept that would encompass, for
18 example, depleted stocks of large piscivores such as cod in New England that
19 have altered food webs and the trophic state of the waters through top-down
20 cascading effects. As written, the focus of this section of the water chapter is only
21 on bottom up, nutrient-related issues. In future Reports on the Environment it
22 would be useful to include considerations of the state of all trophic levels but the
23 name of the indicator could be changed immediately.
- 24 - 3-62/2: It appears from the exhibits that this indicator do not include the Great
25 Lakes coastal regions; this should be denoted in the final 2007 Report.
- 26 - 3-62/7: Note that algal blooms can also include attached, macroscopic algae, such
27 as *Cladophora* or *Enteromorpha* blooms.
- 28 - 3-62/12: If the definition of algal blooms stays strictly planktonic, this sentence is
29 correct as is; however, if it is extended to include benthic algae, then this sentence
30 will need amending to reflect that reduction of chlorophyll *a* by filtering activity
31 is restricted to water column chlorophyll *a*.
- 32 - 3-62/27: It may be instructive to include a table in the final 2007 Report that lists
33 the reference conditions for each region; this gives readers an idea of the
34 thresholds, and how they vary with region.
- 35 - 3-62/34: It does not appear that the composite U.S. score is weighted in any
36 fashion. Is that correct? Given the very different lengths of coastal areas in each
37 Region, what is the rationale for giving them equal weights?
- 38 - Exhibits 3-20 to 3-25:
39 A) In the final 2007 Report, a more effective graphic display would be to show
40 the regional map of the U.S. in the center of the Exhibit (now in the bottom
41 footnote), and have each region blown up as a pie chart, radiating out from the
42 U.S. map. The pie chart would show the 4 water quality categories.
43 B) As noted earlier, ecoregions are a much more scientifically defensible
44 geographic approach for showing regional data than EPA regions.

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- 1 C) There may be value in applying statistical tests to determine if there are
2 differences among regions; one would need to know more about the data
3 computation and distribution, a Chi-square test may work.
4 - 3-63/9: The indicator should be accurately defined in the final 2007 Report—this
5 is dissolved inorganic nitrogen (DIN), *not* nitrogen, *per se*.
6 - 3-64/1: As above, in the final 2007 Report this should be called dissolved
7 inorganic phosphorus (DIP), or ortho-P, not “phosphorus”, which could mean a
8 lot of different things to readers.
9

10 **Dissolved Oxygen**

- 11 - It is unclear when dissolved oxygen (DO) measurements were taken; because DO
12 concentration is dependent on time of day, this point should be reflected in the
13 discussion in the final 2007 Report.
14

15 **Coastal Sediment Quality**

- 16 - 3-67/2: It is unclear why this indicator was not applied to fresh water systems, as
17 well. This does not invalidate its merit for coastal systems, but readers may
18 wonder why there is an apparent inconsistency among systems.
19 - Exhibits 3-26 and 3-27: See comments above regarding 1) using a different
20 graphic for these exhibits, using pie charts from each region emanating from a
21 map of the U.S.; 2) revising composite U.S. score to weight based on coastline
22 within each region; and 3) statistical analysis for differences among regions.
23

24 **Coastal Benthic Communities**

- 25 - Exhibit 3-28: See comments above for Exhibits 3-26 and 3-27.
26

27 **SAV in Chesapeake Bay**

- 28 - 3-74/2: In the final 2007 Report, EPA may want to generalize the importance of
29 SAV beyond just Chesapeake Bay, similar to what is done for the introduction in
30 the Hypoxia Indicator.
31 - 3-74/28: In the final 2007 Report, it would be useful, either here or in indicator
32 limitations, to identify what percent of total area was estimated based on prior
33 years' surveys for those years with incomplete coverage. Is this a small amount
34 (<10%) or something more significant where the uncertainties have more
35 significance?
36 - 3-74/32: The data show two distinct trends – increasing from 1984 to 1992 and
37 leveling from 1992 to 2005. These trends should be discussed.
38 - 3-75/25: Species composition is also an important variable, as not all SAV species
39 provide the same ecosystem functions.
40

41 **Hypoxia in Gulf of Mexico and Long Island Sound**

- 42 - This was a very well structured indicator.
43

44 **HAB Outbreaks Along the Western Florida Coastline**

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- 1 - Other potential limitations to this indicator include: 1) cell density not necessarily
- 2 equate to toxicity; and 2) biovolume may be a better indicator than density,
- 3 although this may be too labor-intensive to compute.
- 4 - The selection of an indicator such as HAB should not be restricted to *coastal*
- 5 *waters*; rather, the question is more appropriately aimed at surface waters—for
- 6 future Reports on the Environment consideration should be given to reorganizing
- 7 the questions in the water chapter around surface water (including both fresh and
- 8 marine coastal), ground water, and drinking water.
- 9 - The HAB indicator is site specific. Perhaps the algal blooms are more common
- 10 along the Florida coastline, but they are not unique to that region.

11 12 **3.5.3 Discussion**

- 13 - 3-84/28: In the final 2007 Report the “location of a large city” should not be
- 14 characterized as a human *activity*—the Report on the Environment is confusing
- 15 state variables and flows. This should be reworded to identify the relevant
- 16 activities (e.g., runoff from impervious surfaces, combined sewer overflows, etc.).

17 18 **Population Served by Community Water Systems (CWS) with no Reported**

19 **Violation**

- 20 - It is unclear why the indicator is not the inverse of what is presented—i.e., the
- 21 number of CWS with reported violations. This seems the more direct
- 22 measurement.
- 23 - 3-90/39: The value of reporting the number regions above the national percentage
- 24 is unclear. Don’t the regional data what makes up the national percentage? What
- 25 is the point of including this information?

26 27 **3.7.3 Discussion**

- 28 - Why not have a regional indicator based on number of beach closings (number of
- 29 beaches or number of days)? This information is currently being collected in the
- 30 Great Lakes, as part of the EPA Beach Act.

31 32 **Coastal Fish Tissue Contaminants**

- 33 - Exhibit 3-38: See comments given above regarding 1) using a different graphic
- 34 for these exhibits, using pie charts from each region emanating from a map of the
- 35 U.S.; 2) revising composite U.S. score to weight based on coastline within each
- 36 region; and 3) statistical analysis for differences among regions.

37 38 **Contaminants in Lake Fish Tissue**

- 39 - Exhibits 3-40/41: In the final 2007 Report, it would be more instructive to
- 40 represent these data by Region to show geographic differences.
- 41 - 3-109/4: In the final 2007 Report, the absence of Great Lakes data should be
- 42 noted earlier in this section, not just as an indicator limitation bullet. This is
- 43 important given the historical legacy of contaminants in this region, so the

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1 exclusion of these data may result in an underreporting of the degree of
2 contamination.

3

4 ***Land Chapter***

5

6 **Land Cover**

7

- 8 - The Panel's issues of concern for the land cover indicator are that: a) the data are
9 old, b) the classification categories for land cover are too coarse, and c) to date
10 there is no time series (trend) information, though EPA reports that time series
11 information is under development. There are a number of regional and national
12 products; including the National Land Cover Data Set (NLDC), LandFire, and
13 others. These would provide greater resolution and time series for these analyses.
- 14 - The Panel recommends that in future Reports on the Environment, EPA consider
15 using a range of land cover classification schemes with different levels of
16 resolution based on what is most appropriate to answer specific questions.
- 17 - In the land chapter there is no discussion regarding the relationship between the
18 status/trends in land cover and the effects on human health and the environment.
19 In the final 2007 Report, it would be helpful to elucidate what data collection and
20 analysis will be required to answer these questions and steps that need to be taken
21 to make this a practical and useful indicator.

21

22 **Forest Extent and Type**

23

- 24 - The Panel believes that EPA needs to characterize land cover of all major
25 ecosystem types. Therefore it is unclear why the Agency chose to only report on
26 forest extent and type over other types of land cover. Other land cover types are
27 distinguishable from existing imagery products data sets, the data presented for
28 the land use indicator show trends in many different land cover (use) types. The
29 rationale for only using forest extent and type needs to be clarified in the final
30 2007 Report.
- 31 - The forest extent and type indicator that is presented in Chapter 6 (ecosystem
32 condition) only represents timberland. This presents only one category of forest
33 land and others should be included in future Reports on the Environment.

