

**DRAFT****Review of EPA's Draft Report on the Environment 2003****An Advisory Report by the Science Advisory Board Panel  
on EPA's Report on the Environment****1. INTRODUCTION**

This report transmits the advice of the U.S. Environmental Protection Agency (EPA) Science Advisory Board (SAB) Panel on EPA's Draft Report on the Environment 2003 (ROE). The draft ROE was developed by EPA to describe what the Agency knows, and does not know, about the current state of the environment at the national level and how the environment has changed as a result of human actions. This analysis is also useful for informing the Agency about areas where knowledge of current environmental status and trends is limited or lacking. Publication of the draft ROE was the first step in EPA's Environmental Indicators Initiative, a multi-year process directed at developing better indicators that EPA can use to measure and track the state of the environment and to support improved environmental decision-making at EPA and elsewhere. The draft ROE is presented in two volumes: a detailed *Technical Document*, and a somewhat shorter more general *Public Report*. The two volumes pose questions about the environment and human health on a national scale, and provide answers to those questions in cases where EPA has determined that scientifically sound indicators and high-quality data to support them are available. EPA has stated that it does not intend to revise the current draft of the ROE, but has conducted a Science Advisory Board review of the document in order to obtain advice for use in developing future Reports on the Environment.

In developing the draft ROE, EPA framed environmental quality issues by: 1) identifying key questions; 2) identifying an initial set of indicators; and 3) reviewing and selecting the indicators and the supporting data to be included in the report. Historically, EPA has used a set of indicators to measure progress in reducing environmental pollution through its major regulatory programs. These traditional measures for air, water and land conditions are discussed in the first three chapters of both the draft *Technical Document* and *Public Report*. EPA, together with its Federal, state and tribal partners, is moving toward supplementing these traditional measures with indicators that provide a better understanding of status and trends in human health and environmental condition. Chapter Four of the *Technical Document* and the *Public Report* presents key information on exposure to pollutants and the status of human health that can be used to develop environmental public health indicators. Chapter Five similarly describes essential attributes related to a synthetic view of ecological condition. Chapter Six of the *Public Report* identifies key challenges in the development and implementation of better indicators of human health and environmental status and trends.

The SAB Panel sees the draft ROE as an extremely important effort and commends EPA for its foresight in taking such strong initiative to develop the Report on the Environment. The SAB

1 supports an increase in national environmental analysis and synthesis of indicators. We  
2 recognize that many of the areas addressed in the draft ROE are not part of EPA's  
3 responsibilities, but the panel believes that EPA is the appropriate agency to lead this effort. Our  
4 comments below are quite lengthy, a reflection of the Panel's view of the importance of this  
5 activity. Our overall response to the draft ROE is that it is of critical national importance and  
6 must be continued and improved.

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8 We provide a number of recommendations for improvements in future versions of the ROE  
9 to make the document more useful to EPA and other intended audiences. The SAB  
10 recommends that EPA reorganize the framework of the ROE to enhance the analysis and  
11 presentation of information in the report. The ROE should contain an opening chapter that  
12 clearly lays out the purpose and vision of the report and sets forth criteria for selecting the  
13 indicators and questions in the report. The ROE should contain important data and indicators  
14 that are available at local and regional scales, as well as trend analyses of greater statistical rigor.  
15 In addition, EPA should develop a working conceptualization of how different parts of the ROE  
16 can be integrated. Health impacts resulting from environmental pollution should be addressed in  
17 Chapter Four (Human Health) through a more rigorous and systematic consideration of linkages  
18 to exposure. Chapter Five (Ecological Condition) of the draft ROE should be devoted to  
19 synthesis of information. Therefore, much of the information currently in Chapter Five should  
20 be moved into other appropriate chapters.

## 23 2. CHARGE TO THE REVIEW PANEL

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25 EPA sought the SAB's review of: the approach and process used to develop the draft ROE;  
26 the scientific and technical soundness of the indicators, data, and conclusions in the report; and  
27 the scale of indicator data used in the report. EPA also requested advice from the SAB on how  
28 measurements of impacts on human health and ecological condition could be more effectively  
29 addressed, and how the presentation of information in the report could be enhanced. The EPA  
30 gave the following five charge questions to the SAB Panel.

### 32 Question 1

33 Please comment on the approaches, processes, or frameworks used in describing the  
34 environmental status and trends and how to measure and manage for environmental results. Do  
35 you have any suggestions to enhance the scientific analysis and presentation of the information?

### 37 Question 2

38 Do the discussions of indicators in the *Technical Document* accurately portray the current state-  
39 of- the-science? Are the conclusions supported by the scientific information provided given the  
40 existing data gaps and limitations?

### 42 Question 3

43 Conventional Agency practice has been to measure and reduce emissions and subsequent  
44 exposure to pollutants. Can you suggest how measurements for human health and ecological  
45 condition impacts resulting from environmental perturbation could be more effectively  
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#### **Question 4**

The draft ROE focuses on indicators at the national scale. Regional indicators are highlighted in a few case studies. How useful are national indicators in presenting information on the quality of the environment? How much consistency is necessary in indicator measurements and data quality across the country? Should more detailed regional data and indicators be accommodated in a national overview of the environment, and how could this regional data be accommodated?

#### **Question 5**

The *Public Report* is intended to summarize the *Technical Document* for a broad, non-technical public audience. Does the *Public Report* accurately and adequately reflect the technical content, including the gaps and limitations, of the *Technical Document*?

### **3. REVIEW PROCESS**

To establish the ROE panel, the EPA Science Advisory Board Staff Office published a Federal Register notice requesting nominations, and identified a subset of the nominees for consideration as panelists. The final panel was selected after requesting public comments on the nominees and further evaluating them against EPA Science Advisory Board selection criteria. The members of the Review Panel included health and ecological scientists.

The review was conducted by an administrative conference call, a public conference call, and a three and one half day public meeting. During the administrative conference call the structure of the review was discussed and panel members were assigned lead responsibilities for reviewing various sections of the report. During the public conference call, EPA answered questions from the panel about the report and the review charge. At the public meeting, the panel heard presentations from EPA on each of the draft ROE chapters and deliberated on the charge questions. Panel writing groups developed charge question responses for each chapter, and these responses are integrated in the development the final SAB Panel report.

### **4. RESPONSE TO THE CHARGE QUESTIONS**

**4.1** *Question 1: Please comment on the approaches, processes, or frameworks used in describing the environmental status and trends and how to measure and manage for environmental results. Do you have any suggestions to enhance the scientific analysis and presentation of the information?*

#### **A. Key Recommendations in Response to Charge Question 1**

Although its present version is limited and imperfect, the ROE is critically important in providing the first ever assessment of the environment in a context of human and ecological health. The SAB notes that there is an urgent national need for this kind of assessment. It can have an important impact on improving the state of the environment by synthesizing information from many sources that can then be used by EPA, other federal and state agencies, Congress and

1 state legislatures, and academic and private sector organizations for the development of effective  
2 environmental policy and protection programs. The ROE can also provide the public with  
3 essential information about environmental status and trends and its relevance to public health and  
4 ecological condition.

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6 There are a number of general and specific concerns that the Panel recommends be  
7 considered by the Agency in the next iteration of the ROE. SAB finds that EPA has not applied  
8 a consistent approach in the development of the draft ROE. In some sections the draft ROE is  
9 primarily a report on the Nation's environment, whereas in others it appears to be more of a  
10 report on EPA's environmental initiatives. The SAB views the ROE as a report on the  
11 environment, not a "report card" for the EPA and therefore discourages the latter approach. The  
12 SAB encourages EPA to clearly make the next iteration of the ROE an overall report on the  
13 environment, and recommends that this perspective be set forth clearly at the beginning of the  
14 document.

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16 As an overall report on the environment, the next ROE should not only address indicators that  
17 are available at the national scale, but also consider and include regional or local indicators  
18 where appropriate. Whenever possible, an explanation of the context, current status, and trends  
19 to date for each indicator should be provided and supporting data should be included or  
20 referenced, as appropriate. EPA should avoid reporting indicator status or indicator trends  
21 without linkages to supporting data.

22  
23 Appropriate allocation of needed resources is key for enhancing the contents, quality, and  
24 utility of future ROE's. Because of the importance, breadth, and complexity of the report, the  
25 SAB believes that additional staff and resources are needed to identify appropriate indicators and  
26 data for the next report and to conduct more analysis and synthesis than included in the current  
27 ROE. To this effect, the Panel recommends that a team be established by EPA and permanently  
28 assigned the task of pooling and analyzing data for the ROE. The team should include expertise  
29 to provide statistical support.

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31 SAB recommends that EPA reorganize the framework of the ROE to enhance the analysis  
32 and presentation of the information contained in the report. This should include:

- 33  
34 1. An initial chapter that clearly presents the purpose and vision of the report and clearly  
35 articulates the criteria for selecting the indicators and questions that are included in the  
36 report. In the initial chapter EPA should also clarify the meaning of "national-level  
37 indicator." Quite a large amount of data in the draft ROE appears to be derived from  
38 state sources, and it is not clear whether EPA requires data for the entire United States for  
39 a national-level indicator. EPA should consider using data sets that are not national in  
40 scope. The opening chapter should also clearly indicate that the report is not intended to  
41 provide an assessment of how environmental regulation or policies have led to current  
42 environmental conditions.
- 43  
44 2. A clearer indication and discussion as to why some indices were included in the report  
45 and why others were not. The SAB notes that it would be valuable to include questions

1 which cannot be answered with currently available indicators as a means to identify  
2 potential programmatic gaps.

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- 4 3. A broader discussion of data gaps. It is very important to list the data gaps, and the draft  
5 ROE does contain information on data gaps. However, the definition of data gaps in the  
6 draft ROE is too restrictive because the gaps discussed in the report are only those  
7 reflected by the known indicators. The listing of data gaps should also include indicators  
8 or linkages that are needed and for which regional or national data may not exist.  
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- 10 4. ROE chapters on air, water and land that focus on current conditions. Much of the  
11 information currently included in the ecological condition chapter should be moved to the  
12 water or land chapters.  
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- 14 5. An ecological condition chapter that is a synthesis of information from the chapters on  
15 air, land, and water, addressing the overall ecological health of the United States.  
16
- 17 6. An expanded Appendix B of the draft ROE technical document that includes a better  
18 explanation of why indicators and data sets were selected, or not selected, for use in the  
19 draft ROE. The sources for the data presented in the ROE must be specified and criteria  
20 used for excluding as well as including data must also be explicitly defined.  
21
- 22 7. The report should contain an index. Without an index, the draft ROE has limited  
23 usefulness as a reference work.  
24
- 25 8. Indicators related to global warming. Apart from one or two brief sentences in each of  
26 several chapters, the issue of global warming (and its relevant impacts on the  
27 environment and human health in the United States) is missing from the draft ROE. The  
28 SAB notes that indicators related to global warming, such as changing temperature  
29 patterns, sea level rise and carbon dioxide levels, are very important indicators  
30 inextricably linked to human health and ecological condition. The SAB therefore  
31 strongly recommends that these indicators be included in the ROE. In addition, more  
32 examples of the use of indicators to illustrate ecological, biological, and biochemical  
33 principles that directly apply to the environment should be included in the ROE.  
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## 35 **B. Specific Comments in Response to Charge Question 1**

### 36 *Introduction to the draft ROE*

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39 The discussion of purposes and approach presented in the draft ROE introduction is not well  
40 developed. The introductory chapter of the report should provide an overall framework for the  
41 report by defining what the environment is, what the report addresses, and what issues are not  
42 considered. Future ROE versions should therefore start with a clear and concise introductory  
43 statement to intended audiences telling them why they should care about the state of the  
44 environment, and why the ROE is an important document to read. This statement should invoke  
45 a fundamental obligation to maintain the planet's habitability for future generations, and indicate  
46 why clean air, clean water, productive land, viable ecosystems, and a healthy population are

1 critical to achieving this goal. The purpose of the ROE should also be clearly stated in the first  
2 chapter using an appropriate analogy that will be meaningful to the general population as well as  
3 policy makers and environmental professionals. One possible analogy is a "report card" on the  
4 status and trends of environmental quality in the United States and its effect on the health of our  
5 citizens and on the condition of critical ecosystems. The SAB does not, however, advocate that  
6 the ROE become, in any way, a report card on EPA's role as an environmental regulatory and  
7 research agency.

8  
9 The SAB recommends that the ROE initial chapter present an expanded introduction that  
10 should serve as a road map for all readers of the report. It should include a discussion of how the  
11 indices and data presented in the report derive from information presented in the air, water, and  
12 land chapters and build towards what the SAB considers to be the overarching themes of interest  
13 in the ROE: human health and ecological condition (currently Chapters Four and Five). The  
14 draft ROE does not clearly present the criteria used to select the indicators that were included in  
15 the report. It is unclear, for example, whether the indicators in the draft ROE are defined as  
16 measures that can track environmental conditions over time, measures that reflect conditions at  
17 one point in time, or both. The expanded introduction should serve as the place to better explain  
18 the criteria for selecting the questions that are asked in the succeeding chapters, to define the  
19 concept of using indicators to answer those questions, and to distinguish among different (and  
20 expanded) categories of data available for the selected indicators. SAB encourages EPA to first  
21 define the critical questions to be answered and then find the indicators to answer those  
22 questions; it is important to not let the availability of data/indicators drive the questions. The  
23 SAB suggests that reasonable criteria for selecting indicators should first include whether the  
24 indicator will reveal an environmental condition that will help answer a specific ROE question.  
25 The indicator should also be scientifically defensible, quantifiable, transparent, and consistent in  
26 application over time. Readers of the new first chapter should be able to clearly see that the  
27 ROE was developed to serve as a report on the status of the environment in the United States  
28 with respect to both human health and ecological condition (or ecological "health") and to  
29 understand the characteristics that are used in the report card to assess health and ecological  
30 condition. The reader should be able to understand that the ROE is intended to be an on-going  
31 effort that will help the American people see how and where progress is being made toward  
32 better ecological conditions and human health as it relates to those conditions, as well as areas  
33 where new or additional efforts may be needed.

34  
35 The SAB also recommends that the introduction be explicit about what is not within the scope  
36 of the ROE. While acknowledging that air, waters and biological resources of the United States  
37 flow across national boundaries, the report should focus on the ecological condition of the  
38 United States. Comparisons between conditions in the United States and those in other nations  
39 or regions should be included when they provide the necessary context for understanding  
40 conditions in the United States; for example, Chapter 4 provides comparisons of a number of  
41 human health indicators in the United States with other nations. Similar comparisons would be  
42 helpful in chapters on air, land and water. The ROE should not attempt to link current  
43 environmental and health conditions and trends to specific policies or programs, except in cases  
44 where a policy or program is the obvious and undisputed explanation for a significant trend or  
45 status. The ROE should not suggest policy and program solutions to the problems described.

### ***Chapters 1-3***

The first three chapters of the current draft ROE should focus on air, water, and land conditions and trends as they relate to human health and ecosystems. The air chapter should make clear the differences between primary air pollutants generated from emission sources and secondary and tertiary air pollutants that are synthesized in the atmosphere from directly emitted precursors. The primary sources of air pollution and the processes of conversion, accumulation, dispersion, transport, and disposal (including acid rain) should be outlined. The cross-chapter linkage between atmospheric sources of pollutants addressed in the air chapter and lake acidification effects addressed in the chapter on water should be discussed and referenced in the chapter on ecological condition. It would also be useful to include relevant indicators from other chapters on the indicator list in the air chapter. The chapter on water should include an overview of the water budget and hydrologic principles. The land chapter should be reformulated and expanded to better reflect symmetry with the air and water chapters. The SAB recommends that the land chapter be focused on land use, and that the chapter's introduction explain this focus. This chapter should provide information about developed land areas (including areas with high industrial and waste impacts), as well as non-developed land. The air, water, and land chapters should all be retitled without qualifiers because the current titles do not accurately reflect information in the chapters. For example, the current title of Chapter Three, "Better Protected Land," while reflecting EPA Administrator Whitman's motivating interest, is inherently imprecise. The SAB suggests that the title, "Land Use" would be preferable. Chapters One and Two should be retitled "Air" and "Water" respectively.

### ***Chapters 4-5***

Chapters Four and Five of the ROE should continue to focus on environmental effects on human health and ecological condition, respectively in future editions. However, the ecological condition chapter should be reformulated and organized around key questions such as: "what is the status of biodiversity?", "what is the status of global warming trends?", and "what is the status of element cycling?" This reformulation of the ecological condition chapter would require that EPA move many of the questions and indicators in the present chapter to the air, water, and land chapters. Questions about the extent of terrestrial communities should be placed in the chapter on land. Similarly, questions and indicators related to the extent of aquatic communities should be moved into the chapter on water.

### ***Other recommendations***

The current ROE is devoid of statistical analysis. The report can be greatly enhanced by the use of appropriate statistical procedures for assessing changes over time (e.g., longitudinal analysis or time series analysis). Averaging of data over time or across a group of more-or-less simultaneous observations at different loci was used to evaluate and report trends in the draft ROE. This is a useful way of making large data sets manageable and presentable. However, a great deal of information is necessarily lost. For example, annually averaged ozone levels are much lower than the averages restricted to the summer months; daily data over a year are not normally distributed so that arithmetic averages alone may be misleading. If the primary data are normally distributed, standard deviation and standard error of the mean can be reported. For

1 non-normally distributed data, means, medians, and ranges might be reported. Time trends  
2 (vectors) are subject to various forms of error. Vectors derived from two points are particularly  
3 suspect and non-linear relations are not adequately expressed with slope and intercept. When  
4 trends are reported in the ROE, slopes of linear relations should be assessed for significance of  
5 the difference from zero (i.e., no change over time) and for the fit of the data points to the trend.  
6 The SAB notes that individual data points in some data sets used for trend analysis in the draft  
7 ROE may themselves represent the mean of multiple observations and therefore incorporate  
8 some quantifiable uncertainty. Changes in measurement methods, changes in a population base,  
9 and changes in a category assignment can also lead to errors of representation and interpretation.  
10 Methods such as meta-analyses, use of rolling averages, and locally weighted scatter plot  
11 smoothing functions (LOWESS) should be applied to evaluate trends.

