

June 2009

Issues for Initial Consultation with the
SAB Advisory Committee on
EPA's Report on the Environment

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DISCLAIMER

This issue paper does not represent and should not be construed to represent any Agency determination or policy. This issue paper has not been externally reviewed. The information is being provided to assist the Science Advisory Board Advisory Committee in its initial consultation on the scientific issues surrounding the future direction for and content of EPA's Report on the Environment.

TABLE OF CONTENTS

SECTION 1. INTRODUCTION.....	1
SECTION 2. PURPOSE AND OVERVIEW OF EPA’S ROE	3
2.1 ROE Future Directions.....	3
2.2 Purpose of EPA’s ROE	3
2.3 2008 ROE Framework	5
2.4 ROE Questions and Indicators	7
2.5 ROE Review Procedure	7
SECTION 3. RESTRUCTURING THE ROE	8
3.1 Aligning the ROE with the Agency’s Strategic Architecture	9
3.2 Example One: Drinking Water	11
3.2.1 ROE and the EPA Strategic Architecture	11
3.2.2 Using a Drinking Water Conceptual Model to Support Planning, Problem Formulation, and Decision-making.....	16
3.3 Example Two: Outdoor Air.....	19
3.3.1 ROE and the EPA Strategic Architecture	19
3.3.2 Using an Outdoor Air Conceptual Model to Support Planning, Problem Formulation, and Decision-making	25
SECTION 4. PROPOSED USE OF SUPPLEMENTAL INFORMATION	28
APPENDIX A. TEXT OF MEMO FROM EPA ADMINISTRATOR CHRISTINE TODD WHITMAN, NOVEMBER 13, 2001	30
APPENDIX B. CHRONOLOGY OF ROE REVIEWS, 2003-2008	32
APPENDIX C. EXCERPTS FROM EXTERNAL COMMENTS ON ROE/INDICATOR INFORMATION AND AGENCY PLANNING	33
APPENDIX D. EXAMPLE: ALIGNMENT OF ROE QUESTIONS AND AGENCY OBJECTIVES	34
APPENDIX E. EXCERPTS FROM SAB COMMENTS ON CONCEPTUAL FRAMEWORKS IN THE 2008 ROE	38
APPENDIX F. ROE INDICATORS.....	40
Excerpts From SAB Comments on Indicator Criteria in the 2008 ROE.....	40
EPA’s Rationale for 2008 ROE Indicator Selection and Proposed Changes	41

Section 1. Introduction

The U.S. Environmental Protection Agency (EPA) created the Report on the Environment (ROE) to provide relevant, science-based indicators and information to inform Agency planning and decision-making and to inform the public about progress toward EPA's broad environmental goals. EPA's *2008 Report on the Environment* (the ROE or the Report) uses indicators to describe trends in the environment and to answer questions that are fundamental to EPA's mission to protect human health and the environment. The *Electronic Report on the Environment* (eROE) (www.epa.gov/roe) is the online, interactive companion to the hard copy Report and is the source for the most recently updated indicator information.

ROE indicators are supported by data collected by a range of federal agencies, states, and nongovernmental organizations (NGOs). All of the indicators were peer reviewed against rigorous criteria for utility, accuracy, representativeness, and reliability. In 2006 and 2007, the entire report received interagency and Science Advisory Board (SAB) reviews and public comment. The comments were generally favorable and many of the recommendations from these reviews were incorporated into the final 2008 ROE. For those recommendations and concerns that could not be addressed in time for the 2008 release, EPA requested a standing SAB Committee to provide ongoing consultation and advice for consideration in developing the 2012 ROE. EPA intends to seek advice from the Committee on a number of issues as the 2012 ROE is developed. The Agency also intends to request that the Committee review the entire report before it is published.

This discussion paper provides information to frame several issues for EPA's initial consultation with the Committee. EPA's Office of Research and Development (ORD) is seeking early consultation with the SAB on conceptual models for restructuring and refining the next version of the ROE in order to better support Agency planning, problem formulation, and decision making and make the conceptual underpinnings of the questions and indicators clearer to the reader. ORD is also seeking consultation with the SAB on the proposed use of supplemental information to help answer ROE questions.