33

34 **Land Cover in the Puget Sound/Georgia Basin**

35

- 36 - The land chapter regional example on Puget Sound using the National Oceanic
37 and Atmospheric Administration Coastal Change Analysis Program (CCAP) data
38 has very coarse classification information that translates to a low sensitivity
39 indicator instrument. The reference point of 10% impervious surface becomes an
40 important metric to make a statement regarding what the indicator means, whether
41 things are falling apart or improving, and when action needs to be taken. There
42 are many changes brought up in this section that may be better suited to the land
43 use indicator category.
- 44 - There is no good explanation why the Puget Sound example was chosen to be
representative of "land cover." Such an explanation should be included in the

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1 final 2007 Report. The area encompasses many watersheds that have many
2 different types of land cover, but the data only assess changes to forest and urban
3 classes. The example does not provide much useful information or methodology
4 that would describe an approach that should be used for assessment of land
5 condition outside of the immediate area covered by the case study. The Panel
6 suggests that regional indicators should provide this use through inclusion in this
7 Report. The Panel supports the inclusion of regional examples, but believes that
8 they should present data or methods that can be applied across the U.S. An
9 example or case study should be chosen to demonstrate particular aspects of the
10 conceptual model underlying the set of indicators and their linkage to the
11 fundamental questions.
12

13 **Land Use**

- 14 - The Panel suggests that in future Reports on the Environment, EPA evaluate and
15 adopt widely-used standardized approaches to classify land uses that have been
16 developed through the National Resource Inventory and the Forest Inventory and
17 Analysis programs as well as the National Agricultural Statistics Service and
18 Economic Research Service. The Panel finds that much of the introductory
19 material in the land chapter discusses the differences between approaches rather
20 than interpreting what they can tell us about the status of land resources. The
21 Panel is pleased to see that this indicator provides a beginning of a time series that
22 can be used to document trends. The usefulness of the discussion will be
23 improved by elaboration of what specific land uses changed from one class to
24 another.
- 25 - The Panel notes differences between national and EPA regional data for land use
26 in the Report. The discussion regarding the land use indicator is inconsistent
27 concerning the inability to obtain data for land cover and the data available for
28 land use. The land use data sets imply that there are trend data available for land
29 cover. If this is not the case because the land use and land cover data are different
30 in nature, this will need further explanation. For future Reports on the
31 Environment the agency should work to adopt standard approaches for land use
32 and land cover analyses. Standardized land use and land cover analysis and
33 reporting at national and regional scales ultimately will benefit from a higher level
34 of classification and mapping consistency across all federal agencies.
- 35 - For future Reports on the Environment, the Panel recommends that EPA consider
36 adding road density (which can be measured directly just like stream density) as
37 an indicator for land use. Accurate road density data are readily available in
38 electronic, Geographic Information System (GIS) format (e.g., as Topographically
39 Integrated Geographically Encoded Referencing System [TIGER] files). Since
40 TIGER is a U.S. Census Bureau product, its limits and accuracy are well
41 documented (<http://tiger.census.gov/>). Nationwide data are available, and
42 changes over time can be mapped and measured. Density can be determined for
43 specified regions of interest. There are other sources of road network data, but a
44 1990-2000 TIGER would be a good start.

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1

2 **Urbanization and Population Change**

- 3 - The Panel finds that the urbanization and population change indicator in the land
4 chapter presents much good information regarding the relationship between these
5 factors. However, the chapter provides limited and indirect examination of the
6 relationship between the available information and the resulting affect on human
7 and environmental health.
- 8 - The Panel finds that the urbanization and population change indicator actually
9 measures a stressor of land use in addition to one type of land use (developed
10 land). The Panel questions whether population is a land use indicator or part of a
11 group of indicators considered to be major drivers (stressors) of most indicators.
- 12 - In the final 2007 Report, the developed land data set that is used in the land
13 chapter to represent urbanization and population change needs to be clearly
14 described in the introductory text for this indicator. EPA should evaluate whether
15 a more useful indicator might be “population density by land use type,” not by
16 EPA region. Exhibit 4-11 on page 4-33 shows population density in the U.S. by
17 EPA Region but the EPA Regional averages do not capture the aggregation of
18 population density. Data aggregation is a major issue and EPA needs to be
19 cautious that this does not misrepresent the extent and intensity of environmental
20 impact.
- 21 - The discussion for the land use indicator addresses human residential and
22 commercial uses. The Panel suggests that more could be said in the final 2007
23 Report about other land changes (e.g., changes in agricultural land and associated
24 fertilizer and pesticide use), beyond just identifying them as gaps.

25

26 **Quantity of Municipal Solid Waste Generated and Managed**

- 27 - The data used to represent this indicator are well defined and consistently
28 collected. However, the connection to human health and the environment is
29 missing and should be discussed in the final 2007 Report.
- 30 - In the discussion of indicator limitations it is stated that the available information
31 is model driven. The Panel recommends that more information be provided in the
32 final 2007 Report about sources of uncertainty associated with the modeled
33 estimates. If the estimated waste generation is based on a model that uses
34 materials utilized, these changes and thus the quality and quantity of the waste is
35 not “consistent from year to year” as stated. The Panel also notes that this
36 indicator does not appear to meet EPA’s indicator acceptance criteria. The Panel
37 does not recommend omission of the indicator, but more discussion of the quality
38 of the estimate is needed in the final 2007 Report.
- 39 - In the discussion of indicator limitations, a gap concerning landfill capacity is
40 identified. The Panel notes that landfill capacity is not a nationally limited
41 resource (only cheap landfill space near some very large cities is in short supply).
42 Therefore, landfill capacity should probably not be listed as a gap in the final
43 2007 Report.

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- 1 - Some interpretation in the discussion of this indicator is not well linked to the data
2 and should be avoided in the final 2007 Report. For example, on page 4-46 it is
3 stated that, “Recycling efforts related to municipal solid waste have increased
4 over the four decades showing the steepest increases between 1980 and 2000,
5 most likely due to the increased awareness about the benefits of recycling and the
6 implementation of policies by state and local governments tying waste generation
7 directly to the cost of waste services.”
8

9 **Quantity of RCRA Hazardous Waste Generated and Managed**

- 10 - The data used to represent this indicator are well defined and consistently
11 collected. However, the connection to changing levels of exposure and the
12 resulting impact to human health and the environment is missing and should be
13 discussed the final 2007 Report. This is an indirect land use issue, especially
14 when deep well injection is a major method of getting rid of the RCRA waste.
15

16 **Fertilizer Applied for Agricultural Purposes**

- 17 - There is good information presented in the land chapter discussion of this
18 indicator, but it is again not related to human and environmental health. The
19 ‘delta’ between fertilizers applied, that taken up by the crops, and that which is
20 released to the environment is the most relevant indicator.
21 - The Panel notes that this indicator is limited to three crops and questions how well
22 it represents fertilizer application in cropping across the U.S. The Panel also
23 notes that separation of data for this indicator by EPA regions could be helpful
24 since nitrogen and phosphorus drain into rivers, and large watershed regions
25 might be more appropriate.
26 - The Panel recommends that a pesticide use indicator be added to the land chapter.
27 Of the final 2007 Report. This could be done by renaming the indicator as
28 “Fertilizer and Pesticide Applied.” In this regard, one possible indicator that
29 could be used is pesticide sales, which could likely be parsed into agricultural and
30 residential/commercial landscape applications. The latter would provide a
31 suburban/urban indicator, which is important from the standpoint of human
32 exposure.
33

34 **Toxic Chemicals in Production-Related Wastes Released, Treated, Recycled, or** 35 **Recovered for Energy Use**

- 36 - The Panel notes that the title for the indicator should perhaps be modified in the
37 final 2007 Report so that it does not appear that only toxic chemicals related to
38 energy use are being considered.
39 - Toxic chemicals have a direct relationship to human and environmental health;
40 therefore any reduction in the release of these chemicals has net positive health
41 benefits. The indicator limitations section clearly points out the gaps in our
42 knowledge and reporting base. In the final 2007 Report, this indicator might be
43 more appropriately placed in a section dealing with toxic and harmful chemicals.

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- 1 - In the final 2007 Report it would be helpful to weight the amounts of toxic
2 chemicals by toxicity (e.g., the un-normalized weights given in Exhibit 4-18 on
3 page 4-55), but this is addressed under limitations.
- 4 - The Panel recommends that in the final 2007 Report indicator data (e.g., Toxics
5 Release Inventory [TRI] derived) be included for persistent bioaccumulative
6 toxics (PBTs) and mining wastes, even if the available data are limited, such as is
7 apparently the case for PBTs. The Panel notes that PBT data are available for
8 some aquatic ecosystems such as the Great Lakes. This indicator therefore
9 provides an opportunity for integrating land the land and water chapters. The
10 Panel suggests that EPA consult PBT data available in the draft 2007 State of the
11 Great Lakes report
12 ([http://www.solecregistration.ca/documents/4201%20Contaminants%20in%20Sport%20fish%20\(SOLEC%202006\).pdf](http://www.solecregistration.ca/documents/4201%20Contaminants%20in%20Sport%20fish%20(SOLEC%202006).pdf)).
13
14

15 **Pesticide Residues in Food**

- 16 - The Panel notes that pesticide residues in food have a direct relationship to human
17 and environmental health and any reduction in pesticide residue has net positive
18 health benefits. However, the linkage of this indicator to land use is weak and the
19 Panel recommends that in the final 2007 Report the indicator be moved to
20 Chapter 5 (Human Health).
- 21 - The indicator limitations section clearly points out that we should be monitoring
22 the detections that exceed established tolerance levels in addition to what our
23 instruments are able to detect.
24

25 **Reported Pesticide Incidents**

- 26 - The Panel finds that the decline in reported pesticide incidents has a direct
27 relationship with human health. However, the link between reported pesticide
28 incidents and the human health impacts of land management practices is tenuous.
29 Reported pesticide incidents cover all sorts of uses of pesticides, and are based on
30 calls to poison control centers. Many of these incidents are related to misuse of
31 household products and activities far removed from land management. The Panel
32 recommends that in the final 2007 Report the indicator be moved to Chapter 5
33 (Human Health).
34

35 **High Priority Cleanup Sites with No Human Contact to Contamination in Excess of** 36 **Health-Based Standards**

- 37 - The Panel finds that this indicator has a direct connection to human health and
38 addresses whether people are being kept away from hazardous sites. It may be
39 useful to include some RCRA Corrective Action sites in the analyses in the final
40 2007 Report. In addition, it may be useful to provide an indicator that would
41 address the number of sites that have been taken off the high priority site list.
- 42 - The Panel recommends that EPA consider including in the final 2007 Report an
43 indicator for the number and associated land area of sites of this type that have
44 been cleaned up.