12  
13 The SAB recommends improvements in the draft ROE to enhance presentation of the  
14 information. Some of the data presented in plots appear to be grouped arbitrarily. Where  
15 feasible, plots should show all of the available data, and additional captions or appendices are  
16 required in the technical document to indicate what is being plotted. For example, in Exhibit 1-1  
17 of the air chapter in the technical document, the methods used to aggregate the data are not  
18 clearly presented. In this exhibit, primary and secondary air pollutants are lumped together, and  
19 the implied emissions of secondary pollutants are not meaningful. The exhibits included in the  
20 ROE should provide information indicating the baseline from which changes or trends are  
21 assessed, the number of monitoring sites, and other relevant information. When possible, the use  
22 of a common baseline for the exhibits would be helpful (e.g. Exhibits 1-1: 1970, Exhibit 1-4:  
23 1988, and Exhibit 1-6: 1982 all use the same data).

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25 **4.2** *Question 2: Do the discussions of indicators in the Technical Document accurately*  
26 *portray the current state-of-the-science? Are the conclusions supported by the scientific*  
27 *information provided given the existing data gaps and limitations?*

## 28 29 **A. Key Recommendations Response to Charge Question 2**

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31 The SAB provides the following key recommendations regarding indicators and conclusions  
32 in the Air, Water, and Land chapters of the draft ROE.

### 33 34 ***Chapter One "Cleaner Air"***

- 35  
36 1. As previously noted, it is important to clearly distinguish between primary emissions and  
37 secondary air pollutants, particularly for "criteria pollutants".
- 38  
39 2. Emission trend plots should clearly state whether they are presenting direct primary  
40 emission data or precursor emission data.
- 41  
42 3. Plots of decreases in "total national emissions of the six criteria pollutants" have little  
43 meaning because, although three criteria pollutant concentrations (SO<sub>2</sub>, Pb, and CO) are  
44 driven by primary emission, three of the six criteria air pollutants (O<sub>3</sub>, NO<sub>2</sub>, and PM)  
45 have very substantial secondary sources, so that there is no scientifically meaningful way  
46 to combine them.

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2 4. Statements in Exhibit 1.2 of the draft ROE indicating that there are “no category 1 or 2  
3 indicators” are misleading because many environmental issues have intrinsic  
4 characteristics that make national indicators either inaccessible or irrelevant. It is the  
5 opinion of the SAB that such statements may be misinterpreted as lack of knowledge,  
6 when in fact indicators of differing temporal or spatial scales, other assessment  
7 documents, and primary literature provide useful information. The SAB notes that this  
8 recommendation is also pertinent to Charge Question 4.  
9
- 10 5. Time trend plots in the ROE should extend as far back in time as practical, be as current  
11 as possible, use linear axes, and avoid starting on anomalous years (e.g., 1988 for ozone)  
12 if percentage changes are presented.  
13
- 14 6. Airborne toxics are an increasingly important issue that should be included in the ROE.  
15 The SAB recommends that data from the National Air Toxics Assessment and new  
16 monitoring programs be included in future versions of the ROE.  
17
- 18 7. Indoor air is a primary determinant of human exposure (and therefore, health effects) for  
19 many air pollutants. Because there are no national scale data to assess indoor air  
20 pollutant levels (with the exception of radon), the SAB recommends that future versions  
21 of the ROE provide information on the relationship between outdoor and indoor  
22 concentrations for key pollutants. Future reports should use the available primary  
23 literature to identify key indoor pollutants and assess their levels.  
24
- 25 8. The SAB notes that climate change will have a fundamental impact on future air quality,  
26 as well as on a wide range of other environmental indicators. The SAB therefore finds  
27 the presentation and discussion of trends of air quality indicators to be scientifically  
28 indefensible in the absence of an assessment of climate change. As noted previously, the  
29 topic of climate change must be included in the next ROE.  
30

## 31 ***Chapter Two “Purer Water”***

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- 33 1. The ROE water chapter should contain a much more detailed discussion of trends and  
34 status in national and regional water demand, supply, and quality.  
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- 36 2. The ROE water chapter should also provide a temporal and spatial perspective for the  
37 indicators presented in the draft ROE. In addition, regional analysis of water indicators is  
38 needed to understand national conditions. Regional status and trends should be reported  
39 for additional areas of the United States where data sets are available.  
40
- 41 3. A more consistent and complete description of the methodology used to collect data and  
42 analyze indicators in the water chapter is also needed. In particular, a more complete  
43 description of the timeframe for data collection and of the derivation of the “good,”  
44 “fair,” and “poor” descriptors is needed.  
45

- 1 4. The SAB notes that some of the criteria and benchmarks used in the water chapter reflect  
2 outdated science. The National Water Quality Assessment and sediment concentration  
3 data in the draft ROE should be compared to appropriate target criteria in order to reflect  
4 levels of concern, not simply the presence or absence of chemicals of concern. It may in  
5 fact be more appropriate to use regional criteria and benchmarks to analyze some of the  
6 water data.  
7
- 8 5. The SAB recommends that indicators be developed to report the following information:  
9 groundwater quantity and quality; the effects of global climate change on sea water  
10 chemistry, sea level, and stream flow; changes in water temperature; changes in total  
11 dissolved solids and salinity over time due to human activities, quality of irrigation water  
12 (e.g. salinity, nutrients, and toxics); and detection of emerging pollutants in water  
13 supplies across the United States.  
14

15 The SAB notes that important available national data are omitted from Chapter Two of the  
16 draft ROE, and recommends that the following information be included in future reports:  
17 drinking water information regarding types and severity of violations, sources of contaminants,  
18 and health effects; fish advisory information regarding types and severity of violations; Clean  
19 Water Act section 303(d) list of impaired waters; and National Pollution Discharge Elimination  
20 System information regarding trends in pollutant loads and toxicity.  
21

### 22 ***Chapter Three (Better Protected Land)***

23

- 24 1. The SAB recommends that future versions of Chapter Five (Ecological Condition) of the  
25 ROE be devoted to synthesis of information found in the air, water, and land chapters.  
26 Much of the information in Chapter Five of the draft ROE should therefore be moved  
27 into future land chapters (or water chapters if related to water). For example, information  
28 on extent and management of forest area, forest age class, population representation of  
29 forest species, and soil compaction should be moved from Chapter Five to Chapter Three.  
30 There are also stark differences in the current ROE between the land chapter and the air  
31 and water chapters. The nature of the questions about the condition of land should  
32 parallel that presented in the air and water chapters.  
33
- 34 2. The SAB recommends that a broader range of indicators be used in future land chapters  
35 of the ROE. Indicators such as extent of roads should be used to provide information  
36 about habitat fragmentation, human use of land, and fragmentation of ecosystem types.  
37 Other indicators such as socioeconomic distribution of human population in relation to  
38 land use and community composition of animal and plant species (biodiversity) should  
39 also be reported in Chapter Three.  
40
- 41 3. EPA should consider using a greater number of ecosystem types than are currently  
42 described in Chapter Three of the draft ROE. Using only the aggregated measures of  
43 ecosystem types assessed in the draft ROE (e.g., forests, grasslands, croplands, etc.) does  
44 not provide important insight about region-specific ecosystem types such as  
45 endangerment of tall grass prairie in the Midwest. For this reason, while the SAB  
46 acknowledges that the ROE will primarily report indicators developed by others, it is

1 recommended that EPA not simply adopt the aggregated ecosystem types presented in the  
2 Heinz Foundation's excellent report on the State of the Nations Ecosystems. EPA is  
3 encouraged to develop the most useful taxonomy of ecosystem types for answering the  
4 ROE-specific questions, and then use original data sources for appropriate indicators.  
5

- 6 4. It is important to clarify differences between indicator gaps and limitations associated  
7 with the inability to answer specific questions, and the gaps and limitations related to data  
8 availability and quality needed to complete regional and national assessments. It is  
9 inappropriate to state that indicators do not exist when in fact, the ROE usually means  
10 that sufficient representative regional data are unavailable to calculate national indicators.  
11 In cases where indicators to answer questions truly do not exist, the ROE should indicate  
12 the scale of reference (e.g. there are no national indicators, or no regional indicators, or  
13 no local indicators).  
14
- 15 5. It is important to provide uncertainty estimates for indicators in the ROE when this is  
16 possible. The SAB notes that many indicators can be derived from multiple data sources  
17 that provide varying estimates of condition. EPA should use such information  
18 strategically by estimating confidence limits for the indicators.  
19

20 The SAB recommends that EPA rethink the indicator gap and limitations (IGL) approach  
21 presented in all chapters of the draft ROE. In the current draft of the ROE, the IGL sections  
22 contain an assortment of qualifiers that often inappropriately discourage the reader from  
23 believing the data presented. The SAB feels that this is largely a result of poor definition of the  
24 IGL section, and an apparent need to include information in the IGL section for each indicator,  
25 or the selection of an inappropriate indicator or measure for that indicator. This is discussed  
26 below in more detail.  
27

## 28 **B. Specific Comments in Response to Charge Question 2**

### 29 *Outdoor air – criteria pollutants*

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32 Exhibit 1.1 plots "aggregated criteria pollutant emissions", but there is no indication of what  
33 data are actually aggregated. As noted previously in our response to the charge question, an  
34 aggregation of data across dissimilar pollutants is not very meaningful. As previously noted, a  
35 clear presentation of the difference between primary and secondary air pollutants is required.  
36 The critical precursors for secondary criteria pollutant formation should also be clearly  
37 identified. Such clarification will emphasize the importance of NO<sub>x</sub> and volatile organic  
38 compound (VOC) emissions data for O<sub>3</sub> formation, and the impact of SO<sub>2</sub>, NO<sub>x</sub>, and VOC  
39 emissions on particulate matter (PM) formation.  
40

41 Although the current set of questions in Exhibit 1.2 addressing criteria air pollutants are valid  
42 and meaningful, additional important questions should be asked in future reports. For example,  
43 questions should be included such as: 1) What are the important sub-classifications of PM<sub>2.5</sub>  
44 (ultrafines, organic carbon, black carbon, toxic metals, etc.) in terms of health, ecosystem and  
45 climate impacts, and what data are available on primary emissions and/or secondary precursor  
46 pollutants? 2) What photochemically generated oxidized organics (e.g. aldehydes, ketones,

1 organic acids, organic nitrates, peroxyorganic nitrates, DMSO, DMSO<sub>2</sub>, etc.) or inorganics (e.g.  
2 HONO, HNO<sub>3</sub>, etc.) may have significant potential human health impacts, and what data are  
3 available on their atmospheric concentration?  
4

### 5 ***Outdoor air – air toxics***

6

7 Air toxics are important pollutants, and EPA is to be commended for including them in the  
8 draft ROE. There are no national data available for most air toxics, beyond data for some VOCs  
9 like benzene, but future reports on the environment should identify and track recent efforts to  
10 begin collecting these data. The National Air Toxics Assessment (NATA) estimates of ambient  
11 air toxics concentrations can be used to provide indicators for the ROE. These data sets are  
12 largely based on models, and therefore may not satisfy criteria for category 1 or 2 indicators.  
13 However, NATA estimates are useful because they are national in scope and they provide a  
14 means for assessing aggregate exposure and risk. The draft ROE includes benzene in results for  
15 95 sites from 1994 to 2000 (Exhibit 1-14). The SAB recommends that EPA expand this analysis  
16 to include other air toxics measured at these sites. EPA should also consider including other  
17 sites where trend data are available for extensive periods of time in areas known to have  
18 significant emissions (e.g., Houston). These data might be presented by source type (mobile  
19 source, area sources, etc.). Care should be taken to avoid obvious errors when presenting  
20 concentrations information. SAB notes, for example, that benzene is not a criteria pollutant so  
21 that the indication of a National Ambient Air Quality Standard (NAAQS) in Exhibit 1-1 should  
22 be removed. The SAB encourages EPA to consider presenting mercury deposition data from the  
23 National Acid Deposition Program (NADP) network either in the air or land chapters of future  
24 reports, and notes that the environmental databases of other agencies may provide useful  
25 information in this regard. It is also noted that many air pollutants (e.g., PM, air toxics) are  
26 emitted by indoor sources, and that these source emissions tend to dominate exposures so that  
27 current status and trends relevant to health are not captured by outdoor air measurements.  
28 EPA should identify these data gaps and limitations. SAB also notes that, although it is  
29 discussed in the air chapter of the draft ROE, lead has little relevance as an air indicator linked to  
30 human health since most of the lead exposure and associated human health effects are driven by  
31 ingestion of contaminated dust, soil and/or paint. The atmospheric sources of lead are now very  
32 limited.  
33

### 34 ***Acid deposition***

35

36 Although the discussion of acid deposition in the draft ROE is basically sound, Exhibits 1-22  
37 and 1-23 are difficult to interpret and reproduced at too small a scale. A better presentation  
38 graphic should be developed for future reports. The “no category 1 or 2 indicators identified”  
39 notation for the third acid deposition question should be eliminated and replaced with a reference  
40 to the relevant National Acid Precipitation Assessment Program (NAPAP) assessment  
41 documents.  
42

### 43 ***Indoor air quality***

44

45 Indoor air is a major microenvironment that can contribute significantly to inhalation  
46 exposures, frequently exceeding the contributions from outdoor air inhalation. Indoor air quality

1 is insufficiently treated in the draft ROE. When inhalation exposures to airborne contaminants  
2 are dominated by outdoor source contributions (e.g., ozone, sulfur dioxide), ambient  
3 concentrations are a reasonable indicator of exposure and potential health effects. Conversely,  
4 for many pollutants (e.g., PM, NO<sub>x</sub>, CO, HONO, toluene, chloroform, formaldehyde) exposure  
5 results from a combination of both indoor and outdoor sources. For many such pollutants,  
6 ambient measurements provide a poor indicator for both exposure and health impact. For some  
7 pollutants (e.g., PM, formaldehyde) indoor levels often significantly exceed outdoor levels and  
8 therefore dominate exposure. Some discussion and literature citations about major sources of  
9 important indoor air pollutants (NO<sub>2</sub>, HONO, H<sub>2</sub>CO, CHCl<sub>3</sub>, and others) should be included in  
10 future reports. In addition, the question, "Is ambient air pollution an adequate surrogate for  
11 human exposure?" should be added to the list in Exhibit 1-2 and addressed in future report  
12 versions. The "no category 1 or 2 indicators identified" notation for the current indoor air  
13 quality question three should be replaced with references to relevant archival reviews or primary  
14 literature.

### 15 16 *Stratospheric ozone*

17  
18 The presentation in the draft ROE on stratospheric ozone depletion is sound. Exhibit 1-28  
19 displaying trends in U.S. industrial production of ozone depleting chemicals contains only  
20 chlorine compounds and should be expanded to include halon 12, halon 13, and methyl bromide  
21 since, on a molar basis, bromine released in the atmosphere is about fifty times more effective  
22 than chlorine in catalytically destroying ozone. The captions for Exhibits 1-27 and 1-29 should  
23 note that they include both chlorinated and brominated compounds, suitably weighted. The "no  
24 category 1 or 2 indicators identified" notation for the third and fourth stratospheric ozone  
25 question should be eliminated and replaced with a reference to the relevant World  
26 Meteorological Organization (WMO) and National Aeronautics and Space Administration  
27 (NASA) assessment documents or primary literature references.

### 28 29 *Climate change*

30  
31 As we have stressed previously, climate change will almost certainly have a fundamental  
32 impact on future air quality (and vice versa). Climate change also has the potential to drive  
33 major changes in human health and ecosystem viability. Thus, scientific relevance requires that  
34 a significant discussion of climate change issues and indicators be included in future versions of  
35 the ROE. The SAB recommends that future reports on the environment address climate change  
36 questions such as: 1) What are the trends in global concentrations of primary forcing greenhouse  
37 gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, CFCs, PFCs, SF<sub>6</sub>)? 2) What are the trends in U.S. emissions of primary  
38 forcing greenhouse gases? 3) What are the trends in tropospheric ozone over North America? 4)  
39 What are the trends in scattering aerosol particles over North America? 5) What are the trends in  
40 absorbing aerosol particles over North America? 6) What are the trends in U.S. emissions of  
41 primary fine particles? 7) What are the trends in the U.S. emissions of secondary aerosol particle  
42 gaseous precursors?