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1
2 **High Priority Cleanup Sites where Contaminated Groundwater is Not Continuing**
3 **to Spread Above Levels of Concern**

- 4 - The Panel finds that this indicator also has a direct connection to human health as
5 it addresses whether contaminated waters are being contained. It would appear
6 that there are many additional CERCLIS listed sites and other RCRA Corrective
7 Action sites that could also be included in these analyses. It may also be useful in
8 this case to provide an indicator in the final 2007 Report that would address the
9 number of sites that have been taken off the high priority list. EPA should also
10 consider including an indicator of the number and associated land area of sites of
11 this type that have been cleaned up.

12
13 *Human Health Chapter*

14
15 **Health Effects of Air Pollutants**

- 16 - In describing health effects associated with air pollutants, authors should be
17 careful to include in the final 2007 Report those effects associated with low-level
18 exposure as occurs in the ambient environment. For example, ambient carbon
19 monoxide is described as having effects including cardiovascular, neurological,
20 visual impairment, reduced work capacity, reduced manual dexterity, poor
21 learning ability, and difficulty performing complex tasks. The Panel questions
22 whether these effects are associated with low level exposures.

23
24 *Ecological Condition Chapter*

25
26 **Need for Additional Indicators**

- 27 - Indicators are provided in the ecological condition chapter to answer the question:
28 “What are the trends in the diversity and biological balance of the nation’s
29 ecological systems?” The Panel notes that the concept of biological balance
30 includes complex interrelationships for which clear indicators are not easily
31 selected. Those indicators selected are either population states or events which
32 are difficult to translate into “balance.” Very few biological taxa indicators are
33 included. At present, it is a good start but inadequate. Far more indicators of
34 floral and faunal groups as well as biological communities should be included in
35 future Reports on the Environment.

36
37 **Ecosystems are Missing**

- 38 - Western Continental Issues. In the ROE 2007 Science Report there is little or no
39 attention paid to the arid ecosystems in the Great Basin and the desert southwest.
40 Grassland/prairie, shrublands, rangelands, and chaparral are important ecosystems
41 in terms of biodiversity. It is important to include information on these
42 ecosystems in future Reports on the Environment.
43 - Coral Reefs. Coral reefs have been in serious decline due to eutrophication,
44 overfishing, siltation, disease, and climate, among other factors. Many of the

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1 factors affecting coral reefs are germane to EPA regulatory programs. Much
2 monitoring data are available on these ecosystems. The Panel notes that earlier
3 reviews recommended that coral reef cover, which had been proposed as an
4 indicator, not be included in the 2007 ROE Science Report because it lacked
5 calibration between methods, does not explain how sites were selected, and lacks
6 a consistent analytical framework to adjust for bias in geographic distribution and
7 sampling method. We think that, because of their ecological, economic, and
8 recreational value, the benefits of including corals in the Report outweigh these
9 problems. Many coral reef monitoring programs use transects, and data from
10 these monitoring programs could be used in the Report. A regional coral reef
11 indicator could be developed, using only those that reefs that were sampled
12 appropriately. Problems with the data could be described in the limitations and
13 gaps section. The Panel recommends that coral reef information could be added
14 to future Reports on the Environment.

- 15 - Soil Ecosystems. Soils are one of the key drivers that cut across all terrestrial
16 ecosystems. Soil is a fragile and finite resource that plays a unique role in
17 maintaining air and water quality. Use and management of native, agricultural,
18 forested, range, and urban lands play an integral part in influencing soil and water
19 quality within a watershed. Protecting soil quality is important for ecosystem
20 productivity and water quality. Soil morphological, physical, chemical, and
21 biological properties can serve as indicators. Spatial data in various ecoregions
22 are currently available on range of soil properties and should be included in future
23 Reports on the Environment.

24
25 **Populations are Missing**

- 26 - Marine/estuarine fish. The Panel recommends that in future Reports on the
27 Environment, the ecological condition chapter include considerations of
28 marine/estuarine fish populations. There are numerous long-term data on these
29 populations available from NOAA Fisheries. Many species are in decline due to
30 overfishing; this has received considerable attention. The depletion of predatory
31 fish can have ramifications through the food web via trophic cascades that can
32 result in reduced numbers of grazers, and subsequent algae blooms, that can
33 exacerbate eutrophication. The depletion of filter feeders such as oysters can also
34 lead to reduced water quality. While fisheries are not EPA's responsibility, the
35 depletion of upper trophic level species can have major effects on the ecosystem
36 and environmental quality.
- 37 - Amphibians. The Panel recommends that in future Reports on the Environment
38 EPA include in the ecological condition chapter an indicator dealing with
39 amphibians. There have been many studies documenting the precipitous decline
40 and loss of populations of amphibians, and some of those could be used to
41 construct an indicator. While the reasons for the disappearance of amphibians are
42 not all understood, some factors involved appear to be climate change, ultraviolet
43 radiation, and pesticides, all of which are relevant to EPA. If development of a
44 national indicator is not possible, a regional one could be developed.

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- 1 - Invasive species. The Panel recommends that in future Reports on the
2 Environment EPA include data on non-indigenous invasive species in a variety of
3 terrestrial and aquatic ecosystems. There are numerous data sets that could be
4 used to develop indicators, at least for some regions. For example, SERC
5 (Smithsonian Environmental Research Center) has data sets for marine/estuarine
6 invasive species. Additional sources of information are the Global Invasive
7 Species Database of the Global Invasive Species Information Network
8 (<http://www.invasivespecies.net/>), and the National Invasive Species Information
9 Center hosted by the U.S. Department of Agriculture
10 (<http://www.invasivespeciesinfo.gov/>).
- 11 - Taxa containing massive diversity. The Panel recommends that in future Reports
12 on the Environment indicators be developed for taxa such as microflora and
13 microfauna, and non-vascular and vascular plants, which have very high
14 biodiversity. Ecosystems host complex microbial communities, including
15 bacteria, fungi, protozoa, and viruses. The size and diversity of microbial
16 communities are directly related to quality and quantity of resources available.
17 Microbial processes and populations have more rapid turnover than higher trophic
18 levels and are often more responsive to environmental change. These
19 characteristics make microbes good indicators of ecosystem condition because
20 they are potentially very sensitive to perturbations such as nutrient loading,
21 hydrologic alterations, and fire. New information is now emerging about these
22 indicators and the Panel hopes this information will be added in future reports.

23 24 **Processes are Missing**

- 25 - Denitrification. The Panel recommends that in future Reports on the Environment
26 the ecological condition chapter include an indicator of the natural denitrification
27 process which is important for nutrient balance in ecosystems, for example, the
28 denitrification of nitrate from atmospheric deposition. Ecological processes in low
29 order streams are important in processing excess nutrients (e.g., denitrification of
30 N from atmospheric deposition).
- 31 - Soil Processes. Another issue of importance is the trend in the extent and
32 condition of the nation's soil resources. As noted above, soils are one of the key
33 drivers that cut across all terrestrial ecosystems. Soil quality and associated
34 processes can have major influences on ecosystem productivity and nutrient
35 cycling. Loss of topsoil due to erosion and other processes can influence
36 ecosystem productivity and long-term assimilative capacity as well as stream
37 water quality. Assimilative capacity is important as ecosystems have finite
38 capacity to provide services before they are drastically altered. For example,
39 long-term application of nutrients via fertilizers or organic wastes may ultimately
40 saturate a system. This is evident through accumulation of phosphorus in soils
41 and increased levels of nitrate in ground waters. Salination of irrigated farmland
42 soil is an urgent issue in the arid Southwest. Potential soil quality indicators
43 include: carbon storage, organic matter, nutrient inventory, phosphorus index,

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- 1 extent and soil type, soil quality, salinity, soil erosion. The Panel recommends
2 that future Reports on the Environment consider these indicators.
- 3 - Acidification. The Panel notes that there are long-term data sets available on
4 responses to acidification and its reduction (National Acid Precipitation
5 Assessment Program [NAPAP]) that should be included in future Reports on the
6 Environment.
 - 7 - Disturbance. Disturbance is a critical process in all ecosystems and should be
8 included in future Reports on the Environment. The Report discusses its
9 importance but has no indicator of disturbance or response to it (e.g., resilience).
10 Disturbance processes can be used as indicators of anthropogenic effects on the
11 environment. For example, maps showing how fire cycles have changed in
12 relation to the health of forests can provide important information on a critical
13 issue

14 15 **Trends in Diversity and Biological Balance of the Nation's Ecological Systems**

- 16 - On page 6-29, the final 2007 Report should acknowledge that some systems
17 inherently have different numbers and variety of species, making it inappropriate
18 to make comparisons among systems.

19 20 **Choice of Forests, Wetlands, and Land Use as Indicators in Chapter 6**

- 21 - While there is nothing wrong with these categories, it is unclear to readers why
22 these were chosen and not other equally appropriate categories. A conceptual
23 framework would be very helpful in the final 2007 Report to place these
24 categories and indicators into some type of context.

25 26 **Forest Extent and Type**

- 27 - This indicator is limited to "timberlands" which is misleading. This is nearly
28 equivalent to using corn and wheat fields in order to describe the extent of
29 grasslands. The Panel notes that this indicator is based on productive capacity,
30 and therefore a statement in the Report concerning the limits of indicators that
31 have excluded production does not apply. However, the discussion of indicator
32 limitations does recognize some of the limits of using timberland data.
- 33 - 6-16/15: What percent of forest land is not being captured in this analysis? In the
34 final 2007 Report this percent should be explicitly noted as part of the uncertainty.

35 36 **Forest Fragmentation**

- 37 - The Panel understands the value of using forest fragmentation as an indicator but
38 questions why a fragmentation indicator is not equally important for the other
39 ecosystems. The Panel questions whether this is because of the availability of
40 data. The Panel finds that in the final 2007 Report, a schematic diagram
41 graphically showing the four degrees of forest cover to complement the narrative
42 would be helpful, as would a presentation of the absolute area of forested lands
43 identified for each region.

44

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1 **Wetland Extent, Change, and Source of Change**

- 2 - Development of artificial wetlands, ponds etc. may skew data for this indicator.

3
4 **Ecological Connectivity (Region 4)**

- 5 - The Panel notes that development of this indicator is an exercise demonstrating
6 how to show connectivity, but since it is regional it does not tell much about
7 connectivity either nationally or in major ecoregions. The distinction between
8 hub and corridor should be better defined and shown in the map in the final 2007
9 Report. If the methodology is relatively simple and uses just National Land
10 Cover Data Set (NLCD) data, then a major effort should be made to see if it is
11 applicable to non-forested regions.

12
13 **Relative Ecological Condition of Undeveloped Land (Region 5)**

- 14 - The Panel finds that this is a case where a tool has been developed for one EPA
15 region but it does not tell the story about the landscape in general or its
16 usefulness. The indices used have the potential to display a lot of information, but
17 it is not stated what exact data layers are included in each index. This tool used
18 only NLCD data to generate three indices, two of which use species diversity or
19 rarity. The Panel questions whether it is possible to go to species level with
20 NLCD satellite data. If models were used for the diversity and rarity indices, they
21 should be explained. In the discussion in the final 2007 Report it should be noted
22 that increases in developed land affect habitat and impact physical and chemical
23 processes such as runoff from impervious surfaces, reduced groundwater
24 recharge, and increased stream temperatures.
- 25 - Shades of green are extremely difficult to distinguish in Exhibit 6-8.
- 26 - Undeveloped is a relative term and appears to be confounded with population
27 density, making it inappropriate to draw conclusions or causative associations (as
28 on page 6-27, “The potential for future land use changes with increasing
29 urbanization is the major determinant for judging potential fragmentation of
30 ecological systems in EPA Region 5...”)
- 31 - In the final 2007 Report EPA should clarify the interpretation or importance of
32 the cover types mentioned: maple-beech-birch, spruce and pine. Is this simply a
33 descriptive statement or should the reader be able to infer something about a trend
34 of ecological significance?

35
36 **6.2.3 Discussion**

- 37 - It is unclear why forests, wetlands, and land development, of all available
38 indicators, are the three worth highlighting for the nation’s ecological condition.
39 This should be clarified in the final 2007 Report.
- 40 - 6-27/1-3: It may also be worth noting that these increases in developed land affect
41 not only habitat loss for biota, but also impact physical and chemical factors, such
42 as more runoff from impervious surfaces, leading to greater loading of nutrients
43 and contaminants, a more unstable hydrology, reduced groundwater inputs, and
44 increased stream temperatures.

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1
2 **6.3 Discussion**

- 3 - 6-30/25-31: It is helpful to know about the absence of a systematic biodiversity
4 initiative in the U.S., but there is still a need to explain in the final 2007 Report
5 the rationale behind including those indicators that are found in the Report.
6

7 **Bird Populations**

- 8 - The limitations on the data set should not detract from the usefulness of this
9 indicator. It is one of the more consistent, long-term sets of ecological measures
10 in the whole Report.
11 - In the final 2007 Report, EPA may want to qualify in the text in the data bullets to
12 note that the significant increases or decreases are of observations, not population
13 size.
14

15 **Fish Faunal Intactness**

- 16 - The discussion in the ecological condition chapter states a concern over the
17 inability to show magnitude of loss. The Panel notes that this could be remedied
18 by using a map of number of species lost. With such a small number of species to
19 begin with, the percent decline figure can be misleading. The Panel questions
20 whether using 1970 as a reference year potentially confounds comparisons from
21 regions that were heavily polluted at that time. The Panel recommends that data
22 from estuarine fish should be included in future Reports on the Environment.
23

24 **Non-indigenous Species in the Estuaries of the Pacific Northwest**

- 25 - The limitation one area implies that non-indigenous species are less important in
26 other estuaries. The Panel notes that the restriction to species captured in a grab
27 sample suggests that this is how most invasive species can be sampled. However,
28 this is not true – more estuarine invasive species tend to be epibionts that attach to
29 surfaces. Some invasive species cause greater disruption of ecosystems than
30 others, so it may make sense to use indicators that address those species that are
31 most ecologically or economically problematic. The Panel finds the preliminary
32 classification of estuaries as “exposed” or “background” depending upon the
33 assumed amount of ballast water or aquaculture releases is naïve, since estuarine
34 biota disperse, and currents aid their spread, particularly in the planktonic stages.
35 There is no need to pre-classify estuaries. Once the data on non-indigenous
36 species are collected, then estuaries can be classified according to their percentage
37 of non-indigenous species. The Panel recommends that in future Reports on the
38 Environment this indicator be expanded to other estuaries as well as other aquatic
39 and terrestrial ecosystems.
40

41 **6.3.3 Discussion**

- 42 - 6-40/18: Chesapeake Bay SAV may not be a representative example for wider-
43 spread phenomena.

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- 1 - 6-40/24: It may not be possible to statistically defend this claim with the available
- 2 data sets.
- 3 - Good regional long-term data sets may be available to address above ground plant
- 4 richness and diversity (e.g., Long Term Ecological Research Programs, Harvard
- 5 Forest data)
- 6 - 6-42/25: Perhaps a useful template for the type of exhibit on this page would be a
- 7 map of the U.S. subdivided into regions, with more detailed maps of each region
- 8 showing data for different representative species. For invasive species, this may
- 9 be an autotroph or a heterotroph, or aquatic vs. terrestrial, depending upon which
- 10 species provides the best information for the region.
- 11

12 **6.4 Discussion**

- 13 - Perhaps the Midwest Environmental Advocates (MEA) model could be used for
- 14 identifying ecological processes that sustain the nation's ecological systems (i.e.,
- 15 provisioning, regulating, cultural, and supporting).
- 16 - There is a fundamental problem in the indicator chosen for this question. The
- 17 question deals with processes, but the indicator deals with a state variable, not a
- 18 process. This can be resolved by changing the question or choosing an indicator
- 19 that answers the question, such as primary productivity, decomposition rates, or
- 20 nutrient uptake/cycling rates. Long Term Ecological Research Program sites
- 21 should provide a rich source of data for these types of information.
- 22

23 **Carbon Storage in Forests**

- 24 - The Panel notes that carbon storage in forests is not an ecological process per se,
- 25 but a condition representing the net balance between the processes of
- 26 photosynthesis and decomposition. This indicator can show trends. However,
- 27 many more processes need to be covered in future Reports on the Environment.
- 28 The use of several geographic regions is more logical here than the use of EPA
- 29 regions elsewhere. Unfortunately, the data in the chapter represent only
- 30 "timberlands" which include many highly managed forests and this should be
- 31 pointed out in the limitations section. Use of this indicator should be expanded in
- 32 future Reports on the Environment to carbon storage reservoirs, such as
- 33 grasslands, especially below ground (soil) storage which holds a significant
- 34 portion of the total carbon.
- 35

36 **Photosynthesis and Decomposition**

- 37 - Photosynthesis and decomposition are the two most important ecological
- 38 processes. Carbon storage is described as an indicator representing the net
- 39 balance between these two processes. Restricting the indicator to forests and
- 40 excluding grasslands greatly weakens this indicator. In the final 2007 Report this
- 41 needs to be discussed in the limitations section on page 6-46.
- 42

43 **6.4.3 Discussion**

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- 1 - 6-48/4: The indicator does not provide data on trends in primary production; this
2 process is a rate. The indicator provides data on a stock, which is different.
3 - 6-49/1: Another limitation, assuming carbon storage is used as the proxy
4 indicator for this question, is that carbon storage from many other important
5 terrestrial ecosystems is missed.
6

7 **U.S. Temperature and Precipitation, Sea Surface Temperature, Sea Level**

- 8 - These are very good time series data. They are all physical attributes that have
9 impacts on biota and on ecological processes. These indicators, and their links to
10 greenhouse gas emissions discussed in the air chapter, should be included in the
11 ecological condition chapter discussion in the final 2007 Report.
12

13 **Sea Surface Temperature**

- 14 - 6-59/4: Why not include statistical information?
15

16 **Sea Level**

- 17 - Although not technically “sea” level, one limitation is the lack of data reported for
18 Great Lakes levels. These data are available from the U.S. Army Corps of
19 Engineers (Detroit District), and should be considered for inclusion in future
20 Reports on the Environment.

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1 **Appendix B: Editorial Comments**

2
3 **General**

- 4
5 - Throughout the Report there is generous use of acronyms, which may be confusing,
6 but perhaps unavoidable. Thus, including a list of acronyms and abbreviations (e.g.,
7 units of measurements) would be an improvement.
8 - As this version of the Report is intended for scientists rather than the general public, it
9 would be helpful to use metric system units throughout for measurements (e.g. °C
10 rather than °F for temperature).