### 43 44 *Atmospheric particulate matter (PM)*

45  
46 The SAB recommends that future versions of the ROE continue to contain information on

1 atmospheric particulate matter. Particulate matter is a very complex mixture of suspended  
2 particles of varying size, shape, and chemical composition. It has taken years of research to  
3 develop and apply the instrumentation required to dissect these complexities and the work is  
4 ongoing. The PM standards have always been mass-based although such approach affords  
5 greater “weight” to the larger particles that may be less likely to be penetrate deep into the lungs.  
6 PM in ambient air is a secondary pollutant in large measure. It was thought that a PM<sub>10</sub> NAAQS  
7 of 150 micrograms/cubic meter (24 hour average) furnished adequate health protection, but this  
8 turned out not to be true, and EPA has now given more “weight” to smaller particles with a  
9 PM<sub>2.5</sub> NAAQS of 65 micrograms/cubic meter (24 hour average). Even this newer standard  
10 neglects smaller particles (< 0.1 micrometer), which contribute so little to mass that they are  
11 quantified as number of particles per cubic centimeter. The precise mechanisms by which  
12 inhaled ambient air PM cause morbidity and mortality are still not clear. However, intensive  
13 research effort has been underway for several years and has produced support for several  
14 hypotheses. Hypotheses link effects to soluble metal compounds – notably zinc, carbonaceous  
15 diesel exhaust particles (DEP) and absorbed semi-volatile organic compounds, ultra-fine  
16 particles, and coarser particles with endotoxin-like activity. In spite of the absence of well-  
17 defined causal mechanisms and uncertainty as to the precise identity of the PM species  
18 responsible, the consistency and coherence of the observed associations has justified the  
19 imposition of more rigorous NAAQS for PM. EPA supports a PM monitoring and speciation  
20 network but the network requires continual upgrading. The SAB recommends that future reports  
21 contain data on trends in PM particle size in different regions, trends in PM particle composition,  
22 and trends in ultra-fine particle concentrations, where such data are available, to provide a  
23 broader picture of the distribution and trends in PM concentrations in this country.

### 24 *Atmospheric ozone*

25  
26  
27 The SAB recommends that future versions of the ROE continue to provide information on  
28 atmospheric ozone. Ozone formation requires photochemical energy plus NO<sub>x</sub> and organic  
29 compounds. The NO<sub>x</sub> arises from NO (and NO<sub>2</sub>) emitted from fuel combustion. Organic  
30 compounds also are released by fuel processing and fuel combustion; some organics such as  
31 terpenes are natural emissions from vegetation. Despite developments in understanding of this  
32 chemistry over the past several decades, the possible role of other oxy-organic compounds may  
33 have been underestimated, and perhaps more importantly, ozone pollution continues to pose  
34 health problems – even in the Los Angeles area, which has seen a generally impressive reduction  
35 in its ozone levels since the 1970s in spite of increasing human populations and vehicular traffic.  
36 Other areas (e.g., Atlanta, Houston, the Northeast megalopolis, Raleigh) have not fared as well.

37  
38 Because significant morbidity is associated with only modest increases in ambient ozone  
39 levels (especially among children with asthma), it is conceivable that alternative approaches may  
40 need to be explored to mitigate these effects in sensitive populations. Such approaches might  
41 include individual avoidance of ozone exposure on days with poor air quality, increased use of  
42 anti-asthma medications, or possibly other forms of chemoprophylaxis specific to ozone induced  
43 mechanisms.

### 44 *Water budget and regional water quantity/quality information*

1 Although the overall presentation of the state of the nation's water resources is very useful,  
2 the SAB recommends that additional information be incorporated into the discussion of  
3 indicators in future reports. The water chapter should provide a better description of the water  
4 budget for the United States (based on recently released U.S. Geological Survey data) with a  
5 discussion of trends. The limited presentation of information on water quantity is a weakness of  
6 the draft ROE. It is also extremely important to include a discussion of regional water quantity  
7 and quality in areas like California, Arizona, and Florida where this is a significant problem, as  
8 well as in other areas where water is an important issue. An indicator that measures or tracks  
9 trends in interbasin transfers of water would also be useful in assessing the condition of water  
10 quantity. The general presentation in the draft ROE of the nation's "average" water supply and  
11 quality is not particularly useful and potentially misleading since it does not provide adequate  
12 information about regions of the United States where water quantity and quality are becoming  
13 increasingly critical issues.

#### 14 15 ***Temporal/spatial information about water indicators***

16  
17 The SAB finds that there is a need to provide a more complete temporal and spatial view of  
18 the water indicators in the ROE. Wherever possible, trends in water quality indicators should be  
19 included in the report with spatial representation of the indicators (i.e., on a map, preferably by  
20 watersheds rather than political or administrative regions). Areas where the issues are  
21 particularly critical should be mentioned in the text. For example, the information on coastal  
22 waters is presented mostly in pie charts. These charts are not sufficiently informative to  
23 understand areas that are under stress. By providing temporal and spatial detail it will be easier  
24 to make the links to human health and ecological condition. In many cases, a regional analysis  
25 should be conducted and discussed before national analyses are presented. Regional analyses  
26 may then be integrated to produce a national indicator, if appropriate. The local information  
27 should be presented along with the regional and/or national indicators.

28  
29 The SAB notes that coverage in the draft ROE is uneven with regard to available regional  
30 information. For example, in the draft ROE there is a heavy reliance on information provided by  
31 EPA's EMAP Mid-Atlantic program, leaving out of the analysis of information available from  
32 other major regional studies on the condition of coastal waters (e.g., Gulf of Mexico, Pacific  
33 Coast) generated by the National Oceanic and Atmospheric Administration (NOAA) and other  
34 agencies. The absence of "easily" available indicators should not be a constraint in providing a  
35 more complete picture. A meta-analysis approach should be considered to bring together these  
36 various datasets to present an integrative evaluation.

#### 37 38 ***Methodologies used to collect data and prepare water indicators***

39  
40 The SAB finds that there is a need to be more consistent and complete in the description of  
41 the methodologies used in the draft ROE to collect data and prepare indicators. For example, in  
42 several cases, the date of the studies supporting static indicators was not included. For a number  
43 of TN, TP and eutrophication indicators, the criteria used to classify the data into  
44 "Good/Fair/Poor" are not described. In other instances, the benchmarks or criteria used for the  
45 indicators reflect outdated scientific interpretation. The wetland indicators in the draft ROE are  
46 generally out of date. There is also a need to recognize that regional or local criteria are often

1 more appropriate benchmarks than national criteria (e.g. DO, TN, TP, TOC). It is dangerous to  
2 oversimplify the analysis by classifying the data based on arbitrary breakpoints. The SAB notes  
3 that the availability of national "indicators" (e.g., water clarity in coastal zones) should not be a  
4 reason to include them in the ROE if they are not truly meaningful indicators of ecological  
5 condition. In this regard, the United States Geological Survey (USGS) National Water Quality  
6 Assessment (NAQWA) study provides a very good assessment of ambient water quality across a  
7 wide number of watersheds. However, when this information was analyzed by the Heinz Center  
8 it was presented only in terms of presence of pesticides and other contaminants. Presence is not  
9 a useful indicator without the additional qualification of the toxicity associated with the  
10 concentrations found. An important question to answer is whether there is a human health or  
11 ecological risk associated with these toxic contaminants in water. Water quality criteria are  
12 available for many contaminants and the criteria can be used to put concentrations in perspective,  
13 producing a more useful indicator. At the very least, a presentation of the available water quality  
14 criteria (e.g., Criterion Continuous Concentration, Criterion Maximum Concentration, and  
15 Maximum Contaminant Level) for the contaminants that exceed these values could be included  
16 in the description of the "presence" indicator. A similar approach could be taken with regard to  
17 contaminated sediments to put their toxicity into perspective.

### 18 *Omissions from Chapter Two (Purer Water) of the draft ROE*

19  
20  
21 The SAB finds that a number of important indicators have been omitted from the water  
22 chapter of the draft ROE. National datasets for these indicators are available and should be used  
23 in the next ROE. Although it is useful to know that more than 94% of drinking water suppliers  
24 are in compliance with drinking water standards, it is also important to provide information  
25 regarding the violations of drinking water quality standards. The ROE should report the severity  
26 and frequency with which different standards are violated and the spatial distribution of  
27 violations across the United States. Knowing the nature, severity, and spatial pattern of drinking  
28 water violations (e.g., pathogens, arsenic) would help identify potential sources of contaminants  
29 and help to correlate diseases with contaminated water. The SAB recommends that this  
30 information be provided in order to address two missing drinking water quality indicators:  
31 sources of contaminants and human health effects. In a similar vein, identifying the most  
32 common contaminants that lead to fish and/or shellfish advisories, as well as the severity of  
33 exceeding risk levels, would help identify sources and make linkages to human health effects.

34  
35 Section 2.2.1 of the draft ROE (Condition of fresh water and watersheds) contains no  
36 discussion of Clean Water Act Section 303(d) listings. These listings reflect water body  
37 impairment and should be discussed in the ROE. The 303(d) listing information was developed  
38 based on state or federal water quality objectives for designated uses of these water bodies, and  
39 the achievement of these objectives. Although there are questions regarding both the statistical  
40 basis for listing a water body and the scientific basis for some local water quality objectives, the  
41 303(d) lists provide a national view of the condition of watersheds. Since the 303(d) lists are  
42 based upon local and state data that may be inconsistent across political or administrative  
43 boundaries, the lists have limitations similar to those associated with beach closings and fish  
44 advisories. However, the 303(d) lists provide an important measure of the nation's progress  
45 toward achieving water quality objectives. The fact that water quality objectives reflect local  
46 values should be considered a strength, rather than a limitation because the objectives reflect

1 criteria that are adapted to local conditions.  
2

3 National Pollution Discharge Elimination System data capture nutrient, toxics, and thermal  
4 loads to water bodies, and the data are available at the national level. The SAB recommends  
5 that these data be organized and included in the ROE in order to show temporal trends. This will  
6 provide information to determine whether the loads of N, P and the most important toxic  
7 compounds to waters in the United States are decreasing or increasing. NPDES data should also  
8 be used to determine the spatial distribution of load reductions (e.g., identifying regions which  
9 are lagging in the reduction of loads, and relating loads to observed water quality and 303(d)  
10 listing).  
11

12 The water chapter of the draft ROE currently contains a discussion of changes in stream flow.  
13 The SAB recommends that this discussion be expanded to provide information on stream flow  
14 and its relation to observed climate change. Stream flow information should also be presented  
15 spatially. It would be useful to view changes in precipitation nationally and regionally to  
16 determine how that has influenced stream flow. A related issue that should be included in the  
17 ROE is the change in global temperature and how it is affecting the timing of snow melt,  
18 particularly in the western United States, where it can have a major impact on water resources.  
19

20 The SAB recommends that, in addition to the suggestions outlined earlier in this document,  
21 the following indicators should also be included in the water chapters of future reports:  
22

- 23 • Changes in groundwater quantity and quality at a regional level, which can then be  
24 integrated to give a national perspective on the state of our groundwaters, including  
25 ground subsidence due to excessive withdrawal, increases in nitrate concentrations,  
26 fraction of drinking water supplies affected by MTBE, PCE, TCE, BTEX and other  
27 important contaminants;  
28
- 29 • Changes in water temperature due to point source discharges (i.e., power plants and other  
30 such uses of water) and riparian alterations of the landscape;  
31
- 32 • Status of invasive species in aquatic ecosystems;  
33
- 34 • Changes in TDS/salinity over time due to human activities;  
35
- 36 • Quality of irrigation water (e.g. salinity, nutrients, toxics);  
37
- 38 • Detection of emerging water pollutants in water supplies across the nation;  
39
- 40 • Harmful algal blooms.  
41

#### 42 ***Validity of conclusions in Chapter Two (Purer Water) of the draft ROE*** 43

44 The SAB notes that despite data gaps, many of the conclusions in the water chapter of the  
45 draft ROE are supported by scientific information. However some conclusions contained in the  
46 draft ROE are problematic or need qualification. In some cases, the draft ROE presents no

1 conclusions and data are presented without analysis. These problems are listed in detail in  
2 Appendix A of this SAB report, but a few are identified below for illustrative purposes:

- 3
- 4 1) Page 2-15: Data interpretation is confounded by the graphical presentation. In exhibits 2-6  
5 and 2-7, the time scales are confounded by using equal spacing despite covering different  
6 periods of record. In addition, the use of different scales on the y-axis can lead to  
7 misinterpretation of trends. Although the absolute changes in exhibit 2-6 are relatively  
8 similar (ca. 5000 acres lost or gained for each wetland type between the 50s and 70s), the  
9 relative difference is much greater for shrubs (41% increase) than forested areas (10%  
10 decrease) or emergents (14% decrease). This problem needs to be corrected, either by an  
11 explanation in the figure or by using similar scales.
  - 12
  - 13 2) Page 2-27: Changing stream flows. The timing of this indicator is not clear. It is not clear  
14 whether the analysis was conducted by evaluating the period of lowest flow in the 1990s to  
15 see if it was the same in the 1930s-19440s. If so, ecological value of flow is not clear.  
16 Hydroperiod is important not as it is linked to dates, but to the life histories of the biota. In  
17 this sense, hydroperiodicity linked to region, as opposed to a national scale, is much more  
18 valuable. Also, the figure label deals only with high flows, it is not clear whether low flows  
19 are also included.
  - 20
  - 21 3) Page 2-28: The text does not accurately describe data in the figure, and vice versa. The  
22 figure relates to percent of streams, while the text refers to percent of no-flow periods. If  
23 only one day of no flow represents a no-flow period, it is possible that the percent of no flow  
24 periods could increase over time, but occur in a fewer number of streams overall. This  
25 should be clarified.
  - 26
  - 27 4) Page 2-35: Phosphorus indicator. It is not clear why total nitrogen is specified for the prior  
28 indicator, but total phosphorus is not specified here. This omission suggests that other forms  
29 of phosphorous are included in the analysis. The total phosphorus categories seem skewed  
30 toward the high end. Even EPA's nutrient criteria guidelines suggest that a lower standard is  
31 appropriate. This issue deserves greater attention since impairment is likely at 100 ppb. It is  
32 also not clear how often samples were collected, whether storm events were sampled, and  
33 when total phosphorus is likely to be elevated.

34  
35 The kinds of information discussed in the cases listed above should be provided for other water  
36 quality indicators in the draft ROE as well.

### 37 38 ***Indicators in Chapter Three (Better Protected Land) of the draft ROE***

39  
40 The motivating questions and related indicators included in Chapter Three (Better Protected  
41 Land) of the draft ROE are, with few exceptions, good. While recognizing that the sub-themes  
42 of Chapter Three (land cover, chemicals, and waste) do not necessarily hold together coherently  
43 when viewed apart from the rest of the document, the SAB believes that their placement together  
44 is appropriate in light of the recommendations made about the structure (and recommended  
45 restructuring) of Chapter Five. One indicator that is not really helpful in Chapter Three (or  
46 anyplace else in the ROE) is "extent of forest ownership." This metric is not relevant to an

1 understanding of environmental quality. The SAB also notes that Chapter Three is missing  
2 many important indicators. Some of them are presented in Chapter Five, and the SAB  
3 recommends that they be moved into Chapter Three. Specific indicators that should be moved  
4 from Chapter Five into Chapter Three are identified below.

5  
6 A number of important land use indicators are not included in the draft ROE, and the SAB  
7 recommends that they be added to future drafts of the report. These indicators include: the  
8 extent of roads, metrics related to sprawl, and metrics related to socio-economic distributions of  
9 the human populations in relation to various land uses and land-based sites of contamination.  
10 The SAB recognizes that the EPA may not be able to find data to apply to all of these indicators,  
11 but because the indicators are meaningful and important they should be mentioned in the report.  
12 When necessary, EPA should explain that no data are currently available for the indicators.

#### 13 14 ***Data gaps and limitations in Chapter Three (Better Protected Land) of the draft ROE***

15  
16 The SAB is concerned about the tone and content of the discussion of some “indicator gaps  
17 and limitations” in Chapter Three of the draft ROE. It is not always clear whether data gaps and  
18 limitations in this chapter are identified because the indicators cannot provide answers to  
19 questions, or because few data are available to assess the indicators. Most of the gaps and  
20 limitations in Chapter Three are stated in such definitive terms that they unnecessarily convey to  
21 the reader that the data may be inappropriate or unable to answer the question. In fact, many of  
22 the data sets used for these indicators are accompanied by error estimates or assessments of  
23 confidence levels; thus the extent to which indicators are limited by data availability can be  
24 assessed. When estimates of accuracy are available for data sets, they should be provided in the  
25 ROE. The SAB also notes that some of the statements in the draft ROE about gaps and  
26 limitations are incorrect. Examples of these are included in Appendix A. Some of the stated  
27 gaps and limitations are, in fact, neither. For example, the second gap/limitation list on page 3-  
28 31 merely states that the available technology to detect residues exceeds what is needed to detect  
29 levels of residue that have health consequences. This statement does not call into question either  
30 the indicator or the data. Therefore the statement should not be included in the report.

31  
32 As mentioned previously, the SAB recommends that EPA rethink the indicator gap and  
33 limitations (IGL) approach presented in the draft ROE. In the current draft of the ROE, the IGL  
34 sections in all of the chapters contain an assortment of qualifiers that often inappropriately  
35 discourage the reader from believing the data presented. The SAB feels that this is largely a  
36 result of poor definition of the IGL section, and an apparent need to include information in the  
37 IGL section for each indicator, or the selection of an inappropriate indicator or measure for that  
38 indicator. IGL segments in the draft ROE include: (1) actual data gaps (pages 3-22, 5-12); (2)  
39 actual limitations (pages 5-39); (3) descriptions of the data (pages 3-20, 5-12); (4) needless  
40 apologies for data that are too accurate (page 3-31); (5) descriptions of problems that are not  
41 problems (page 5-16, BBS and volunteers); and (6) vague descriptions of things that may or may  
42 not be problems (e.g., page 5-15 states, “It is not clear that trends can be quantified with any  
43 precision”). A few segments report data uncertainty (page 5-12, end of first bullet). This  
44 assortment of qualifiers leaves the reader feeling bewildered and unnecessarily confused. If an  
45 indicator must be qualified the use of that indicator should be reassessed to insure that it is truly  
46 reliable and reportable.

1  
2 The SAB recommends that indicator gaps and limitations should be provided in detail in an  
3 appendix (currently Appendix B of the draft ROE Technical Document) that fully describes the  
4 rationale for indicator choice, data sets used, data sets not used, and constraints on these data  
5 sets. When these descriptions are placed within the body of the technical report, they are  
6 distracting and often portray the data in an unrealistically poor light. The SAB also recommends  
7 that EPA should not label accuracy statements about data as a gap or limitation. For example,  
8 the fact that PDP can detect pesticide residues at concentrations below regulated levels is an  
9 asset to the data, not a limitation. Data relevance is also a critical issue in assessing data  
10 limitations that is not sufficiently interpreted in the draft ROE. For example, assessing soil  
11 erosion on undisturbed forested lands (page 5-22) seems to have little meaning when it is known  
12 that most forest soil erosion is associated with harvest.

13  
14 The SAB also notes that data omitted in Chapter Three of the draft ROE is also a critical  
15 issue. Several notable data sets are used sparingly in the draft ROE (Breeding Bird Survey,  
16 NatureServe rarity ranking, Forest Inventory and Analysis [FIA] plot data). Other metrics are  
17 available from these data sets (e.g., population trends of grassland birds) and the lack of explicit  
18 detail explaining why some portions of the data sets were included in the draft ROE, and others  
19 were not raises concern among people familiar with the data sets.

### 20 21 ***Organizational scale of ecosystems in Chapter Three (Better Protected Land) of the draft ROE***

22  
23 The SAB finds that the current draft of ROE Chapter Three addresses indicators of terrestrial  
24 ecosystem extent and condition with a taxonomy and at a scale that are not appropriate. The use  
25 of seven landform types is not adequate to accurately inform the public about questions of  
26 national importance pertaining to the condition of land, or the ecological consequences of land  
27 condition. As an example, the category of grassland/ shrubland/desert lumps together numerous  
28 well-recognized ecosystem units, such as tallgrass prairie habitat, short-grass steppe, cold desert,  
29 warm desert, and many others. The problems that face different ecosystems are quite different.  
30 For example, habitat loss of tallgrass prairie, as well as most other eastern U.S. grassland types,  
31 is nearly complete (estimates generally report > 99% loss). A United States Department of  
32 Agriculture (USDA) report on ecosystem endangerment lists multiple endangered ecosystems  
33 which are eastern grassland. Yet, the draft ROE summarizes the extent of the broad grassland  
34 category as quite high (85-94% extant, though it does acknowledge that the quality has changed,  
35 p. 3-18). This results in a misleading interpretation of this system. In addition, threats to  
36 systems cannot be well captured at the resolution currently described in Chapter Three of the  
37 draft ROE. A leading concern for grassland integrity of eastern tallgrass prairie is the on-going  
38 conversion of pastureland to row crops, leading to the decline of numerous grassland-dependent  
39 bird species (J. Herkert, and others).

40  
41 In future editions of the ROE, the EPA will face a number of hard decisions regarding  
42 classification schemes for ecosystems. Different data sets, summarizing different indicators of  
43 land condition, use differing ecosystem classification schemes. Often these different ecosystems  
44 are not easily compared. Some are based on physiognomy, others on bioclimatic zones, and still  
45 others on dominant species. This will result in difficult decisions with respect to data treatment.  
46 Future reports on the environment may be organized around the currently used types (forests,

1 grasslands, etc.), but the SAB recommends that indicators must, wherever possible, use  
2 meaningful ecosystem classifications. These should be, as a rule, at a finer scale than the broad  
3 types currently described in the draft ROE.

4  
5 The SAB offers the following five recommendations regarding selection of an ecosystem  
6 classification scheme for the ROE. 1) Choose an ecosystem classification scheme that  
7 summarizes ecosystems of the United States in approximately 20 different fundamental  
8 ecosystem units for reporting on the environment. The approximately 20 ecosystem types would  
9 include the wetlands, estuaries and marine ecosystems described in Chapter Two. The Vector  
10 Smart Map (VMAP) project uses one such scheme. 2) When using data from other studies that  
11 use a hierarchical classification (e.g., NatureServe), trim the ecosystem classification scheme to  
12 this same level (approximately 20 units). 3) When using data that do not trim well to this order of  
13 magnitude (United States Fish and Wildlife Service [USFWS] Forest Inventory and Analysis  
14 [FIA]) data, it is possible to use summaries at a coarser scale (e.g., the order of the forest  
15 classification used in the Heinz report), but EPA should note that most rare and threatened  
16 community types reside in the category of "other forest types." Thus, statements interpreting  
17 trends in forest cover must be constrained by the fact that there is no information presented on  
18 the loss of forest types, because the ones most likely to be lost are aggregated into an "other"  
19 category. (4) We encourage EPA to use particularly sensitive ecosystems as a focal area upon  
20 which to report indicators. For example, rivers and oceans are treated as large ecosystem  
21 categories in the current report, but prominent bays and estuaries are critically important  
22 ecosystems for both biodiversity as well as extractive resources. These ecosystems share two  
23 additional attributes: they are very susceptible to degradation and perturbation because of human  
24 impacts, and there is a large and robust set of data describing the conditions of these ecosystems.  
25 Judicious use of critical ecosystems can be very useful for characterizing condition at a broader  
26 level.

### 27 28 ***Questions in Chapter Three (Better Protected Land) of the draft ROE***

29  
30 A deficiency of the draft ROE is that questions are framed differently in the land chapter as  
31 compared to the air and water chapters. In some cases questions are framed to answer questions  
32 about extent of ecosystems, and in other cases they are framed to answer questions about  
33 ecosystem condition. Answering questions about condition requires a different suite of  
34 indicators than those currently used in the report. The SAB recommends revising the questions  
35 and indicators to make them more illuminating of actual ecosystem condition. In some cases the  
36 use of new indicators may be appropriate. In developing the next ROE the EPA should consider  
37 framing questions to reflect land condition. The SAB provides examples in Table 1.0 of the  
38 kinds of questions and indicators that might reflect forest condition. Similar kinds of questions  
39 and indicators can be developed for various types of grasslands, deserts, and aquatic systems.  
40 These examples are neither intended as an exhaustive list, nor a specific prescription for choice  
41 of indicator. The SAB recommends that the authors of the next ROE think hard about which of  
42 these indicators may be obtained and analyzed in the short time available for preparation of the  
43 report. The SAB also recommends that EPA begin thinking about the activities that may be  
44 initiated now in order to expand these indicators in the future, given the current constraints on  
45 monitoring.

1  
2  
3

Table 1.0 Possible indicators of condition and response to stressors

Question: What is the extent of forest habitat diversity and contiguity?
Rationale for selecting question: We know that plant community diversity determines food chain structure. Disruption of community diversity degrades ecological integrity.
Indicators: <u>Forest Community Diversity.</u> Despite the observation that overall forest quantity has, if anything, slightly increased during the past 20 years, there are likely numerous ways by which changing land use continues to threaten biological diversity of forests. One indicator of habitat loss as a stressor would be changes in the quantity of forest types that are rare and threatened. Indicator opportunities: (a) spatial and temporal changes in rarity ranks of threatened forest types (based on NatureServe classification scheme); (b) Changes in spatial extent of key community types.  <u>Habitat Patch Size.</u> Ecological data indicate that the size of forest fragments has an important effect on species richness (e.g., birds, mammals, amphibians) and on trophic structure (i.e., the presence or absence of top predators). A critical indicator of forest patch size can be captured through an index of changing road density as well as geostatistical approaches to remote sensing data (i.e., FRAGSTATS on land cover data). Indicator opportunities: (a) DOT Road density data; (b) Random selection of representative forest patches distributed across the US using LANDSAT data; (c) Millenium ecosystem assessment (This report should be completed soon, and it provides global data analysis, so that patch attributes in the United States. could be compared to other parts of the world).
Question. Are invasive species degrading forest productivity?
Rationale for selecting question: Invasive species are competitive dominants that displace native species, disrupt biogeochemical cycles; and engineer abiotic environments. Invasive species represent the second leading cause (behind habitat loss) of species endangerment on the United States. (Wilcove).
Indicators: <u>Acreage spread of key invasive species.</u> Indicator opportunities: USFS and BLM track acreage spread of key invasive species. Numerous state and local agencies map regionally important invasive species (e.g., hay-scented fern in New England, garlic mustard in the upper Midwest, kudzu in the southeast, scotch broom in the west). Regional trends and case studies can be used to illustrate a problem of national scope and concern.
Question: What is the ecological condition of forests? (forest age)
Rationale for selecting question: Forest age is an indicator of standing productivity and a surrogate for the likelihood of disturbance (e.g., fire susceptibility); disease or pest invasion; and a measure of degree to which U.S. forests are represented by old growth stands.
Indicators: <u>Indicator opportunities:</u> Forest Age data from USFS FIA plot data; classified into USFS community types; perhaps by biome. A sequence of spatially explicit maps can be used to show time trends using isoclines of net growth across the country.
Question. What are trends in the disease state of forests? (Insect pests and microbial pathogens)
Rationale for selecting question: An indicator of forest tree health is pests and pathogen outbreaks.
Indicators: <u>Indicator opportunities:</u> Exhibit 5-10 of the draft ROE provides a temporal trend in acres of forest impacted by insect outbreaks and disease. This trend is problematic in that it is difficult to discern a single outbreak event in the 1980's from which we are experiencing a recovery, or a real trend toward fewer outbreaks. A spatial analysis combined with this temporal analysis would allow these data to reveal whether there were chronically higher insect outbreak levels in the 1980's or if this peak results from a single large event and subsequent recovery. Additional opportunities include the spatial spread of prominent insect pests such as gypsy moth, woolly adelgid, Japanese ash-borer for insects; dogwood anthracnose; white pine blister rust and others among tree diseases. USFS collects data on these infestations.

1  
2 There are likely to be state-collected data on wildlife health status that can be used as  
3 indicators of forest condition. Wildlife status indicators that could be developed include: tick  
4 loads of deer; morbidity (papiloma on deer), and peregrine eggshell thickness. EPA should also  
5 consider using breeding bird data on neotropical migrants. Multiple data sets for the same  
6 indicator should be compared in table form. Very few differences are likely to be observed in  
7 agricultural land, but it would be useful to know about transformations within agricultural land.  
8

9 The SAB notes that, Chapter Three of the draft ROE also provides information on indicators  
10 of waste and toxic contaminants released to land. The ROE Panel did not comment on this  
11 section of the draft report because the panel did not have the expertise to assess the information  
12 provided. However, the Panel notes that the ROE should contain a discussion of the problem of  
13 intense land contamination by discarded chemicals, leading to such problems as leaching into  
14 ground water and potentially toxic human and wildlife exposures. Such contaminated sites are  
15 sufficiently widespread to constitute a national problem even though each site may be relatively  
16 isolated.  
17

#### 18 ***Indicators in Chapter Four (Human Health)*** 19

20 This Chapter lacks an overall framework that would relate the health indicators to the  
21 environmental stressors presented in the other chapters. The SAB recommends that some  
22 additional indicators be added to Chapter Four of the draft ROE. Endocrine disruptors in the  
23 environment should be addressed and consideration should be given to adding indicators of: time  
24 of puberty, testicular cancer, prostate cancer, sperm counts and function, gender ratio at birth,  
25 and thyroid disease. In addition, neurobehavioral function (including cognitive function, visual  
26 memory, etc.) could be listed as an environmental health indicator. The discussion of relative  
27 rates of infant mortality in Chapter Four should indicate that one reason why infant mortality in  
28 the United States is high is the proportion of teenage mothers. Chapter Four currently does not  
29 provide any reason for the relatively high infant mortality rate in the United States, and readers  
30 may conclude (inappropriately) that it is completely a result of exposure to environmental  
31 chemicals and not related to socioeconomic conditions. The discussion of lead in Chapter Four  
32 (case study) should reference recent articles in the April 17, 2003 issue of the *New England*  
33 *Journal of Medicine* providing evidence that even the current "acceptable" blood lead level of 10  
34 micrograms/dl may not be protective of health. These articles reported that: 1) serum lead levels  
35 of three versus one micrograms/dl delayed puberty by several months in blacks and Hispanics  
36 (but not whites), and 2) IQ was adversely affected by serum lead levels even up to only ten  
37 micrograms/dl, with most of the loss between the levels of one and five micrograms/dl.  
38

39 The SAB recommends several other additions to Chapter Four. Brain barrier differences in  
40 children are discussed as a reason for the susceptibility of children to environmental  
41 contaminants. It should be also be noted that end organ susceptibility may be equally or more  
42 important. Breast milk monitoring should be considered as a method for determining the body  
43 burdens of many of the most worrisome chemicals. The SAB also notes that, old data on the  
44 incidence and rising incidence of autism are used in Chapter Four. Current estimates for autism  
45 spectrum disorder are 6.7 per thousand. New technologies should also be discussed in greater  
46 detail in Chapter Four. These include the use of genotypes and more sensitive and specific

1 neurobehavioral testing (e.g., visual memory testing and functional MRIs). Chapter Four is  
2 focused on disease causation. It should be noted, however, that environmental chemicals may  
3 not cause certain diseases, but may exacerbate disease processes such as asthma and cystic  
4 fibrosis. Neurobehavioral function in typical and dysfunctional children may also be affected by  
5 environmental chemicals. EPA should also link longstanding state databases on health such as  
6 cancer registries and birth defects to environmental data sets. Data from the CDC's  
7 Environmental Public Health Tracking Project may be available to provide this type of  
8 information for the next ROE. In Chapter Four EPA should also consider addressing emerging  
9 persistent chemical contaminants such as brominated flame retardants and perfluorooctane  
10 sulfonate.

11  
12 The SAB also notes that there is extensive peer-reviewed literature documenting associations  
13 between PM pollution and ozone pollution and human health effects such as respiratory  
14 morbidity and cardio-respiratory mortality. The arbitrary insistence on "national scale" data  
15 seems to have obscured these important findings in EPA's draft ROE 2003.

### 16 17 *Indicators in Chapter Five (Ecological Condition)*

18  
19 The SAB finds that the status and trends of ecological conditions at the regional and national  
20 scale were not communicated well in Chapter Five of the draft ROE, and it was difficult to  
21 understand why EPA had judged many of the indicators as important to include. For many  
22 indicators, both the value of the indicators and supporting information is diminished by the way  
23 the indicators were presented, developed, and assembled in the report. Some examples of these  
24 deficiencies and recommendations for improvement may help EPA make the Report on the  
25 Environment more clear, concise, and persuasive.

26  
27 Several indicators collapsed data and measurements into pooled or average values that are too  
28 generalized to convey clear information on environmental status and trends. For example, the  
29 pooled surface area of lakes and reservoirs (exhibit 5-25) show little change in a five decade data  
30 series spanning the era of dam building in the United States from the 1960s through the 1980s.  
31 Also, the desirability of increases or decreases in lake and reservoir area is not evident or  
32 explained. The statement that "changes in this indicator reflect the effects of climate on water  
33 level..." is greatly oversimplified and misleading. Report sections on indicators often provide  
34 numerous qualifications on indicator use, and at times go so far as to state that indicator value  
35 changes cannot distinguish natural from human pressures (e.g., marine mortalities). The  
36 problems and reservations on indicator clarity, precision, and interpretation can be greatly  
37 reduced by limiting indicators to those that have a direct relationship to specific environmental  
38 changes, and indicators known to be sensitive to targeted trends. The ideal indicator would be:  
39 (1) based on familiar and easily understood measures; (2) based on data known to be strongly  
40 correlated with the environmental attribute of interest, (3) and relatively insensitive to  
41 confounding and non-environmental factors.

42  
43 The SAB finds that in Chapter Five of the draft ROE there is frequent redundancy among  
44 indicators and with regard to their intended interpretation. Chapter Five appears to collect  
45 indicators from the basic chapters on air, land, and water. The repeated use of related indicators  
46 can be helpful for reinforcing a status or trend conclusion, but the SAB perceives this practice as

1 an impediment to developing a clear and concise message on the ecological condition of the  
2 environment. For example, there are three indicators based on animal, fish, and marine organism  
3 deaths and deformities even though strong reservations are stated for interpreting each one. In  
4 another example, model results are used from a single government database to project indicator  
5 values for two closely inter-related indicators: soil compaction and soil erosion. Rather than  
6 amassing related indicators with suitable data, the SAB feels that the overall impact of the ROE  
7 will be greater if the most informative and well supported indicators are used to answer specific  
8 questions and show specific trends.