11
12 **Introduction**

13
14 1-4: Identify explicitly the philosophy behind choosing indicators.
15

16 **Water Chapter**

- 17
18 3-7/14: Replace “like” with “such as”.
19 3-7/42: Move “only” to after “meet”.
20 3-9: Should N and P discharge be load?
21 3-9: Delete “wetland extent...” from the coastal waters box.
22 3-11/37: Seems that NPS paragraph also should include affects of land cover, such as
23 impervious surfaces.
24 3-12/1-3: Air deposition should include nutrients, as well (N and P)
25 3-12/12-18: It is not just extent of the fresh waters, but also their configuration in the
26 landscape that matter. This should be noted.
27 3-15: Exhibit 3-1: Clarify caption: “Relative percentages of rivers and streams in terms of
28 their changes of high and low flow ...”
29 3-17/3: Are any estimates available of the percentage increase of dammed rivers between
30 1949 and 1970?
31 3-26/10: Suggestion--briefly explain the weighting scheme used.
32 3-28/24: Change to “have a broad geographic distribution”.
33 3-36: Needs enumeration of rows 1-45.
34 3-42/19: Add: Groundwater accretions in agricultural watersheds may also increase
35 contaminant loads of rivers and streams.
36 3-50/17: This is not a *location* classification—it is salinity of media
37 3-53/4: Insert “and other types of coastal” after ‘Estuarine’
38 3-53/7: Insert ‘, chemical’ after ‘biological’.
39 3-53/14: Insert “These conversions reduce the area of the relatively unique systems such
40 as forested swamps and bogs and increase the area of the ubiquitous ponds and marshes.”
41 after “pond.”
42 3-54/19: Insert “although still much less in absolute terms than the other wetland types”
43 before “Panel D”.

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- 1 3-54/40; 3-55: Exhibit 3-19--Please clarify the meaning of describe the process of
2 “deepwater conversion”.
- 3 3-57: Insert “and continue to be lost” after “1990s”.
- 4 3-57/29: Insert “and some wetland types such as forested swamp and bogs are difficult or
5 even impossible to create or restore.” after “lost”.
- 6 3-57/32: Insert “using a logistically plausible” after “estimate” and Remove “without an
7 impractical”.
- 8 3-58/3: Insert “function and” before “condition”.
- 9 3-63/9; Exhibit 3-21: Include quantitative information for nitrogen concentrations.
- 10 3-64: Exhibit 3-32: Include quantitative information for phosphorus and chlorophyll.
- 11 3-67/3: May want to define what is meant by “adverse”.
- 12 3-71: Exhibit 3-28 is missing letters and a dash in the label within the text box.
- 13 3-79: Exhibit 3-32 is missing data in Panel A.
- 14 3-71: Exhibit 3-38--Fix caption number.
- 15 3-72/19: Address the possible effect of the weighting scheme and methodology on the
16 results.
- 17 3-79: Exhibit 3-32--- Include missing data in graphic.
- 18 3-82/6: Limitations---the temporal trend is limited by the short time span (only 5 years of
19 data).
- 20 3-84/30: Comment---How much different? Many times higher or less?
- 21 3-87/5: Suggestions---Include brief definitions of surface water and ground water.
- 22 3-103/17: Suggestion---Include brief description of health risk basis of guideline.
- 23 3-104: Exhibit 3-38---Indicate that the values are percentages. Add: “Percent” to caption.
- 24 3-108/10: Briefly explain toxic equivalents (TEQ). MDLs have no direct relations to
25 health risk.
- 26 3-109/2: Comment---Imported seafood accounts for 70% of consumption. Perhaps it is
27 also an FDA issue.

28

29 ***Land Chapter***

30

- 31 4-61: Consider an outline to the bars in Exhibit 4-6, 4-7 (pp. 4-26, 4-27) to make them
32 more visible, such as in Exhibit 4-23.
- 33 4-31: legend is incomplete in Exhibit 4-8
- 34 4-50: NPK are identified as pounds per acre; are these the desired units? Are these values
35 devoid of inert ingredients (i.e., just element)?

36

37 ***Human Health Chapter***

- 38 5-7: Figure 5-1 can be enhanced by depicting susceptibility factors including genetics,
39 diet, etc. described in the paragraph starting on line 28 of page 5-6. Furthermore, this
40 figure might more effectively appear within the introduction as a way to provide both a
41 conceptual framework for the Report on the Environment as well as the organizing
42 principle. The figure and text would need to be modified to include ecological effects
43 and to show increased uncertainty as indicators move from left to right.

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1 5-7 and 5-8: In the introduction, terms such as definitive proof” and “conclusive
2 evidence” are used. It might be better to omit the adjectives.

3
4 ***Ecological Condition Chapter***

5
6 6-14: In Exhibit 6-2 add black outline bars to make it easier to see light colors.

7 6-14: In Exhibit 6-2, indicate the percentage changes rather than absolute changes
8 because forest coverage and sizes differ from region to region.

9 6-15: Clarify that emphasis in Exhibits 6-3 and 6-4 is on economically important species.

10 6-15: In Exhibits 6-3 and 6-4, indicate percentage changes rather than absolute changes
11 because covering and sizes differ from region to region.

12 6-18: On line 13 explain “degree of connectivity.” Can a quantitative definition be used?

13 6-21: In Exhibit 6-6, a different color scheme should be used. The map does not show
14 clearly the difference in the greens.

15 6-22: On lines 22-24, please specify the twelve layers and the four layers if possible. Are
16 any weighting factors used?

17 6-25: On line 15 clarify “decreases in Regions 6 and 9” and “increases in Regions 3 and
18 5.” The data in Exhibit 6-2 show discrepancies from the general statement in the text.

19 Region 9 has increased during 1977-2002.

20 6-30: Insert acknowledgement that nutrient enrichment can also be considered a
21 “pollutant” and be responsible for community shifts toward invasive species.

22 6-30: On line 1 the following suggested change in the wording is provided: “...by global
23 events such as large meteor impacts...” or ...”bolide collisions...”

24 6-32: With regard to bird populations, delete the following debatable statement, “are
25 among the most visible and important biological components of ecological systems and”

26 6-32: Note whether abundances in Exhibit 6-9 are standardized by numbers of observers.

27 6-32: On line 22 discuss the possible causes for the decrease in grassland species.

28 6-34: With regard to fish faunal intactness, explain why 1970 is chosen as the reference.

29 6-35: Expand the legend in Exhibit 6-10 to explain the pie chart (i.e., reduction areas
30 expressed as % total land area).

31 6-37: On line 12 replace “>=” with “≥”.

32 6-38: In Exhibit 6-12, illustrate where the “exposed” and “minimally exposed” estuaries
33 are located on the map and provide an idea of the sampling intensity.

34 6-40: On line 24, the following statement needs supporting data and justification:

35 “...fewer blooms in recent years as compared to 1996...”

36 6-45: The key in Exhibit 6-13 is missing the color codes. Letters are missing in the title
37 of the exhibit.

38 6-45/32: The word “somewhat” understates the trend. Inspection of the data indicates a
39 decline in the 1990’s of approximately 33%, which is more substantial than “somewhat.”

40 6-46: In Exhibit 6-14, indicate in the captions and on the labels that the values are net
41 changes of storage, not total storage.

42 6-46: On line 31, can an estimate of carbon storage (e.g., % of total) in soils be provided?
43 How significant is this omission?

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- 1 6-46: In Exhibit 6-14, add outlines to fill in order to increase the visibility and
- 2 acknowledge that the net carbon storage is affected by climate and soils.
- 3 6-48: On line 9, the dates in the discussion do not correspond to the dates presented in the
- 4 indicator.
- 5 6-49: On line 2 include estimates of carbon storage in soils.
- 6 6-53: On line 41, what is the confidence level or statistical significance of the regression?
- 7 6-54: In Exhibit 6-16, add negative signs on the temperature scale.
- 8 6-55: On line 14, include the names of the three climate regions.
- 9 6-56: In Exhibit 6-18, the graphs as presented do not clearly show support for the
- 10 discussion. Please modify the graphic data to show statistical significance.
- 11 6-56: In Exhibit 6-18, the Y axis scales should be changed to appropriate values to better
- 12 show trend data.
- 13 6-57: On line 2, a limitation should be added indicating that the empirical debiasing
- 14 models used to adjust the data may themselves introduce non-climatic biases.
- 15 6-61: On line 33 the following change in wording is suggested: "subsidence or uplift
- 16 caused by tectonic movements of landmasses." Delete "changes in natural land
- 17 accretion."
- 18 6-64: On line 6, the following change in wording is suggested: "...due to changes in sea
- 19 level or land elevation caused by tectonic movements."

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1 **Appendix C: Example Conceptual Framework and Indicator Description**

2
3 A synthesis chapter is needed to pull together the findings of EPA's Report on the
4 Environment. The findings reported through the questions and indicators show status and
5 trends of many different environmental parameters. Although these parameters have
6 been placed in two types of chapters, three chapters dealing with media (i.e., air, water
7 and land), and two with "health" or 'condition' (i.e., human and ecologic), they (the
8 parameters) are linked through attributes and processes that control them, and attributes
9 and processes that they influence. Consequently, to demonstrate the integration and
10 synthesis of the report, three components need to be added (1) conceptual framework,
11 and (2) synthesis discussion, and (3) a simple and clear description of each indicator, with
12 a discussion providing a rationale of why it was selected, and what it should tell. It is
13 recommended that the conceptual framework and the description of each indicator be
14 added to the final 2007 report, and the synthesis chapter be added to future Reports.