9  
10 The SAB feels strongly that there are too many indicators included in Chapter Five of the  
11 draft ROE, and too many for a number of the ecosystems assessed. While we support the  
12 numerous indicators in the chapters on air, land and water, we believe that the overarching  
13 chapter on ecological conditions should concentrate on limited number of select indicators.  
14 Large numbers of indicators can impede communication when an overall sense of status and  
15 trend is being sought. This chapter of the draft ROE includes 74 indicators, with the number per  
16 ecosystem type ranging from 4 to 16. Most people can recall and synthesize as many as 7 to 9  
17 facts or values. When findings come in greater numbers, readers will conduct their own  
18 averaging or counts to gather an overall sense of status. The SAB therefore notes that seven or  
19 fewer indicators per assessment realm (an ecosystem type, region, or the nation) is an optimal  
20 number, and additional indicators only complicate gaining an understanding of environmental  
21 status and trends. The SAB recognizes that cutting the number of indicators to a few or several  
22 per assessment level poses a very difficult challenge. Selecting a few well supported, sensitive,  
23 and precise indicators is a substantial technical challenge. It also runs counter to the natural  
24 interests of agency programs, report participants, and interest groups who often want to see their  
25 work and resources highlighted. Nevertheless, the SAB feels that relying on the strongest and  
26 most informative indicators will considerably strengthen the impact of the total message and  
27 increase the influence of the report. If EPA decides that the best approach to assessing the  
28 ecological condition of each ecosystem is to synthesize multiple indicators, then perhaps the  
29 multiple indicators could be included in appendices, with the synthesis for each ecosystem  
30 presented in the report, along with the synthesis for all the ecosystems in each region, or the  
31 nation.

32  
33 The section of the chapter that discusses essential ecological attributes captures only a limited  
34 set of human drivers of ecological change. The drivers considered in the draft ROE are mainly  
35 those associated with physical alterations of the habitat and the impacts of that alteration on  
36 ecological health. There are other human drivers that have marked impacts on species  
37 populations and ecological health. For example fisheries can have direct impacts on the  
38 biological condition, growth characteristics, life histories, and genetic composition of the  
39 targeted species. However the impacts of fishing can extend beyond the target species to other  
40 aspects of the ecological community. For instance, changing predator abundance and size  
41 distribution can alter forage species characteristics and composition, and consequently impact the  
42 species that serve as the food source for foragers.

43  
44 There are other less obvious ecological impacts that can result from human drivers. While it  
45 is widely recognized that water quality influences biological communities, the integrity of  
46 ecological community structure can influence the sensitivity of the community to water quality.

1 The depletion of filter feeders and grazers can adversely affect water quality through reductions  
2 in filtration of plankton and suspended sediment or through a reduction in grazing of plankton or  
3 other algae. The resulting increases in turbidity or decreases in plankton can have substantial  
4 impacts on water quality and remaining biological communities. For example, the loss of oysters  
5 (filter feeders) and the depletion of menhaden stocks (plankton grazers) in Chesapeake Bay has  
6 led to increased turbidity and planktonic primary productivity. In many coral reefs, a persistent  
7 shift from coral to macroalgal dominance has been attributed to a reduction in herbivorous fish  
8 and invertebrates, causing increasing ambient levels of nutrients to be channeled into less  
9 preferred autotrophic forms, resulting in less material being transferred directly to higher trophic  
10 levels. Alternatively, increases in bottom-feeding fish in ponds and small lakes can lead to  
11 increases in the suspension of sediments, increases in planktonic production, and a decrease in  
12 bottom vegetation due to reductions in light penetration. We therefore recommend that  
13 indicators of fish stocks and diversity for coastal, estuarine and Great Lakes fisheries be  
14 developed and discussions of how the condition of fisheries can impact water quality be added to  
15 the discussion of ecological conditions.

16  
17 **4.3.** *Question 3: Conventional Agency practice has been to measure and reduce emissions*  
18 *and subsequent exposure to pollutants. Can you suggest how measurements for human health*  
19 *and ecological condition impacts resulting from environmental perturbation could be more*  
20 *effectively addressed?*

### 21 22 **A. Key Recommendations in Response to Charge Question 3**

23  
24 The SAB provides the following key recommendations to enhance synthesis in the human health  
25 chapter of the draft ROE.

- 26  
27 1. Presentation of the state of the environment in a health context greatly enhances the value  
28 and meaning of the ROE while at the same time complicating it. The linkages described  
29 in the draft ROE are extremely important in representing the state of the environment as  
30 it relates to human health. However, the SAB notes that health impacts resulting from  
31 environmental pollution should be addressed in the ROE through a more rigorous and  
32 systematic consideration of their linkages.
  - 33  
34 2. The criteria for identification of environmentally-related health effects should be  
35 identified and included within future human health chapters. Because of the technical  
36 challenges associated with identifying health effects associated with low level chronic  
37 exposure to environmental contaminants (e.g., endocrine disruptors), there is scientific  
38 bias in favor of identifying health effects associated with acute exposures. This bias is  
39 reflected in the draft ROE, although it is addressed in section 4.3.5 of the report through  
40 identification of emerging health effects.
  - 41  
42 3. The selection criteria for identification of health effects should take into account the  
43 precautionary principle (i.e., the magnitude of the public health threat should be  
44 considered when determining the requirements for weight of evidence and/or strength of  
45 association).
- 46

- 1 4. For those diseases that are included in future human health chapters, a clear description  
2 of the role and strength of evidence that relate a disease to pollutants in air, water, land,  
3 or diet should be provided. Bradford-Hill criteria should be considered in characterizing  
4 the nature of the evidence and strength of association.  
5
- 6 5. For many environmental pollution-related health effects, susceptibility is a key  
7 consideration and should be discussed in the context of linkages. Where appropriate,  
8 susceptibility factors such as age, gender, polymorphisms, and socioeconomic status  
9 should be acknowledged. EPA should use the strongest and most informative indicators  
10 in the ROE, even if data are not readily available. The Agency should carefully select  
11 indicators that will support future strategic program planning activities.  
12
- 13 6. The current document does not adequately treat the health threats posed by environmental  
14 contaminants in diet. Diet represents an important route of exposure for a wide range of  
15 contaminants (e.g., pesticides, metals, PAHs, heterocyclic amines) representing an  
16 integrative medium across air, water, and land. The U.S. Department of Agriculture and  
17 or Food and Drug Administration have databases that are likely to satisfy the criteria for  
18 category 1 or category 2 indicators.  
19
- 20 7. The section on emerging health effects (Section 4.3.5 on page 4-38 of the draft ROE),  
21 particularly that part of the section on arthropod-borne diseases (page 4-40), should be  
22 linked to the ecological condition section of the draft ROE (Chapter Five, or those parts  
23 that are moved into Chapter Three). This section is important because of the growing  
24 awareness that many "new" infectious diseases emerge in large part from changes in the  
25 environment. These diseases, in turn, can result in changes to the environment as well.  
26 Lyme disease is mentioned in this section, but should be elevated as a case study to  
27 emphasize this concept. Ecological phenomena such as habitat fragmentation (increased  
28 "patchiness"), reforestation in the eastern United States that led to the explosion of the  
29 deer population, and oak tree masting events that increased deer mouse populations all  
30 allow for increased transmission efficiency to humans of the tick-borne bacteria that  
31 cause Lyme disease. Emergence of ehrlichiosis, babesiosis, Powassan virus fever, and  
32 other tick-borne infectious diseases could be prevented or minimized by a better  
33 understanding of interactions between infectious agents, their hosts, and the environment.  
34 Pathogen and host genetic factors may also exert selective pressures that affect infectious  
35 disease emergence. Linkages also exist between water pollution and human exposure to  
36 aquatic pathogens such as *Pfisteria*, *Cryptosporidium*, and Microcystin toxins.  
37
- 38 8. Linkages exist between land use, standing water, and the emergence of West Nile virus  
39 (WNV) fever. Genetic factors may help explain why the North American strain of WNV  
40 has become more virulent and now (for the first time ever) is manifested by poliomyelitic  
41 presentations. Long-term exposure to low levels of xenobiotics may make individuals  
42 more susceptible to infections by pathogens. Conversely, prior infection with pathogenic  
43 microbes may predispose individuals to more severe outcomes from chronic exposure to  
44 industrial pollutants.  
45  
46

1 The SAB provides the following key recommendations regarding enhanced synthesis in the  
2 ecological condition chapter of the draft ROE.

- 3  
4 1. It is recommended that future ROE chapters addressing ecosystem condition be  
5 reorganized and refocused on ecological condition. The single variable approach  
6 currently used in the chapter should be de-emphasized, and a conceptual model of  
7 linkages and feedbacks should be created to explore how certain drivers of environmental  
8 change lead to altered ecological condition. This chapter presents an opportunity to  
9 synthesize the most critical indicators from prior chapters to obtain an assessment of  
10 ecological condition. This will require a dramatic change in the organizational structure  
11 of the chapter. Various parts of the draft ROE should be integrated in a conceptual  
12 model, and Chapter Five should be populated with synthetic analyses driven by major  
13 questions about ecological condition. The conceptual model should include two essential  
14 elements: symmetry of questions and indicators focused on conditions and trends, and  
15 symmetry between Chapters Four and Five. The use of such a model will improve the  
16 discussion of linkage between ecological attributes and health.
- 17  
18 2. The use and presentation of each indicator should be reevaluated to focus the ROE on  
19 the most meaningful indicators.
- 20  
21 3. The gaps and limitations section should also be reorganized to place some material in an  
22 appendix.
- 23  
24 4. The appropriate level of ecosystems and associated indicators should be included in the  
25 ROE using some examples of sensitive ecosystems, and some examples that are explicit  
26 in their linkages to ecological attributes of human concern (e.g. the Chesapeake Bay and  
27 the Great Lakes where contaminated sediments, fish advisories associated with high  
28 levels of mercury and PCBs, and beach closings caused by pathogens in recreational  
29 waters link environmental perturbation to human health risks).

### 30 31 **B. Specific Comments in Response to Charge Question 3**

#### 32 33 *Linking environmental exposure and human health effects*

34  
35 The linkage between environmental exposure and human health is addressed in Chapter Four  
36 of the draft ROE. The SAB believes that the following approaches and suggestions will help to  
37 make this critical linkage. The SAB recommends that the overall document should be  
38 reorganized and a conceptual summary should be included at the beginning to help set the stage  
39 for a discussion of links between exposure and human health effects. The SAB also believes that  
40 it will be important to look for and include additional measurements that are intermediate  
41 between ambient concentration and human/ecological effect. These can include measures of  
42 personal exposure, biological markers of exposure, measures of body burden (the direct result of  
43 exposure and uptake), and measures of sub-clinical change. Ambient concentration does not  
44 directly describe exposure and uptake of toxic materials from the environment. Within the  
45 context of the conceptual model outlined at the beginning of the document, measures of personal  
46 exposure to compounds with known health/ecological implications are one step closer to an

1 index of health impact than ambient concentration. In addition to the examples currently  
2 included in the draft ROE, which are restricted primarily to blood levels of heavy metals,  
3 additional possibilities to explore include: Pb and other bone seeking elements and radio-  
4 nuclides in bone (a more stable measure of integrated exposure than concentration in blood  
5 which has a relatively short half-life); heavy metals in nail and/or hair; bio-accumulating organic  
6 and inorganic pollutants in human breast milk; carboxyhemoglobin (COHb) levels as a marker of  
7 exposure to emissions from combustion sources; exhaled breath concentration of volatile  
8 organics; and heavy metals or metabolic byproducts of organics in urine. The SAB recognizes  
9 that data to support the development of indicators for many of these markers of exposure may  
10 not be available from national representative surveys. However, movement in this direction is  
11 important to establish linkages between the condition of the ambient environment and  
12 human/ecological impact.

13  
14 Evaluating sub-clinical changes resulting from environmental exposures is another strategy  
15 for linking exposure and effects. For example, there are well-developed relationships between  
16 exposure to ozone and pulmonary function. These effects have been demonstrated in a wide  
17 range of individuals including asthmatics and healthy exercising adults. Recent studies have also  
18 demonstrated the use of protein adducts and DNA adducts as measures of exposure. Within this  
19 general context, it is important to consider mixtures and multiple routes of exposures. In the  
20 toxics area, effects are likely to be at least additive or possibly multiplicative, and exposure can  
21 be from air, water and food. It also may be necessary to consider health and ecological  
22 outcomes, when the causal relation between exposure and outcome is not completely confirmed.  
23 This relationship is especially important in light of the potentially severe adverse consequences  
24 of not acting to mitigate ecological change.

25  
26 The SAB believes that it will also be necessary to develop indicators of the impact of air  
27 quality change on ecosystem health. This linkage has the potential to lead to the direct synthesis  
28 of ecological and health impacts. Emission of climate forcing gases and aerosols is obvious and  
29 important area for development. The goal is to track major ecosystem changes that result from  
30 environmental perturbation from the emission of pollutants. For example, ecological impacts  
31 with known health implications include habitat fragmentation and loss of bio-diversity.

32  
33 The SAB also recommends that emissions should be analyzed in a GIS context, incorporating  
34 climate, population, and other factors to describe how people come in contact with pollutants.  
35 This analysis should include pollutants that may be derived from sources or processes not  
36 regulated by current EPA programs, acknowledging the fact that some impacts are derived from  
37 sources outside the United States. For example, a systematic summary of global transport (from  
38 satellite observations) could track the movement of Asian/African dust, which has implications  
39 for coral reefs as well as human asthma. An additional example is an analysis of the link  
40 between global deforestation and desertification with resulting dust events that can lead to  
41 ecological and health impacts.

### 42 *Environmental justice*

43  
44 It is the opinion of the SAB that measurements for human health and ecological condition  
45 impacts resulting from environmental perturbation could be more effectively addressed by  
46

1 adding a question, and related indicators, focused on environmental justice to Chapters One,  
2 Two, and Three of the draft ROE. The following question should be added to each of the first  
3 three chapters, "Are there areas receiving high levels of environmental pollutants that may  
4 disproportionately expose ethnic subpopulations or economically disadvantaged communities to  
5 environmental contaminants?" The data on air, water, and land pollution (including waste) that  
6 will inform this question, and indicators, should be included as maps and tables in the  
7 appropriate media chapters of the ROE.

### 8 9 *Synthesis to provide an integrated picture of ecosystem condition*

10  
11 The draft ROE provides many indicators describing the condition of air, water and land.  
12 There is, however, a need recognized by both EPA and the SAB to combine information from  
13 the air, water and land chapters and synthesize them in ways that provide an integrated and  
14 meaningful picture of the condition or integrity of individual ecosystem types. In addition,  
15 insights about condition of individual ecosystem types should be synthesized to assess condition  
16 of entire ecoregions or the whole country as data present themselves for future reports on the  
17 environment. The SAB notes that the current draft of the ROE attempts to do that, but the SAB  
18 finds that the draft ROE takes a decidedly single variable approach (e.g., extent of a land use  
19 type across time). The limitation of such an approach is that it does not adequately reveal the  
20 linkages and feedbacks among various biotic and abiotic components that make up an ecosystem.  
21 While the SAB does not suggest that future ROEs should contain a model of ecosystems that  
22 reflect real world complexity, the SAB does recommend that these ROEs should contain some  
23 conceptualization of important linkages among ecosystem components (e.g., extent of land cover  
24 type and biodiversity) and then explore how certain drivers of environmental change lead to  
25 altered environmental condition (e.g., extent of invasion by alien species which impacts the  
26 number of species and index of biodiversity within an ecosystem; changes in air and water  
27 quality that can impact species and/or habitat quality). Doing this effectively requires changing  
28 the organizational structure of Chapter Five of the draft ROE in two ways. First, EPA should  
29 develop a working conceptualization of how different parts of the ROE can be integrated.  
30 Second, the synthetic analysis of condition should be driven by major questions about  
31 environmental problems.

### 32 33 *Example of information integration.*

34  
35 The synthesis of information ultimately must articulate the specific goal of analysis. It is  
36 presumed that the goal of analysis for the ROE is to describe the condition or health of different  
37 ecosystem types. This goal begs the question, "health or condition in relation to what?" The  
38 answer to this question requires defining the environmental problems of critical concern, for  
39 example, consequences of global warming, consequences of biological depletion (biodiversity  
40 loss, habitat loss), consequences of altered nitrogen cycling, etc.

41  
42 Descriptions of ecosystem condition should then be expressed in terms of essential ecosystem  
43 attributes (EEA's), which are influenced by a host of variables that determine the air, water and  
44 land components of an ecosystem. The following schematic describes an approach one might  
45 take to combine information from Chapters One, Two, and Three of the draft ROE in order to  
46 provide an integrated picture of the health of different ecosystem types and of the United States.