15
16 Conceptual Framework Component (to be part of introductory chapter and possibly
17 part of introduction of human health and ecological condition chapters): air, water, and
18 land, as well as human health and ecological condition are linked through physical,
19 chemical and biological processes. This can be illustrated in a conceptual diagram (either
20 simple or complex or possibly in words) that shows flows, influences or connections
21 among the many parameters selected to be used in the ROE 2007 (see figure). For
22 human health and ecological condition chapters, a conceptual framework would be
23 limited to the parameters discussed in the chapter.

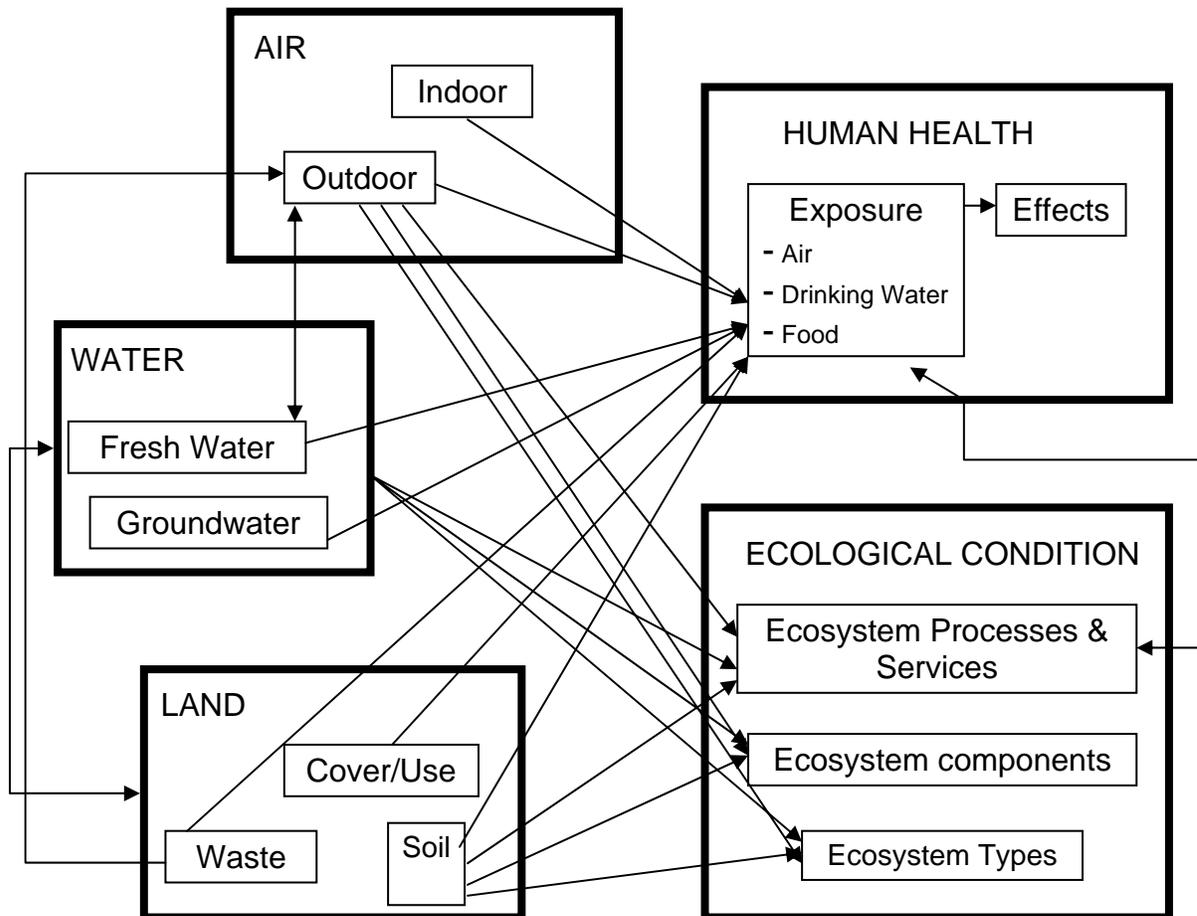
24
25 Synthesis Discussion: A discussion of the interactions among the many parameters
26 selected to assess the state of the environment should include a commentary on the
27 importance of status and trends of selected parameters within a particular media based
28 upon the discussions of importance within each indicator text, and how these might
29 influence each other as well as status and trends of parameters in other media. This cross
30 media discussion then should demonstrate how status and trends in media parameters
31 might influence status and trends of parameters within the integrative chapters (human
32 and ecological health and/or condition). The status and trends within the human health
33 and ecological condition chapters should each be discussed to describe the importance of
34 the findings relative to "well being" and/or "sustainability" of each attribute (i.e., humans
35 and ecosystems). The synthesis discussion should not put values (e.g., good, bad,
36 inconsequential) on status and trend data but rather focus the discussion on the
37 importance of the magnitude or "direction" of the status or trend and its implications for
38 other factors.

39
40 Importance of Indicator: Each indicator should have a clear explanation of why it is
41 important based upon a scientific (perhaps conceptual) fundamental understanding of
42 drivers and processes that if changing will alter the status of the indicator over time.

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2

Example Conceptual Framework Diagram



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4
5
6

Example Indicator Description

7
8
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10
11

The following example is based on information contained in the SAB report, a Framework for Assessing and Reporting on Ecological Condition (U.S. EPA Science Advisory Board, 2002)

12

Landscape Condition:

13

14

1. Describe what the indicator is and the rationale for its selection. Landscape is an area composed of a mosaic of interacting ecosystems or habitat patches. A change in the size and number of natural habitat patches, or a change in the connectivity between habitat patches, affects the probability of local extinction and loss of diversity of native species, and can affect regional species persistence. At the landscape scale, the extent of broad

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1 land cover classes (e.g., forest, agriculture, urban/suburban, surface waters) can serve as
2 surrogates of habitat extent for broad classes of species.

3
4 Landscape indicators are reported in the following three categories: extent of ecological
5 system type, landscape composition, and landscape pattern/structure. The extent of
6 ecological system type is an important indicator because it is correlated with species
7 decline. Landscape composition information provides insight into long-term population
8 viability because populations are unlikely to persist in landscapes where the largest patch
9 of habitat type is smaller than that species' home range. Landscape pattern and structure
10 provides a measure of habitat fragmentation that may isolate vulnerable species restricted
11 to specific habitat types.

12
13 2. Describe the metrics used to measure the indicator.

14 Extent of the ecological system/habitat type: (e.g., habitat area, perimeter-to-area ratio,
15 core area, elongation, etc.)

16 Landscape composition: (e.g., number of habitat types, number of patches of each
17 habitat, size of the largest patch, presence/absence of native plant communities, measures
18 of topographic relief, slope, and aspect, etc.)

19 Landscape pattern/structure: (e.g., dominance, distance between patches, longitudinal and
20 lateral connectivity, juxtaposition of patch types, width of habitat adjacent to wetlands,
21 etc.).

22

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1 **Appendix D. The Use of Ecoregionally Derived Indicator Information for Action**
2 **and Decision Making at the EPA Regional Offices**
3
4

5 All indicators need to be developed, analyzed and reported within an appropriate
6 ecoregional context. This context includes important dimensions of scale and boundary,
7 and must be driven by the intended uses for the indicator information. The formulation
8 of the indicator parameters will be constructed from knowledge regarding their
9 relationship to regional-scale ecological processes. The mapping of indicator values will
10 be dictated by the amount of relevant data available for spatial analysis.
11

12 Environmental protection and resource management agencies are administered
13 through hierarchical regional structures. These regionalizations are agency specific, and
14 were developed through a complicated historical set of administrative and mission driven
15 factors. Knowing that many environmental management and protection actions will be
16 implemented by the regional offices, it is a common error to use these administrative
17 regions as a surrogate for ecoregions for all ecological indicators. Rarely do these
18 administrative regions represent the ecological boundaries of the resources that are being
19 protected and managed by the Agency. These administrative regions should not be used
20 as a framework for indicator analysis.
21

22 A two-step process is required to use environmental indicators to inform priority
23 management and protection actions within an administrative region. First, the indicators
24 must be developed within an appropriate ecoregionalization framework, and the
25 analytical results must be generated for each indicator within each ecoregion in that
26 framework. Second, the indicator results must be spatially parsed to provide relevant
27 management directives to the regional offices.
28

29 As an illustrative example, let us consider the use of freshwater mussels as an
30 indicator of water quality factors and biological intactness. The current distribution of
31 mussel species represents a combination of hydrological connectivity, geo-chemical, land
32 use and pollution factors. The logical ecoregional context for this indicator would be a
33 hydrologic watershed framework that is represented at an appropriate scale that captures
34 the relevant geo-chemical regimes and associated land-use patterns. Time series data on
35 the composition and distribution of these species within these ecoregions relative to land
36 use, exotic introductions and pollution sources would provide the desired indicators of
37 ecological health.
38

39 Any administrative region could contain either entire watersheds or parts of
40 watersheds. When a watershed is completely contained in one regional jurisdiction, that
41 region would take responsibility to respond when the indicator demonstrates the need for
42 intervention. When a watershed is shared by multiple jurisdictions, a decision must be
43 made to lay out a formula for a) responsibility sharing, or b) designating full
44 responsibility for management and protection decisions across the entire watershed to a

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1 particular administrative region. The designation of full responsibility could either be
2 based on the relative percentage of geographic intersection between watersheds and
3 administrative regions, or by capacity and expertise factors within the different
4 administrative regions. The critical point is that responsibility must be assigned and
5 accepted to ensure the appropriate management response.