- 1 1. The SAB recommends that indicators in the ROE should not be limited to those for  
2 which data are available at the national level. The report appears to be more of a national  
3 inventory than a description of national environmental health examination. Much can be  
4 inferred from data available at local and regional scales. A nationally focused  
5 epidemiological approach masks important regional and local changes and impacts. By  
6 taking an exclusively national focus, potential issues may not be noticed until they  
7 become severe  
8
- 9 2. Additional categories of indicators and data should be further developed in the next  
10 iterations of the ROE. Indicators that are relevant on a local or regional scale, such as  
11 groundwater withdrawal in key aquifers and contaminated sediment levels in the Great  
12 Lakes, should be used to evaluate goals and assess progress toward the improvement of  
13 environmental conditions and public health at the relevant scale.  
14
- 15 3. Approaches that could be used to evaluate local and regional data include: determining  
16 whether criteria are exceeded, evaluating data to determine whether regional goals have  
17 been met, and integrating regional goals to evaluate national progress.  
18
- 19 4. EPA must be judicious in choosing regions from which data are to be analyzed and  
20 presented. The use of EPA Regions as frames of reference is probably arbitrary. The  
21 SAB notes that EPA has regional data available (e.g., Regional Vulnerability  
22 Assessment, ReVA), and these data should be reflected in the indicator exhibits of the  
23 ROE when they help to answer appropriate questions.  
24
- 25 5. Spatial distribution information in the form of maps describing indicator data should be  
26 included in the ROE when possible because these are very informative. Greater use of  
27 maps in the ROE would provide important information on spatial distributions that is  
28 largely lacking in the current draft. Exhibit 1-8 of the draft ROE, which provides spatial  
29 distributions of PM<sub>2.5</sub>, is a good example of how maps can be used to identify regional  
30 differences.  
31
- 32 6. It is very important to use appropriate spatial or temporal averaging methods when  
33 describing indicator data. The SAB recommends that data distributions should not be  
34 averaged across individual EPA Regions. EPA should instead consider using areas like  
35 ozone urban core sites for grouping and scaling data. It is also important to use an  
36 appropriate time basis for reporting data. For example, annual averaging of SO<sub>2</sub>  
37 emissions is appropriate, but annual averaging of ozone data is not the best approach  
38 because of large seasonal variability and because averages are a poor measure of  
39 exceedence episodes.  
40

## 41 **B. Specific Comments in Response to Charge Question 4**

### 42 *Use of regional data*

43 Regional (and even local) data are useful if the regions are defined appropriately. However,  
44 grouping data according to EPA administrative region is arbitrary and should be avoided (e.g. the  
45  
46

1 ozone distribution in Exhibit 1-11). The appropriate grouping or scale will differ depending  
2 upon the particular indicator. Ozone provides a good illustration. Rather than grouping ozone  
3 data by EPA Region, it would be useful to group the data by transport sites and urban core sites.  
4 Another possible approach is to present national data, and then present trends for particular hot  
5 spots (e.g., Los Angeles and Houston) and pristine areas in related vignettes to assess impacts.  
6

7 Charge question 4 asks whether consistency in data quality is required. While the SAB  
8 recognizes EPA's desire to use Category 1 or 2 indicators when possible, the use of other  
9 indicators is strongly encouraged if data are available and have been reported in peer-reviewed  
10 form. This is particularly important in cases for which high quality indicator data are available at  
11 a local or appropriate regional level. The SAB encourages the EPA to use such data in the ROE,  
12 particularly where regional data could be used to draw conclusions about the national condition.  
13 The SAB is concerned that EPA has included the statement, "no category 1 or 2 indicators exist"  
14 in tables such as Exhibit 1-2 in the draft ROE Technical Document. This statement implies that  
15 associations between, for example, human health and stratospheric ozone depletion are not  
16 known or do not exist. It would be better for the table entry to include a statement such as "Only  
17 regional (local) data available; see section \*\*\*." This could provide a reference to another part  
18 of the draft ROE.  
19

### 20 *Data averaging*

21  
22 The SAB is concerned that the extensive use of annual averaging in the draft ROE causes a  
23 great deal of information to be lost. For some indicators, such as SO<sub>2</sub>, annual averaging of  
24 emissions levels is certainly appropriate. For others, such as ozone, annual averaging (exhibit 1-  
25 11) is not the best approach, since annual averages are a poor measure of exceedence episodes.  
26 It is also unclear in some cases whether reported annual averages in the draft ROE are for the  
27 entire year or for the summer ozone season only. Annual averaged ozone levels will be lower  
28 than the averages restricted to the summer months. The mean may also not be the most  
29 appropriate statistic to use if data are not distributed normally. If the data are normally  
30 distributed, one could consider inclusion of standard deviation. If the data are not normally  
31 distributed, one might report median and range with some measure of uncertainty.  
32

### 33 *Data gaps*

34  
35 The identification of data gaps and limitations is an important part of the ROE. In the draft  
36 ROE, EPA effectively identifies explicit gaps associated with the individual indicators (e.g.,  
37 "ozone monitoring is conducted mostly in urban areas..."). However, as noted previously in  
38 this report, discussion of some gaps appears to be unnecessarily negative (e.g., "the indicator  
39 does not present actual emissions data; thus, it has the inherent limitations of estimates..."). This  
40 data gap could be stated simply by describing the approach used to estimate the data and  
41 referring to Appendix B. The SAB also notes that the discussion of gaps focuses on the specific  
42 indicators that are listed. It would be helpful if missing indicators were also identified. For  
43 example, in the indoor air section, the listed gaps are gaps in the reported data. Some indication  
44 of useful indicators for which data are not available (e.g. indoor concentrations of formaldehyde,  
45 PM<sub>2.5</sub>) would be helpful.  
46

1 **4.5** *Question 5: The Public Report is intended to summarize the Technical Document for a*  
2 *broad, non-technical public audience. Does the Public Report accurately and adequately reflect*  
3 *the technical content, including the gaps and limitations, of the Technical Document?*  
4

#### 5 **A. Key Recommendations in Response to Charge Question 5**

6

7 It is the opinion of the SAB that the draft ROE Public Report should be restructured. While it  
8 reflects the technical content of the draft ROE Technical document, it does not convey  
9 information in a fashion that is easily digestible by the public and possibly policy makers as well.  
10 In particular, the public document reads as a distillation of the Technical Document. This makes  
11 the public report less useful than it could be. Rather than only containing selected examples  
12 from the Technical Document, the Public Report should also provide restructured and  
13 recomposed information in a readily understandable format (i.e., with language that is accessible  
14 for those with a 10<sup>th</sup> grade education and beyond). The Public Report could be a valuable tool  
15 to educate the public on issues identified in the report and on the relationship between human  
16 activity and the environment. The SAB provides the following recommendations for  
17 improvement of the draft ROE Public Report:  
18

- 19 1. The executive summary needs revision; there is no information in the executive  
20 summary on human health and ecological conditions in the United States – this needs to  
21 be redressed.  
22
- 23 2. The Public Report should be shorter in length; where appropriate, the report should  
24 contain hyperlinks to the Technical Document or relevant URLs that provide supporting  
25 information. The supporting text does not have to be in the Technical Document itself.  
26
- 27 3. If possible, the graphics in the Public Report should not be drawn only from the  
28 Technical Document. Graphics in the Public Report should be simple and user-friendly.  
29 They could involve color-coding (assigning colors to relative state of health), reduction  
30 of text in graphics, and making graphics map-based. Examples of useful approaches  
31 recommended by the SAB for EPA review include the State of the Great Lakes (2001)  
32 and Reefs at Risk reports.  
33
- 34 4. Where possible, information in the Public Report should be presented in a spatially  
35 distributed fashion. The use of national maps, with blow-ups of information within  
36 specific regions, would be very useful. There must be a balance between providing  
37 enough data to make graphics informative, but not overwhelming readers with too much  
38 data. If done well, the graphics in the Public Report can provide a quick overview of  
39 national status and also allow readers to see how their regions fit into the national  
40 condition.  
41
- 42 5. In places, the scientific terminology used in the Public Report reaches beyond the  
43 average grasp of the general public. The SAB recommends that EPA thoroughly review  
44 the Public Report to remove or define these terms.  
45  
46

## B. Specific Comments in Response to Charge Question 5

The public document of the draft ROE reads as a distillation of the Technical Document. The Public Document can be enhanced by providing restructured and recomposed information in a more easily digestible format. In particular, the graphics in the Public Document should be simpler and cleaner, with the data sources and caveats hyperlinked to the technical document. The SAB suggests that a graphic approach patterned after the State of the Great Lakes document might be used. This approach would involve a color coding scheme, with all indicators presented as having (red), mixed/deteriorating (orange), mixed (yellow), mixed/improving (green), and good (blue) values. For, static indicators such as area, categories could reflect increasing and decreasing size instead of value.

The Public Report should do more than simplify the Technical Report (the SAB notes that the Public Report does not in fact simplify the Technical Report). It should generally summarize the state of human and environmental health today. It should also point to upcoming problems and solutions and discuss the tools used to understand the health of the planet, from molecular to ecological levels. The Public Report should also discuss the kinds of responses needed to address environmental problems. It is important that this be done without mitigating the responsibilities of all parties, e.g. the public, the government and corporate America.

In developing future versions of the ROE Public Report the SAB recommends that EPA identify and consider target audiences. The document must educate journalists, members of Congress, government officials, and other diverse audiences. Although the Technical Document can be made available on the internet, the Public Report should be made available in printed form. EPA should consider including a CD with the Public Report containing hyperlinks to internet websites where more information is available.

### Appendix A: Technical Corrections and Comments on the draft ROE

#### Page number

1-3: Exhibit 1-1. The method for averaging emissions is unclear (how are PM2.5 data and ozone data combined?) Were the emissions of secondary pollutants such as ozone included, or were the ozone precursor compounds used? There are many questions associated with the aggregate curve; it should be replaced with curves for individual criteria pollutants. Averaging is inappropriate here.

1-8: Exhibit 1-4. AQI is a poor measure when used in this fashion, particularly when essentially no changes were observed since 1989. Minor point – the method of plotting percentage implies error bars. Is the number of monitoring stations consistent throughout period? This figure is confusing and better omitted.

1-11: Exhibit 1-6. It would be better to show all years than two arbitrary groupings. If showing two groupings, 1982-1992 and 1992-2001 is preferred over the two overlapping periods shown.

1  
2 1-14: Exhibit 1-11. EPA regions are a poor choice for spatial averaging. The method of  
3 averaging is not clear.

4  
5 1-17: Exhibit 1-14. Benzene does not have a NAAQS.

6  
7 1-26: Exhibit 1-22 and 1-23. It is difficult to discern differences. It is better to plot differences  
8 directly, color coded, so that regions of increase/decrease, and magnitude of change, can be  
9 readily seen.

10  
11 1-34: Exhibit 1-26. The right hand side referred to as 1984 data in figure; 1994 in caption. Edit  
12 to correct value.

13  
14 2-9: List URLs for the existing programs on conditions of water resources.

15  
16 2-10: The examples in the side-bar of statistically-based examples really don't explain the  
17 statistical design of the programs. Rather than focus on the results, the focus should be on the  
18 actual design.

19  
20 2-11: The altered fresh water ecosystem indicator combines physical alterations (streams and  
21 wetlands) with land use alterations (riparian, lakes). Does this combination of apples and  
22 oranges present a conceptual problem? Is there a consistent approach that can be taken?

23  
24 How about other possible indicators? For example:

- 25 • Streams/rivers: ratio of current baseflow to prior baseflow
- 26 • Riparian zones: % continuous; % total area
- 27 • Lakes: % hardened shoreline
- 28 • Wetlands: % native plant species (current metric could have a wetland that was not  
29 physically altered but now totally covered by a monospecific stand of an invasive, and  
30 not be considered as "altered")

31  
32 2-12: Lake trophic state index usually has a very specific meaning (Carlson, 1977), which  
33 includes TP, chlorophyll a, and transparency. Given the focus on TP here, the use of trophic  
34 state index may be confusing. Might also note the possible limitations of using TP, how often  
35 and where samples are taken, and pros and cons of other parameters.

36  
37 2-14: Coastal wetlands should also include Great Lakes coastal wetlands; the ca. 1500 Great  
38 Lakes coastal wetlands totaling ca. 17,017 km<sup>2</sup> were ignored in the document. It seems as  
39 though the document was written in the year 2000 and then quickly updated with a few citations  
40 in 2001 making it very much outdated for its content. Huge leaps regarding these topics have  
41 been made in the past 4 or 5 years. For example, the U.S. EPA established a national  
42 bioassessment of wetlands working group (BAWWG), much of which deals with establishing  
43 standardized protocols for inland wetlands. They also established the Great Lakes Wetlands  
44 Consortium dealing with establishing standardized protocols for measuring the status and trends  
45 of Great Lakes coastal wetlands:

46 <http://www.epa.gov/owow/wetlands/bawwg/>

1 <http://www.glc.org/wetlands/>

2 <http://www.epa.gov/waterscience/biocriteria/States/wetlands/wetlands0.html>

3  
4 2-17: The figure is not very intuitive about how gains (especially) and losses are partitioned  
5 among the reasons.

6  
7 2-18: Section 2.2.3 recognizes the role that chlorophyll plays in SAV growth and distribution.  
8 Unfortunately, as indicated in the Chesapeake Bay SAV synthesis, suspended solids play an  
9 equally important role in many systems. Omission of this fact from the discussion and is a  
10 serious shortcoming in the discussion. Furthermore, an indicator for suspended solids is  
11 necessary to describe the condition of the water clarity.

12  
13 2-19: The figure needs more explanation for depth of measurement; possibly use SAV cover as  
14 an indicator (based on remote sensing or aerial photography data).

15  
16 2-19: The water clarity indicator is taken from the EPA Coastal Condition report. There are  
17 serious problems associated this indicator and it should not be used in its current form. In fact,  
18 the use of the indicator is qualified by stating that “the indicator does not account for naturally  
19 turbid conditions” and “low light penetration conditions are not necessarily associated with  
20 impaired aquatic health”. After seeing this qualifier, one is left questioning the value of  
21 information in the report.

22  
23 The problem is not with the indicator but rather the parameter used as the measure. It is not  
24 always possible to use the same level of parameter on a national scale. This is a situation where  
25 a regional or even a local value is necessary to develop the indicator and then the local indicator  
26 is aggregated up to a national scale.

27  
28 2-20: The dissolved oxygen (DO) indicator is taken from the EPA Coastal Condition report.  
29 dissolved oxygen is a valuable indicator however the values employed to develop the indicator  
30 are inappropriate for use on a national scale. Bottom DO varies depending upon the degree of  
31 vertical stratification and time of year. It is widely recognized that in waters from the  
32 Chesapeake Bay north, summer bottom DO should not fall below a site-specific value of  
33 between 3.2 and 3.8 mg/l. This range of values protects aquatic life and is considered safe for  
34 resident biota. Bottom water in the Gulf of Mexico can actually be a little lower and still be safe  
35 for resident aquatic life. It is misleading to rate waters in these areas less than “good” when they  
36 are below 5.0 mg/l but above the appropriate value. As with clarity this indicator should be  
37 developed at the regional level and aggregated up to the National level. Once again, this  
38 indicator was qualified by stating that “The relationship between threshold values and effects on  
39 aquatic life is neither well established nor expected to be consistent.” Statements such as this  
40 undermine the credibility of the ROE effort and such indicators should be modified or not  
41 presented at all.

42  
43 2-20: Another data gap would be time of day for sampling, as DO exhibits a strong diel pattern.

44  
45 2-21: Referencing the 15 ppb chlorophyll level as “equal to the restoration goal recommended  
46 for SAV restoration in the Chesapeake Bay” is inappropriate and not consistent with the goal

1 recommended by the Chesapeake Bay program. The value of 15 ppb was taken out of context  
2 from table in Batuik, et. al (2000). The table states emphatically that the recommended criteria  
3 for SAV restoration is a specific percent light penetration at a site-specific restoration depth.  
4 Chlorophyll levels necessary for SAV growth are site-specific and depend upon a combination of  
5 suspended sediment and chlorophyll values that enable the necessary percent light penetration at  
6 the site-specific depth of application. Furthermore the site-specific light penetration value and  
7 associated parameters are growing season averages. The draft ROE and the National Coastal  
8 Condition Report from which this data came does not indicate whether growing season averages  
9 or raw data scores were used. Therefore it is not possible to determine if the data correctly  
10 match the appropriate duration period.

11  
12 2-22: There is a disconnect between the figure and text; do the data deal with ocean or coastal  
13 systems? Chlorophyll is not indicative of species composition, so harmful algal blooms (HABs)  
14 may be missed.

15  
16 2-23: Additional considerations - eutrophication. The desired indicator is certainly desired and  
17 necessary however the presentation of the indicator as shown in the draft ROE does little to  
18 further it's development. The use of static measures on a seemingly arbitrary scale needs to be  
19 revisited and the indicator further refined. The document does qualify the indicator, raising  
20 questions about its use here. As correctly noted, "High scores may not be a true measure of  
21 eutrophication". It is also pointed out that "there is no strong scientific data to indicate that the  
22 thresholds used are indeed indicative of eutrophic conditions on a region-by-region basis." It  
23 may be possible that trend data may be more appropriately used here to show an increasing or  
24 decreasing trend rather than some arbitrary static measure. It is strongly recommended that the  
25 Agency develop this indicator further before incorporation into the future ROE.

26  
27 While this section discusses eutrophication, the reference to "these conditions" including sea  
28 grass decline needs the additional parameter of suspended sediment in order to fully capture the  
29 causes of SAV decline.

30  
31 2-24: It seems that the differences between urban and agricultural pressures are also due to the  
32 activities associated with each land use.

33  
34 2-25: a) The name of indicator may not be representative—perhaps "urban/developed land  
35 cover" would be appropriate. b) Why restrict this indicator to riparian buffer strip? Increasing  
36 urbanization or developed land cover has impacts throughout watersheds in terms of storm  
37 runoff and nonpoint source pollution. c) Wouldn't percent change over time be a better metric,  
38 assuming there are consistent baseline dates available? d) The spatial arrangement of the buffer  
39 zone (either what is left intact or removed) should be considered—contiguous zones vs. patches  
40 can affect efficiency of riparian zones. It is not just simply how much, but how it is arranged.

41  
42 2-26: Similar concerns to above. Why limit agricultural land cover to just riparian zone?  
43 Perhaps change detection over time would be a better indicator. Consider refining the  
44 agricultural land indicator to type of agricultural land use. Perhaps subdivide the indicator by  
45 relatively broad categories, such as row crops, Concentrated Animal Feeding Operations  
46 (CAFOs), etc.

- 1  
2 2-29: Sedimentation index. How often were samples taken per stream? Were these one-time  
3 grab samples, integrated over time, do they include storm events? More information is needed to  
4 assess the indicator.  
5
- 6 2-31: Atmospheric N deposition. It may be of use to note that although the absolute deposition  
7 rate is potentially useful, the percent of total N that is supplied by atmosphere is also important.  
8 A low rate in a very low N system may be of greater concern than a high rate in a very high N  
9 system.  
10
- 11 2-32: Nitrate concentrations. It is unclear when surface water samples were taken, how often,  
12 and whether they include storm events or are base flow.  
13
- 14 2-34: P also can be very important; the ROE should not focus exclusively on N in estuaries (see  
15 Smith, 1998 Pages 7-49 in: Successes, Limitations, and Frontiers in Ecosystem Science, Pace  
16 and Groffman (editors). How often were samples collected for this analysis? This section  
17 should be cross-referenced to page 2-37 indicator (TP in coastal waters).  
18
- 19 2-34: The section on total nitrogen in coastal waters includes Mid-Atlantic estuaries as well as  
20 near shore coastal waters. The use of arbitrary percentiles of distributions without regard to site-  
21 specific issues is misleading. EPA recognizes that each estuary reacts differently to nitrogen  
22 concentrations. The same nitrogen concentration would have a greater impact on water quality  
23 in the Chesapeake Bay than it would in the Delaware River. A more technically defensible  
24 approach to this dilemma would be to use a regionally derived end-point indicator (such as DO)  
25 for evaluations of good or bad, and then use trend data for the nutrient concentrations as warning  
26 signs to indicate whether the situation is getting better or worse. This is the approach being  
27 employed in the Chesapeake Bay. It provides more meaningful information and avoids the  
28 subjective and site-specific issues of quality.  
29
- 30 2-36: P in large rivers. It is good that sampling frequency was included, but the threshold for  
31 goal for impairment is too high.  
32
- 33 2-38: Sediment toxicity in estuaries. The indicator of sediment toxicity should be associated  
34 with the cause of toxicity. The references used contain information that can identify the causes  
35 of toxicity, including artificial toxicity due to sample manipulation and handling. It is not clear  
36 from the draft ROE how artifactual toxicity data was accounted for. Subdividing the toxicity by  
37 cause would provide invaluable information to the public and decision makers and improve the  
38 utility of the ROE.  
39
- 40 2-39: Hg. it is not clear how often data were collected, how many samples, variance, etc. in the  
41 data shown.  
42
- 43 2-40: The chemical contaminant data shown reveal nothing about absolute concentrations;  
44 shouldn't there be an explanation about a threshold or criterion that must be exceeded? Are  
45 these based on predicted environmental concentrations (PECs) or dose compliance  
46 concentrations (DCCs)? Do they exceed drinking water standards? Also, could these data be

1 shown as trends from '92 to '98?

2  
3 2-41: Pesticides in streams and groundwater. Detection does not necessarily translate into  
4 hazard. Why not use human health standards for the limits? Why use 0.01 and 0.1 ppb  
5 standards?

6  
7 2-43: This seems like an indicator that should be cross-referenced to the air emission chapter  
8 (for NOx and SOx).

9  
10 2-44: Toxic releases. This is a good example of how the metric may be quantifiable, but without  
11 more spatially explicit information, the data can be misleading. Even if overall release levels  
12 decline, unless those declines were proportional among all sites and regions, it is likely that  
13 certain areas may be getting worse even if overall trends are better. In addition, we may be  
14 reducing in areas that have gross release rates, but still not meeting ecosystem needs (similar to  
15 losing weight in obese people---first few pounds are easy to lose, but unless you lose a lot the  
16 overall health of a person may not be demonstrably improved).

17  
18 2-46: Sediment contamination. There is nothing included on Areas of Concern in the Great  
19 Lakes. Lots of EPA information is available and should be included.

20  
21 2-47: Sediment contamination of coastal waters. This report should recognize that for many  
22 older cities sediment contamination is largely the result of historical practices and activities.  
23 There are numerous studies in regions such as the San Francisco Bay and the Elizabeth River in  
24 Virginia that demonstrate vastly improving trends in sediment quality. This data should be  
25 mined and the appropriate indicators developed to capture these trends.

26  
27 2-53: Recreation in and on the water. This section discusses a number of sources of pathogens  
28 in recreational water but leaves off waste from domestic (urban pets) animals and wildlife.  
29 Studies from TMDLs are showing that animal waste is a major source of indicator organisms in  
30 all waters. That animal waste is originating from wild life (sea birds, deer, etc) as well as  
31 domestic pets.

32  
33 2-54: Section 2.4.2. What are the sources of recreational water pollution? It would be  
34 informative to note in the text that the sources identified and listed in this section account for  
35 only 25% of the total reported cases.

36  
37 2-56: Consumption of fish and shellfish. It would be useful to point out in this section that the  
38 mercury body burden of some marine species such as swordfish are natural and, according to  
39 studies cited on the University of California at Davis web site, have been stable for 100 years.

40  
41 3-3: Paragraph four: Change "a function of human needs and population density" to "a function  
42 of human needs, wants, and population density."

43  
44 3-3: Exhibit 3-1. In the figure caption, the line is labeled with the units "per acre mile," which  
45 cannot be an accurate measure.

46

1 3-4: U.S. population density map. This is a critical figure. Consider putting this figure in the  
2 introduction. This map should be the focal point for many analyses within this chapter. (Is there a  
3 map with changes in population density to see the drivers of change?) When phrasing the idea of  
4 "regional" analyses, the draft ROE mentions EPA Regions as the regional unit. Please use the  
5 resolution of the data to guide the definition of regions, and if the regional indicator can be  
6 displayed over the entire United States, use this map as the basis for the indicator because  
7 population density ultimately is the key driver for many environmental conditions (but not all).  
8

9 3-4: Exhibit 3-2. There's nothing wrong with this map, but it should be accompanied by a  
10 comparable map that shows the rates of change in population density. Data clearly show that the  
11 fastest rates of change have consistently (since the early 1800's, in fact) been in the West, a point  
12 that gets lost if only the static measure of density is presented. As has been mentioned  
13 previously, considerable revision is needed in the questions asked and indicators selected. It  
14 matters where the different ecosystems types are located, what their quality and size is, and what  
15 the adjacent ecosystem types are.  
16

17 3-5: Exhibit 3-3, list of indicators. With the tabular listing of the indicators, please include a  
18 column that references the page upon which it appears. This helps guide the reader through a  
19 long document.  
20

21 3-7: Text indicates that indicators were not identified for protected lands. Future ROE versions  
22 should be able to find indicators for both the extent and quality of protected lands by integrating  
23 data available from many of the sources in the box on protected lands on page 3-8, as well as  
24 non-government organizations such as World Wildlife Fund, The Nature Conservancy, the  
25 Wilderness Society, the Land Trust Alliance and the National Parks and Conservation  
26 Association. Most state governments and NGOs also have reports on the status of public and  
27 private protected lands.  
28

29 3-8: The box on protected lands should acknowledge that protected legal status does not always  
30 mean protection in reality. Conservation easements often only protect private land from major  
31 development, but do not restrict uses that can significantly degrade water quality and biological  
32 resources. In addition, the lands put under conservation easement are often already significantly  
33 degraded from a biological and ecological perspective, so the easement only conserves scenic  
34 views.  
35

36 3-9: Urban –suburban. There is no getting around the fact that land use categories ranging from  
37 urban to wilderness is a continuous gradient and that definitions are arbitrary. Definitions of  
38 suburban vary and recognition and discussion of the ones used, as on this page, is good. For land  
39 cover and fragmentation very low density (1 house/40 acres) is an increasingly used and  
40 important category. Although there might be little to do in the short term, the long term goal  
41 should be to classify land use along a continuous gradient of human use density (e.g., land in row  
42 crops is as dense as suburban in terms of habitat loss).  
43

44 3-10: Dot map of metro area boundaries and central cities, NRI. This does not add much  
45 beyond the map on page 3-4. The map on page 3-11 (change) is the one that is useful.  
46

1 3-12: Extent of urban / suburban lands. It seems that the 1km<sup>2</sup> pixel area as the minimum  
2 mapping unit for suburbs used in the Heinz report will miss capturing low density housing on a  
3 major scale. The age of this data is problematic. Perhaps data from the U.S. Census Bureau that  
4 would indicate the density of housing could be mapped.

5  
6 3-14: Extent of croplands. This graphic is a little odd in that the dots suggest something like  
7 point occurrences or towns, whereas this really indicates regions of nearly continuous  
8 agricultural land. Please consider alternate mapping form, although the map and the information  
9 are good to use.

10  
11 3-15: Change of extent of cropland, pastureland, CRP. This graphic shows little change, yet  
12 there has been a massive shift away from pastureland in the eastern tallgrass prairie region of the  
13 Midwest that has resulted in a strong decline in grassland associated birds of this region. This is  
14 the type of national indicator that misses critical changes. Mapping change in pastureland by  
15 county would be ideal. A spline fit of the change that was then mapped as isoclines would be  
16 nice.

17  
18 3-16: Percent change in cropland. This is a great map. The report needs more like it.

19  
20 3-17: Cropland extent. Surely the USDA has county level statistics on row crop acreage. This  
21 would be a variable indicator that changes because of changing cropping patterns and farmland  
22 economies, but it would still be a good indicator of an important variable in land use because row  
23 crops receive so many more chemicals than pastureland.

24  
25 3-18: Extent of Grassland Shrubland. This says relatively little regarding extent or condition.  
26 The graph is overly complex; stacking the bars would suffice and allow you to assess this at  
27 different time periods to denote change. In capturing trends in the extent of the categories, this  
28 would be strengthened by a geographical presentation as there are ecoregions where this is likely  
29 to be more important than others.

30  
31 3-19: Forest extent. Regional information on amount of forest is fine, and would be even better  
32 if there were graphed data for more than one time. The text talks about the change in forest  
33 acreage since 1987. It would be nice to show what regions that has occurred in. It is not clear  
34 why public vs. private ownership matters. Inclusion here seems to imply that there is little the  
35 government can do to protect forests since so much is privately owned. Exhibit 3-10 in current  
36 form does not bring added value and should be deleted.

37  
38 3-20: Exhibit 3-11. This figure also does not improve understanding of forest extent or quality  
39 and should be deleted. Data on the amount of timber that is certified as being sustainably  
40 harvested from public and private land would be of greater value in terms of indicating potential  
41 environmental impacts in forests.

42  
43 3-20: Timber harvest. If timber harvest is disaggregated by forest types, even hardwood vs.  
44 softwood, interesting trends can be observed as U.S. timber harvest increases in softwoods and  
45 decreases in most hardwoods.

1 3-20: This section requires an indicator on the extent of change, or status of change of plant  
2 community types (habitats) at risk. The USDA has reported on this (Reed Noss, author).  
3 NatureServe (contact Denny Grossman) has plant community threat ranking information that  
4 would be useful here as well.

5  
6 3-21: Section 3.1.5 - Human health effects associated with land use. This section is weak. For  
7 example, trends in work related health problems in the agricultural and forestry industries would  
8 be a good indicator. It may not work for this report, but it would be an indicator. So, EPA  
9 should think more about the question, in the broad sense, then write carefully about why what we  
10 might think of as indicators do not work for this report. There should be a section like this for  
11 each land use category.

12  
13 3-21: Section 3.1.6 - Ecological affects associated with land use. There should be a section like  
14 this for each land use category. This has a very specific introduction that suggests that sediment  
15 runoff is a good indicator in general for this. It is a good indicator for agricultural land. Thus,  
16 this should be a subsection of agricultural land.

17  
18 Other good indicators:

19 Agricultural Lands:

20 Change in sediment run-off potential (as presented)

21 Change in acreage of organic farms (USDA)

22 Change in streamside buffer strips

23 Change in fertilizer / pesticide sales (as a measure of application)

24 Grasslands

25 Changes in leased acreage or total stocking of federal grazing lands (Bureau of  
26 Land Management [BLM] and U.S. Forest Service [USFS])

27 Changes in Invasive species spread, or acreages infested (BLM and USFS)

28 Changes in grassland Associated bird populations (Breeding Bird Survey [BBS];  
29 see papers by J. Herkert on this issue.)

30 Forests:

31 Changes in patch size (L. Iverson; USFS, Delaware, OH may have statistics, may  
32 have published them.

33 Changes in stocking rates of trees (FIA)

34 Changes in number of acres listed as fire hazards (USFS)

35 Population trends in forest associated birds and neotropical migrant birds (BBS).

36  
37 3-26 and 3-27: Exhibits 3-15 and 3-16. Some consistency needs to be developed in how data  
38 are presented. There is no logic in presenting some data as histograms and others as line graphs.  
39 Exhibit 3-16 should be changed since it implies what the values would be for 1992, 1994, and  
40 1996, which are not actually known.

41  
42 3-27: Exhibit 3-16. Printing the cumulative % change is misleading. This is a % change from  
43 1991, but could be interpreted, if not read carefully, to imply and increasing rate at which this is  
44 decreasing. If anything, this should report the time interval % change.

45  
46 3-28: Agricultural pesticide use. This is a good indicator, but one has to be very careful here in

1 that a change, up or down, could reflect changes in environmental management or impact, but  
2 could also mask effects if the response unit is pounds and the dose changes between chemicals  
3 (i.e., switching chemicals for a control may alter the pounds, or the impact per pound). That  
4 problem is difficult to solve.

5  
6 3-31: Pesticide residues in food. This is an important indicator and would benefit from graphic  
7 presentation.

8  
9 3-33: Potential pesticide runoff. Is there an indicator available that does include fruits, nuts and  
10 vegetables. There are parts of California, Florida, Michigan and elsewhere that would be wholly  
11 misrepresented because they focus on something other than the big grains (Napa valley and  
12 grapes, for example). It would be excellent if the text could include a few actual pesticide runoff  
13 values and compare them to the potential values to help the reader take the potential estimates  
14 seriously. The text should explain why a potential impact is being used here (and in exhibits 3-  
15 20 and 3-21), while most of the report is focused on actual values (e.g., because the issue is so  
16 critical and actual data not available at national scale).

17  
18 3-37: Section 3.2.5 - Human health effects associated with toxic substances. Organizationally,  
19 EPA should put this under Agricultural land. Data from poison control centers appears to be an  
20 indicator. Why not treat it as such?

21  
22 3-37: Persistent bioaccumulative toxic chemicals. EPA has missed a couple of very important  
23 data sets here. First, it is important to track eggshell data on birds that were susceptible to DDT  
24 (e.g., peregrine falcons). Joel Pagel (USFWS, Los Angeles) would know where these data are.  
25 There is also data on bioaccumulation in marine birds and mammals from Alaska. There is  
26 probably more elsewhere. Keith Miles, University of California at Davis knows about these  
27 data.

28  
29 3-38: Nitrogen runoff from farmlands. This section seems to get disorganized. Creating a  
30 similar construct to Chapters One and Two should help. Doesn't EPA track data on factory  
31 farms (concentrated animal facilities) and their pollution exports? This would be a good  
32 indicator here. Not capturing the rise of the concentrated animal facilities and discussing  
33 pollution concerns regarding them is an obvious omission from this report.

34  
35 3-40 and 3-41: It was difficult to determine which type of waste includes automobiles.

36  
37 3-45: Exhibit 3-28. Aren't there data on this metric from before 2000? A trend on this would  
38 be as interesting as a static measure.

39  
40 3-47: What is the extent of contaminated lands? It would be helpful to see a geographic  
41 presentation of where contaminated lands are. The lack of a treatment of contaminated  
42 groundwater is an obvious omission. Something should be said about it.

43  
44 3-49: The superfund information. This implies that we are getting a good grip on superfund  
45 sites. One would wonder if the problem is getting better or not because we could be generating  
46 new superfund sites at a rate that exceeds their rate of cleanup. While there has been good

1 control on this, it would be useful to report on the year(s) of superfund creation to show that the  
2 development of new superfund sites is on the decline.

3  
4 3-52: Exhibit 3-31. This exhibit is was interesting in showing how close some of the estimates  
5 were, and how different others were. It helps the reader understand the challenges in preparing  
6 this report. Similar comparisons for other ecosystems or issues could be included in the report.

7  
8 3-52: This says that data on protected lands of different types and levels of government do not  
9 exist. The data likely exist, but have not yet been integrated in a format that is readily useful to  
10 EPA.

11  
12 5-12: Extent of area by forest type. There are classifications by type, and assessments of area by  
13 type. Here EPA aggregates by type and lumps everything uncommon into "other". It may be  
14 better to capture "other" and try to detect which of the low abundance types are declining.

15  
16 5-14: Forest Pattern and Fragmentation. The program FRAGSTATS is used specifically to look  
17 at attributes of fragmentation and has been applied by USFS researchers on US forests. Contact  
18 Louis Iverson (USFS, Delaware OH) for details.

19  
20 5-15: At risk native forest species. "Too little is known about plants" is not really accurate. No  
21 one has aggregated the data, but habitat associations for all plants is, in fact, known. The Biota  
22 of North America Project (BONAP, John Kartesz) manages the floristic database for  
23 NatureServe rarity rankings. They may have this habitat information. Certainly, this can be  
24 done by region. Also, why not use the United States endangered species list is for part of this?

25  
26 5-15: Exhibit 5-8. This does not tell us much. Try for a geographical presentation of the  
27 distribution of rare species.

28  
29 5-16: Exhibit 5-9. This needs to be labeled "change in diameter class sizes for representative  
30 forest species". Also, it is quite unclear.

31  
32 5-18: Exhibit 5-11. This is a good indicator. Can EPA go back and distinguish stress due to  
33 pollutants from climate, disease and others?