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Appendix E. Tables of Recommendations

This appendix contains two summary tables presenting the specific recommendations listed in the report. Table E-1 presents recommendations to be considered before finalizing the 2007 Report. Table E-2 presents recommendations that should be considered to improve future Reports. The second column of each table provides page numbers where recommendations may be found this advisory report. Additional comments and suggestions are provided in the text of the report. Detailed comments pertaining to specific indicators are included in Appendix A.

Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Overarching	4	The introduction should be revised to clearly indicate that the first three chapters address status and trends using specific indicators for the individual “media” of air, water, and land, and that the next two chapters are syntheses that provide integrated assessments of status and trends in human health and ecosystem condition . The introduction should also identify how EPA plans to use the Report and its analyses, and how the Agency wants the Report to be used by the broader public.
Overarching	4	The introduction should clearly state its purpose for intended audiences and EPA.
Overarching	5	A conceptual framework should be incorporated into the introduction to illustrate the connectedness between the media, human health, and ecological condition chapters.
Overarching	5	In appropriate places, interconnections between the indicators should be established by cross-referencing the discussion of indicators in different chapters.
Overarching	7	All questions should be broadened to ask “What are the status and trends...” rather than focusing only on trends.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Overarching	7	EPA should explicitly state how each question in the Report is related to the conceptual framework of the Report.
Overarching	7	EPA should provide a clear description of why each indicator is important, the rationale for selecting the indicator, what it tells, and the documented relationship between the indicator and human health and ecological condition.
Overarching	8	Additional indicators should be included to capture the status of and trends in ecosystem services.
Overarching	9	EPA should identify the status of the monitoring programs (e.g., extant, “on hold,” or expired) that have provided indicator data used in the Report.
Overarching	8	Additional trend data (classified as either qualitative or quantitative) should be included for as many indicators as possible.
Overarching	10	EPA should clarify whether specific bullets in the indicator limitations sections refer to indicator limitations or data gaps.
Overarching	10	The discussion of gaps and limitations should be expanded to identify some of the more prominent available data sets that were excluded and the reasons for their exclusion (e.g., technical concerns, lack of statistical power, or other specific reasons).

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Overarching	10	The discussion of data gaps and limitations should be strengthened by adding or expanding existing information in several areas. These include: 1) Discussion of the need for a transparent set of indicator metrics that can be well-justified. 2) The need to provide additional information on emerging issues such as exotic wildlife diseases or invasive species (the emerging issues should be discussed at the end of each individual chapter and summarized in an expanded chapter 7 - afterword). The Panel specifically notes that perfluorinated chemicals should be added to the list of emerging contaminants of importance Chapter 7 of the ROE 2007. 3) Further justification and discussion of limitations associated with the intervals of time used to establish trends.
Overarching	10	The implications of each indicator limitation should be discussed, and the uncertainties associated with each limitation should be quantified to the extent feasible.
Overarching	11	If EPA administrative regions continue to be used as the basis for regionalizing data, the Panel recommends that this process be better explained.
Air	16	A science framework is should be incorporated into the air chapter to show the interaction within, between and among media as well as between and among indicators.
Air	16	A short historical section should be added to the air chapter to provide background information on the criteria pollutants.
Air	16	SO₂ concentration should be added to the air chapter as an indicator.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Air	16	An air toxics indicator should be added to the air chapter.
Air	17	A broader explanation of what is in the National Emissions Inventory (NEI) should be added to the air chapter.
Air	17	Further analysis of the trends in air indicators should be added to the air chapter. While it is important to know whether air indicator trends are increasing, it is important for the reader to understand the reason for the direction of indicator trends. The Report should state where have we been, where we now, and where we are going.
Air	17	An indicator should be added to the air chapter to focus on the clear reduction of primary pollutants (CO, SO₂, and Pb) but much flatter trends in secondary pollutants (O₃ and PM_{2.5}), reflecting the growing importance of secondary air pollutants.
Air	17	A piece should be added to the air chapter to discuss how climate is affecting aerosols.
Air	18	EPA should acknowledge and discuss the limitations of a single pollutant, local source approach to pollution control in the context of the marked reductions in individual pollutants documented by the indicators, as exemplified by continuing challenges with regard to ozone and PM_{2.5}.
Air	18	EPA should view the PM speciation network as the vehicle to provide the needed information on PM composition.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Air	18	The bias that may result from the choice of base year for trends for a given air indicator should be discussed as this has implications in the interpretation of the air indicator data.
Air	18	The effects of trends in ambient concentrations of air pollutant indicators on exposure and dose should be discussed Report.
Water	20	The questions in the water chapter should be expanded to focus on the interconnectedness of different systems (both within the different water types and across media).
Water	20	Additional questions should be included in the water chapter to incorporate missing information on availability and usage of water for human activities, especially with respect to both ground water and surface water withdrawals (see data in Roy. et al., 2005 and Solley et al., 1995).
Water	21	EPA should examine the relevance of measures of “Extent and Condition” across all aquatic ecosystem types. In this regard, the Panel finds that the question on the “extent” of coastal waters is not meaningful because for coastal waters, the issue of importance is their condition not their extent.
Water	24	Data for the indicator “pesticides in agricultural streams” should not be compared to human health benchmarks.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Land	30	EPA should consider the following suggested revisions of the land chapter questions in order to improve their clarity: 1) The Panel suggests that trend information be developed wherever possible, and that EPA use both qualitative as well as quantitative data to generate trend information for all indicators. 2) The waste deposition addressed in Question 3 (wastes) could be considered a “land use” issue and included as a subtopic of Question 2 (land use). 3) The topic encompassed by Question 3 has overlap with the fundamental question regarding groundwater in Chapter 3, and there is a need for an explanation of integration among components of the Report in the introduction. 4) The agency may wish to list agriculture explicitly as the focus in Question 4. An alternative would be to include agricultural land indicators under Question 2 (addressing land use), considering agriculture as a specific land use. 5) The factors distinguishing Question 5 (addressing contaminated land) from Questions 3 and 4 should be explained more fully.
Land	32	EPA should include more direct indicators of effects in the land chapter.
Land	32	EPA should consider adding indicators for mining wastes and wastes applied on agricultural land (biosolids, compost, etc.).
Land	32	EPA should add an indicator based on the generation and disposal of civilian radioactive waste.
Land	32	In the final 2007 Report, a pesticide use indicator should be added to the land chapter.

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Table E-1. Recommended changes in the final 2007 Report		
Chapter	Page	Recommendation
Land	32	The reported pesticide incident indicator should be moved to the human health chapter.
Land	33	The discussions of the data gaps in the land chapter should be modified to make it clear that the gaps mentioned are the highest priority gaps determined by the agency, and that the list is not intended to be comprehensive.
Human Health	35	The questions in the human health chapter should be reordered to be consistent with event sequence in the environmental health paradigm as depicted in Figure 5.1 of the Report (i.e., exposure precedes the health effect).
Human Health	35	The human health chapter should be more descriptively renamed as “Human Exposures and Health.” This change is needed because the questions contained within the chapter encompass both human health and exposure.
Human Health	36	If credible quantitative impact estimates are available (e.g., estimates of the mortality impacts of particulate air pollution in selected locations in the U.S.), they should be included.
Human Health	37	The discussion of gaps and limitations should be expanded to include a more quantitative description of the indicator’s relevance by relying on the epidemiologic literature.
Human Health	37	The concept statements in the indicator limitations sections such as “the measurement of mercury or any other environmental chemical in a person’s blood or urine does not by itself mean that the chemical has caused or will cause harmful effects in that person” should be removed from each discussion of indicator gap and instead placed in the conceptual framework section of the chapter.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Human Health	38	EPA should build on the higher geographic resolution theme by presenting individual or multiple state data which could inform the gross national estimates presented and point toward the future. This should be done if it is possible within time constraints.
Human Health	39	Bullet #2 on page 5-5 should be rewritten to include biological agents. The following sentence should be added: “Infectious diseases associated with environmental exposures or conditions are also addressed.”
Human Health	39	The discussion of sensitive populations should be expanded because these populations are important in considerations of environmental health.
Ecological Condition	40	The climate indicator trends in the ecological condition chapter should be placed in a paleoclimatic context in order to distinguish between human induced changes and other long-term changes, and references to the Report of the Intergovernmental Panel on Climate Change (IPCC, 2007a,b) Report should be included.
Ecological Condition	40	Rather than focusing on trends in biomarkers, a question should refer to trends in exposure and effects of contaminants in organisms.
Ecological Condition	41	EPA should reorganize the ecological condition chapter to focus on three major indicator categories: Ecosystems, Ecological Processes and Services, and Ecosystem Components.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Ecological Condition	41	Appropriate indicators should be included in the ecological condition chapter to provide information on the ecosystem extent (e.g., land cover, land use, urbanization) and quality /condition (e.g., landscape integrity, connectedness, fragmentation, and contamination) of major ecosystem types.
Ecological Condition	41	Indicators should be included in the ecological condition chapter to represent important ecosystem processes and services such as: provisioning (e.g., timber, fuel, minerals, and other services); regulating (e.g., disease, climate, and flood processes); cultural (e.g., spiritual and aesthetic services); and supporting (e.g., soil formation, primary productivity, pollination,, decomposition, disturbance, nutrient cycling, hydrological/chemical cycling, carbon sequestration processes, and services such as clean air, clean water, and [production – decomposition]).
Ecological Condition	41	Indicators should be included in the ecological condition chapter to represent physico-chemical components of ecosystems (e.g., soils, water, chemicals, snow pack, and physical habitats).
Ecological Condition	42	Indicators should be included in the ecological condition chapter to represent biological components of ecosystems ranging from the genome to the community level of organization. Such components include biodiversity, endangered species, invasive species, keystone species, and communities.

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Table E-1. Recommended changes in the final 2007 Report

Chapter	Page	Recommendation
Ecological Condition	43	The discussion of “trends in diversity and biological balance of the nation’s ecological systems,” (on page 6-29) should acknowledge that some systems inherently have different numbers and variety of species, making it inappropriate to make comparisons between systems.
Ecological Condition	43	The discussion of “fish faunal intactness,” should explain why 1970 is chosen as the reference.
Ecological Condition	43	Trend data should be adjusted to account for methodological inconsistencies. For example, in the discussion of “SAV in the Chesapeake” which shows trends since 1978, the Report on the Environment states that “methods changed over the course of this study. However, data have been adjusted to account for any methodological inconsistencies.” The same should have been done with other parameters that are presented as a snapshot at one time that could have shown trends.
Ecological Condition	44	It should be clearly stated that specific case studies in the Report may not be representative of a general or national situation when they represent either a picture of success or one of failure.

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Table E-2. Recommended improvements for future Reports on the Environment		
Chapter	Page	Recommendation
Overarching	5	A synthesis chapter should be included to fully integrate the Reports and provide an overall assessment of health and ecosystem status, trends and effects. The synthesis chapter in future reports could also analyze and discuss in more detail the connections among various related indicators.
Overarching	6	A summary section should be included after each media chapter to summarize information presented in the chapter and identify relevant emerging issues that could potentially affects human health and the environment.
Overarching	6	EPA should incorporate statistical analysis and interpretation. This should be part of the results presentation for each indicator. In some cases, this may involve formal statistical analyses, whereas in other cases it may involve the inclusion of additional information such as error bars around mean values.
Overarching	8	The indicators selected should be clearly related to the “big picture” fundamental questions, and not chosen just because of data availability or compliance with indicator criteria (i.e., they are the only indicators left after others have been eliminated).
Overarching	8	EPA should consider relaxing the restrictive indicator selection criteria so that additional indicators can be included. This will enable EPA to better evaluate trends and answer questions in the Report.
Overarching	10	Each of the sections that address data gaps and limitations should be separated into clear discussions of types of limitations (e.g., geographic, statistical, data coverage, etc.)

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Overarching	11	EPA should analyze the air, water, land, human health, and ecological condition indicators using appropriate airshed, watershed, and ecoregional units.
Overarching	13	EPA should identify and use, with appropriate caveats, more regional indicators and data bases to illustrate trends when national data sets are not available. The Panel notes, however, that such regional data are not a substitute for national or even representative national data and can be misleading if not carefully presented.
Overarching	13	EPA should develop clear and transparent criteria that are uniformly used for the selection of regional indicators and case studies, with the recognition that not all data will meet the criteria for these regional indicators. For example, regional indicators should have long-term well supported data sets, be of particular national or local significance, or represent an assessment approach that that could be replicated.
Air	13	The discussion provided in the response to the indoor air quality question should be expanded. The Panel finds that the discussion of indoor air and related indicators is too limited considering the importance of the indoor environment and the amount of time spent by the population indoors. While indoor environments do not fall within the statutory mandate of EPA, exclusion of available and relevant data makes the Report incomplete.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Water	20	Additional questions should be included in the water chapter to incorporate missing information on critical habitats or thematic elements such as: 1) Extent and condition of coral reefs; 2) Wastewater management information (it is recommended that EPA review available National Pollution Discharge Elimination System data for possible useful indicators); 3) Extent and condition of, and trends in, riparian zones and lake shoreline (i.e., land-water interface, where much of the biological activity occurs), and their effects on human health and the environment; and 4) More national indicators and analyses providing data and information on non-indigenous invasive species.
Water	20	Some key model aquatic systems should be identified in several ecoregions of the U.S. and data collected from these systems should be mined and analyzed in the context of questions presented in the Report.
Water	20	EPA should examine the 2004 National Research Council Report on national and global water resources and water infrastructure problems, and the importance of research in addressing them (National Research Council, 2004).
Water	23	EPA should include appropriate indicators of condition of lakes, ponds, and reservoirs.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Water	23	EPA should consider including the following important specific indicators: 1) Snow pack (extent, condition, and volume); 2) Pathogens (coliforms, enteric viruses, toxins, etc.); 3) Storm water and wastewater (contaminant effects); 4) Drinking water primary contaminants (e.g., microbial indicators and pathogens: bacterial, viral or protozoan); 5) Emerging contaminants such as pharmaceutical and personal care products, nanoparticles, and others.
Water	23	Additional wetland data should be used. In many areas, wetlands will more efficiently indicate the ecological integrity of the entire watershed than will any other portion of the landscape.
Water	23	EPA should evaluate whether nutrient indicators based on bioavailable nitrogen and phosphorus or nitrogen:phosphorus ratios, may be more useful.
Water	23	EPA should develop drinking water indicators based on the available data from the Agency's own databases and the consumer confidence reports released to the public annually by community water systems. Based on these data, EPA could formulate indicators that can delineate trends in drinking water quality. The water chapter should include source water monitoring data in addition to treated water quality data.
Water	24	Pathogen monitoring should be investigated as a primary indicator for water quality trends and human health effects across various water sources.
Water	24	Composite or multi-metric indicators should be complemented with single metric indicators that are easier to understand and require fewer caveats and assumptions.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Water	24	EPA should incorporate more information on specific toxic industrial chemicals for which the Agency has statutory responsibility under the Clean Water Act.
Water	24	EPA should analyze fish tissue contaminant data by different species, or at least conduct separate analyses of fish from different trophic levels or different habitats (as was done for the “lake fish tissue” indicator) to see which species (e.g., piscivores) are more likely to have higher levels of contaminants than others.
Water	26	EPA should visit (or revisit) the Agency’s guidance manuals for lakes, rivers, coastal waters, and wetlands for potential data sets to fill identified data gaps.
Water	26	Long-term monitoring programs of EPA (e.g., Environmental Monitoring and Assessment Program - EMAP) and other Federal Agencies (e.g., the U.S. Geological Survey’s National Water Quality Assessment Program, and the National Oceanic and Atmospheric Administration’s Status and Trends and Mussel Watch Programs), and of states or universities should be examined. Indicator criteria should be relaxed (within reason) to enable use of important trend data.
Water	28	EPA should utilize and build on existing databases that have been collected and existing local expertise that has been developed at benchmark sites in various ecoregions.
Water	28	EPA should give state data sets much closer scrutiny for possible inclusion. Some states have a wealth of area-specific data.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Water	28	EPA should consider using data from the California State Water Resources Control Board Ground-Water Ambient Monitoring and Assessment (G.A.M.A.) program (http://ca.water.usgs.gov/gama/),
Water	29	In addition to the Gulf of Mexico and Long Island Sound, other places where hypoxic conditions tend to occur and are well monitored (such as Chesapeake Bay, the coastal waters off Oregon, and parts of Lake Erie) should be added to the hypoxia indicator.
Water	29	EPA should develop indicators for arid regions. In this regard the Agency should draw upon the numerous studies and data collection efforts conducted by various federal and state agencies in the western states where the climate is arid.
Water	29	A summary section should be included after each media chapter. In addition to summarizing information presented in the chapter, this section should also identify relevant emerging issues.
Land	30	EPA should consider adding a fundamental question on soil quality and conservation to the land chapter. The structure of the question could be parallel to the others in the chapter.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Land	32	EPA should: 1) consider a range of land cover classification schemes with different levels of resolution. This is necessary because the resolution of the data in the current Report is too coarse to completely answer the questions; 2) characterize land cover of all major ecosystem types, not just the forest land cover characterized the current draft of the Report; 3) adopt standard, established approaches for land use and land cover analysis to evaluate information and document trends across a range of available data sets.
Human Health	36	EPA should consider using an expanded suite of human health indicators (discussed in Section 9.0).
Human Health	37	EPA should adopt the suites of indicators that other agencies have developed, but present them in relation to environmental factors.
Human Health	38	EPA should consider making use of county-level data available from the states. All of the vital statistic data presented and used for the EPA Regional indicators can and have been scaled to the county level and excellent maps have been generated and already published in books.
Ecological Condition	43	EPA should use available information from the Agency's water quality criteria guidance manuals. The Panel notes that EPA has previously conducted a detailed review of current information and developed water quality criteria guidance manuals for lakes, rivers, coastal waters.

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Table E-2. Recommended improvements for future Reports on the Environment

Chapter	Page	Recommendation
Ecological Condition	44	Specific case studies using regional indicators should be selected for their ability to demonstrate the long-term trends that cannot be accomplished at the national level. It would be useful to pick well-studied sites (e.g., Lake Mendota, Lake Tahoe) where there are long-term data sets available for each region.
Ecological Condition	45	Some of the regional indicators should be expanded to become national indicators (e.g., SAV, invasive species, harmful algal blooms).

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