34  
35 5-19: Exhibit 5-12. Ozone injury. Even bad ozone problems would not manifest much in some  
36 areas owing to lower industry. Mapping damage would be the ideal. For example, damage is  
37 probably highest downwind from major industrial cities. This is good, but would be better with a  
38 map of the response.

39  
40 5-20: Carbon storage. This, of course, makes the most sense as an indicator with global change.  
41 It is essential to deal with climate change. This is also an area where an international comparison  
42 is possible.

43  
44 5-21: Soil Compaction. It would be ideal to restrict this to forests that are actually harvested.  
45 Alternatively, compare harvested and unharvested stands. This is the sort of indicator that  
46 requires some comparison to background expected. This comparison probably would show

1 forests to be in good condition, but it is hard to interpret without some context.

2  
3 5-22: Soil Erosion indicator. The indicator seems like a good idea. However, given the data  
4 limitations, this isn't worth reporting because EPA claims it misrepresents forested lands. EPA  
5 should try to use some estimate of error, report that, and provide details about the error estimate  
6 in the appendix B. Alternatively, EPA should decide it isn't reliable and discard it. It seems  
7 that this should be presented under "Forest Condition", as should all measures using forest health  
8 monitoring (FHM) data.

9  
10 5-23: Processes beyond the normal range of variation. Although the idea of this indicator is  
11 sound, this does not tell us anything. If related to climate change, then it might have some  
12 import. As it stands, it seems out of place.

13  
14 5-24: Landscape condition. The text states that "...although the acreage of some of the types of  
15 forests have changed, none are currently at risk of being lost." This is strictly true of the data  
16 presented, but badly misleading. Certainly there are forest types that are at risk of being lost  
17 (See NatureServe data). Since EPA lumps all rare types, EPA only assesses exceedingly  
18 common ones. This is a bit like surveying fast food restaurants to see how often they go out of  
19 business; create McDonalds, Burger King, three others and lump every independent restaurant  
20 into an "other category". The answer would be that no one ever goes out of business, which  
21 would be erroneous.

22  
23 5-24: Biotic condition. EPA reports that no reliable data set exists on forest stream biota. This  
24 seems very odd. Certainly there are many indicators of biotic integrity, from the endangered  
25 species list to the NatureServe rankings. "Precious Heritage" has published lists of the fraction  
26 of species at risk. These data clearly show that aquatic organisms, in general, are in rough shape.  
27 To report that there are no indicators available for forest streams seems to be an overly narrow  
28 slice of the pie. If EPA reorganizes to create biodiversity measures by region, by taxonomic  
29 group, or nationally, EPA would not be boxed into these kinds of statements that, while strictly  
30 true, are uninformative and misleading.

31  
32 5-25: Farmland Landscapes. EPA is assessing ecological condition of a landscape here. This is  
33 very different from other sections where EPA assesses condition of an ecosystem. This section  
34 will require indicators of pastureland change and forest fragment change and condition. One  
35 approach would be to create a set of polygons around regions that are dominated by agricultural  
36 lands and then assess landscape condition and biotic condition in these regions. That would  
37 require de novo analysis.

38  
39 5-26: Right column, 2<sup>nd</sup> paragraph "Unfortunately, there is no single, definitive, accurate  
40 estimate of the extent of cropland." That seems to be a weak excuse. There are many. They  
41 vary for sensible reasons. EPA should choose one, justify the choice and use it.

42  
43 5-26: Why not map the nitrogen leaching into groundwater? EPA has a map of groundwater  
44 leaching potential that can be used.

45  
46 5-29: Exhibit 5-17. Despite the fact that soil quality index (SQI) scores from 1994 and 1995

1 were calculated using “different calculation procedures and sampling variability.”, sampling  
2 variability suggests that EPA can estimate a confidence interval and compare the two. Given  
3 that this is just one year, any trends are likely to be insignificant. Thus, this reads as if it is due  
4 to index calculation. The differences between these years is large and consistent. Pick one year  
5 and report it. Otherwise, this just lacks credibility. Frankly, many read as if they were written so  
6 as to best minimize credibility and that is disturbing.

7  
8 5-31: Near bottom, right column. “... Agricultural lands ..highly managed, .. no natural  
9 reference exists.” The point is not a natural reference, it is trend in condition data. This is not a  
10 sufficient justification for a lack of indicators.

11  
12 5-32: Grassland / Shrubland indicators. EPA identifies stressors (non-native species,  
13 desertification, groundwater depletion, overgrazing). There are indicators of all of these. They  
14 are likely to be either regional, or require assembly and analysis on a national level. Look  
15 beyond the Heinz report to USDA, USFS, BLM statistics.

16  
17 5-33: The table on page 5-33 is somewhat misleading. It argues that we need more data, but it  
18 also fails to get at data that really do exist, just not previously published in a national report.

19  
20 5-34: At risk grassland species. As in animals, there is better data. BBS can identify grassland  
21 birds and EPA could examine trends in those species. NatureServe could also identify grassland  
22 associated species (perhaps even plants using Biota of North America Program [BONAP]) and  
23 do a better job.

24  
25 5-35: Declining birds. EPA misses an important interpretation here. Although native and non-  
26 native birds aren't really doing anything different (except for the latest time period), grassland  
27 birds have been markedly declining since the 1980's. That is an important trend that probably  
28 reflects the concentration of animals and the loss of pastureland regions.

29  
30 5-37: Ecological condition of urban / suburban areas. See R. Primack on plants in New York  
31 City and regions. See R. Blair on birds and butterflies in San Francisco. The Baltimore and Long  
32 Term Ecological Research Programs (LTER) , the urban to rural gradient in New York City, and  
33 other individual studies provide a means to assess ecological condition within selected urban  
34 environments.

35  
36 5-38: Summary on urban indicators from previous chapters. The three final bullet points on the  
37 right are reported in a funny way. What is the minimum acceptable nitrate concentration, 0.1? If  
38 so, then 97% of the 21 urban streams failed. If the phosphorus concentration is 0.1, 67% failed  
39 (why use “two-thirds” here and 40 and 25 percent above if not to underplay the large number?).  
40 For contaminants, 85% or 100% failed, depending on our standards, which aren't reported. This  
41 is a compelling case that urban surface waters fail our standards for water quality. Don't sugar  
42 coat it.

43  
44 5-38 to 5-40: Index of Biotic Integrity (IBI) indicator. The report correctly identifies that  
45 expected biotic diversity in urban streams is lower than for other traditional free flowing streams.  
46 However the IBI scores for all systems were aggregated into one indicator. This aggregation

1 results in a loss of valuable information which could be used to demonstrate the potential adverse  
2 relationship between urbanization of the landscape and the loss of biologic diversity instream.  
3 The aggregation can also be interpreted as indicating that those urban systems could be restored  
4 to the level of diversity that they had before development. It is recommended that an indicator  
5 be developed to measure the shift of streams from natural to urban (such as the % of stream  
6 miles as urban) and then segregate the IBI score indicator by stream types. This combination of  
7 indicators would provide data on the loss of streams to urban encroachment and the associated  
8 loss of diversity as well as provide a measure of the relative health of each type. For example,  
9 what percentage of urban streams had good or bad IBI?

10  
11 5-39: Exhibit 5-23. Patches of habitat within urban lands. EPA's interpretation under "what the  
12 data show" contains a logical error. The "large" bar is taller in the Northeast than others, but  
13 these are percentages of "natural lands." Let's say that the Northeast has no natural lands, but  
14 those that exist are big (Meadowlands, Central Park, Jamaica Bay). The result would be that a  
15 relative high proportion of these would be large, even though other regions had more large areas,  
16 and more small areas (San Francisco, for example). So, it may be better to express as acreage  
17 and not a proportion of the regional total.

18  
19 5-40: Top left: "...but their overall condition, nationally or even regionally, is virtually  
20 unknown." This is just wrong. We know more about urban areas than most. The data are just  
21 varied and scattered.

22  
23 5-42: Right column - "Urban development accounted for an estimated 30% of all wetland  
24 losses....". The report would benefit from an indicator of trends in wetland losses in urban and  
25 other areas over the last few decades.

26  
27 5-43: Top left - Dams, impoundments. There may not be readily available published figures,  
28 but there are estimates. The data on what proportion of lakes are oligotrophic lacks meaning  
29 because we do not know what we should expect. Is this high or low? Why not use the EPA data  
30 on impairment?

31  
32 5-45: Extent of ponds, lakes and reservoirs. This is out of place and belongs in the extent  
33 portion of chapter 2, but is also a bit of a nonstarter in that lakes and reservoirs are not to be  
34 equated, and that error rate relative to the other data EPA reports is 100% (indicator gaps and  
35 limitations).

36  
37 5-46: At risk freshwater native species. Use the NatureServe data by taxonomic group.  
38 Lumping them together gives an unrealistically favorable impression of the condition of aquatic  
39 biota because of the large number of some groups of species with relatively low risk. A large  
40 number of these groups are very threatened, but contain fewer species, and this simply misses  
41 this obvious point.

42  
43 5-49: At risk freshwater plant communities. Once again, NatureServe has better data. The  
44 USDA (Reed Noss, lead author) reported on this a few years back.

45  
46 5-52: Landscape condition. The Heinz report may have declined to pick any one of the several

1 acceptable methods for stream classification. Nonetheless, they exist and EPA should pick one  
2 and use it.

3  
4 5-52: Left column. No fish caught in 16% of streams. Is this an indicator, or do we not expect  
5 to catch fish in these streams? EPA's next report should make this determination.

6  
7 5-53: Oceans. Look to the Pew Oceans Commission for new indicators on the state of the  
8 Oceans. This is an area where EPA can compare U.S. ocean waters to International waters.

9  
10 5-57: Coastal Living habits. Coral Reefs. There is an abundance of reef information. Check  
11 "Shifting Baselines." They have a website with resources. There is good data on Pacific  
12 estuaries and invasion by *Spartina* and *Caulerpa* and seagrass beds in Southern California, as  
13 well as invasion in transportation bays, such as San Francisco Bay through ballast water. There  
14 is an abundance of knowledge on habitat loss in nearshore environments along the Pacific.  
15 Knowledgable people are concentrated at the Bodega Bay Marine Lab (Don Strong, Susan  
16 Williams, Ted Grosholz,...), although others exist. Their reports are peer reviewed and  
17 published. Similar studies have been done on the east coast. his comment applies throughout  
18 this section.

19  
20 5-64: Ecosystem condition of the nation. Here is where EPA misses the opportunity to use  
21 many good indicators. EPA mentions neo-tropical migrants in the introduction, but then does  
22 not analyze the Breeding Bird Survey data on them. Why?

23  
24 5-69: Exhibit 5-42. Please consult the authors of the original data on this figure. It does not  
25 make sense. The figures a-c, at a glance, are virtually identical (aside from the pacific ~1998).  
26 We expect growth to vary with climate, but we don't expect climate to be uniform across the  
27 continent. We expect normalized difference vegetation index (NDVI) to vary because of cloud  
28 cover or other instrumentation errors, but we hope to minimize those. So, what drives the very  
29 similar patterns across regions? If they were a continuous trend, that would suggest a driver.  
30 This variability makes one suspicious of whether or not it is real.

31  
32 5-72: It is good to see the report attempt to synthesize all the information presented for each of  
33 the six Essential Ecological Attributes into some assessment of the national condition for that  
34 attribute across all ecosystems (although no data is presented for 2 attributes). It would be great  
35 if Exhibit 5-44 on page 5-75 did not merely have indicator categories in each box, but instead  
36 had some assessment of condition in each box.

37  
38 5-72: Biotic condition. This section is unfairly disparaging. There is a wealth of information  
39 available that was not used in this report. We know considerably more than this report suggests,  
40 and the biotic condition of most systems is considerably worse than this report suggests.

41  
42 5-74: Vertebrate deformities. Isn't there data on eggshell thickness and birth failure in large  
43 birds (pelicans, eagles, peregrine)? These would all be non-target effects. There are likely lots  
44 of case studies of non-target effects of herbicides and pesticides.

45  
46 5-76: There are figures on the estimate rates of harmful algal blooms through time. Why aren't

1 these used?  
2  
3

#### 4 **Appendix B: Specific Comments Referring to the draft Public Report**

5

6 A major deficiency in the public document is the lack of qualifying language for some of the  
7 indicators. The technical deficiencies in the National Coastal Condition Report that were  
8 outlined previously in Appendix A should be explained. The technical document did provide  
9 qualifying language concerning the limitations of those indicators. Unfortunately the qualifying  
10 language was not included in the public report. The public report therefore presents an inflated  
11 sense of the accuracy of these indicators. Lack of qualifying language for these indicators is a  
12 serious omission.

#### 13 14 Page

15  
16 i: Executive Summary. The report does not meet one of its stated purposes, communicating how  
17 to better “manage for environmental results”. SAB does not think that the report should focus  
18 on this issue.

19  
20 ii: The cleaner air summary has too much focus on how quality has changed, and not enough  
21 description of the what our current air quality is.

22  
23 iii: The average reader will not understand the opening statement; that we know a great deal  
24 about the condition of water at the regional, state, tribal and local levels, but we don't know the  
25 national status. The average person would ask why?

26  
27 iv: The opening box summary talks about EPA's role in protecting land, and not about the status  
28 of land (in contrast to the air and water opening boxes). The report should not talk about EPA's  
29 role here.

30  
31 x-xi: The public report could use lots of graphics like exhibit I-2, that put data in a geographic  
32 context. Unfortunately, with the exception of the Great Lakes pie chart, the data presented on  
33 these two pages have nothing to do with the maps on which they are placed.

34  
35 1-2: The section opens with the question “how clean is the air we breathe?”. The apparent  
36 answer “cleaner than 3 decades ago”, does not answer that question.

37  
38 1-6: Pollution is not only impairing visibility in national parks; it affects visibility in cities too.

39  
40 2-6: Overall Condition of estuaries and Great Lakes. This presentation used the results of the  
41 National Coastal Condition Report that had numerous qualifiers concerning the accuracy of the  
42 indicators as true indicators. The absence of any of this language in the presentation of the report  
43 seriously undermines the credibility of the public report.

44  
45 Pg: 2-7: Dissolved Oxygen and Clarity. The manner in which these indicators were developed  
46 undermines their utility as indicators of “good or poor” conditions. The Technical report

1 actually provided information about this shortcoming, but the omission of the DO and clarity  
2 qualifier in the public report calls into question the objectivity and utility of this report.

3  
4 Pg 2-11: What are the ecological effects associated with impaired waters? This section deleted  
5 the discussion in the technical report that recognizes that urban waterways have reduced  
6 diversity due to their very nature, and that it is unreasonable to expect urban waters to have fish  
7 and benthic diversity comparable to more pristine waterways. The public report missed a  
8 valuable opportunity to educate the public about the impact that urbanization has on aquatic  
9 systems. Prevention is the key to this problem and this discussion could have played a major  
10 role in that activity.

11  
12 5-5: Seems like the draft ROE is “mixing apples and oranges”. For most ecosystems, the focus  
13 is on area of overall system, but for coastal the draft ROE includes biotic elements (SAV); this  
14 could create confusion due to lack of consistency.

15  
16 5-6: column one has switched from ecosystem type to land cover type; was this intentional?  
17 Why are wetlands broken out from fresh waters in this table, but aggregated with it in text?

18  
19 5-7: Define what is meant by imperiled or critically imperiled. Does this have a quantitative  
20 component?

21  
22 5-7: Biotic Condition . The EPA missed an invaluable opportunity by not providing a  
23 discussion of the status of fish stocks and the role that fish stocks have on water quality. The  
24 Essential Ecological Attributes currently focus on the role of human management activities have  
25 on water quality through the alteration of the physical and chemical aspects of the environment.  
26 However it is well established that human management of the biological systems (fisheries) has a  
27 role affecting water quality. Reductions of filter feeders and grazers though harvesting adversely  
28 affects water quality, and this role needs recognition in the ROE. The public report provides an  
29 excellent opportunity to educate the public as all aspects of the environment and our impact on it.

30  
31 5-9: Consider using ppm instead of mg/L—it is easier to understand for lay audience.

32  
33 5-10: Use a figure to explain role of solar energy instead of text.

34  
35 5-11: Exhibits 5-7 and 5-8 should be better coordinated to use same scale of units, and with  
36 better explanation of what yield and load mean. Load, in particular, can confuse the general  
37 public, so care must be taken to differentiate that high loads may be due to discharge,  
38 concentration, or both. Is the high load in the Mississippi because of its discharge or  
39 disproportionate concentrations?

40  
41 5-18: The parallel with GNP or a similar macroeconomic index is not yet appropriate. To have  
42 a macroecological index, one would need to aggregate at a higher level than is being done here—  
43 perhaps take the individual indices for each ecological condition and sum, or weight  
44 appropriately, to develop an entirely new index.

## References

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Bryant, D.G. et al. 1999. *Reefs at Risk: A Map Based Analysis*. World Resource Institute  
[www.wri.org](http://www.wri.org)

Canfield, R.L. et al. 2003. Intellectual impairment in children with blood lead concentrations below 10ug per deciliter. *New England Journal of Medicine*. 348:1517-1526.

Carlson, R.E. 1977. A trophic state index for lakes. *Limnology and Oceanography*. 22:361-369.

Environment Canada and U.S. EPA. 2001. *State of the Great Lakes 2001*. EPA 905-R-01-003,  
<http://binational.net/sogl2001>

Pace, M.L., and P.M. Groffman, eds. 1998. *Successes, Limitations, and Frontiers in Ecosystem Science*. Springer, New York.