This paper describes how EPA proposes to restructure and refine the next version of ROE. The paper contains two generalized examples of conceptual models to illustrate the scope of the questions and to select indicators. One example is a conceptual model framing the 2008 ROE question, "What are the trends in the quality of drinking water and their effects on human health?" The other example is a conceptual model framing the 2008 ROE question, "What are the trends in outdoor air quality and their effects on human health and the environment?"

The paper is organized as follows:

- Section 2: Purpose and Overview of EPA's ROE
- Section 3: Restructuring the ROE
- Section 4: Proposed Use of Supplemental Information

Appendices to the report present additional detail about the history of the ROE and SAB Panel recommendations on the Report.

Future meetings of the SAB Advisory Committee on EPA's Report on the Environment will address systematic treatment of indicator uncertainty, issues regarding scaling and sub-national indicators, questions pertaining to ecological condition, and the inclusion of a synthesis and integration component of the ROE. The input from these consultations will be used as EPA revises the eROE and prepares for another major release of EPA's ROE in 2012.

Section 2. Purpose and Overview of EPA's ROE

To accomplish its mission to protect human health and the environment, EPA must pay close attention to trends in the condition of the nation's air, water, and land, and to related trends in human health and ecological systems. To meet this need, EPA embarked on an initiative in 2001 to ask and answer important questions about trends in the environment and human health that are important to EPA's mission (Appendix A). The ROE consists of multiple products; the Office of Research and Development (ORD) was responsible for producing the technical document (*Draft Report on the Environment Technical Document*), intended for environmental professionals, and the Office of Environmental Information (OEI) took the lead in developing a highlights document (*Draft Report on the Environment*), intended for a public audience. The Agency released these draft reports in 2003. Since then, EPA has revised, updated, and refined the ROE in response to scientific developments and feedback from the SAB and other stakeholders. EPA released *EPA's 2008 Report on the Environment* on May 20, 2008. The *2008 Report on the Environment: Highlights of National Trends* document (ROE HD) was released on September 24, 2008.

In September 2008, EPA released the online companion to the hard copy ROE—the electronic Report on the Environment or eROE (www.epa.gov/roe). This dynamic Web site allows users to navigate and query the content of the ROE and provides the public access to a wide range of environmental trend data in one location. The eROE contains the most current indicator data, which are updated quarterly as new data arise. (Data included in the 2008 ROE hard copy report are as recent as October 2007.)

2.1 ROE Future Directions

EPA intends to publish the next full edition of the ROE in 2012. As the project continues, greater emphasis will be placed on making future reports more useful not only to the Agency but also to the public and EPA stakeholders. For example, EPA plans to enhance the indicator information to include quantitative uncertainty information, displaying indicators in a geospatial format, and presenting indicators, where possible, at sub-national scales. In the meantime, EPA is committed to providing the most current indicator information on the eROE Web site. Indicator updates are provided on a quarterly basis as new data become available. This involves the addition of new data points (over time) to any of the current 85 indicators. On an annual basis, EPA issues a call for indicator additions, revisions, and deletions to the existing 85 indicators in the 2008 ROE.

2.2 Purpose of EPA's ROE

The ROE helps to inform planning and decision-making within the Agency by presenting the status of and trends in environmental and human health conditions of interest to the Agency. The Agency has worked toward incorporating the findings reported in the ROE indicators into EPA's strategic planning activities (including the development of quantitative strategic targets) since the first Draft Report was issued in 2003 (see Box 2-1).

Box 2-1. Excerpts from EPA Strategic Plan Documents on the Importance of the ROE

"The Agency's work on environmental indicators and Draft Report on the Environment are critical steps in our more comprehensive effort to identify priorities, focus resources on areas of greatest concern, manage our work effectively to achieve measurable results, and report regularly on our progress to the American public. In the coming months, we will be consulting with partners and stakeholders on how best to align and integrate our environmental indicators work with our strategic planning."

2003-2008 EPA Strategic Plan (<http://www.epa.gov/ocfo/plan/2003sp.pdf>)

"In EPA's *2009-2014 Strategic Plan* update, The Agency is focusing on a limited number of targeted areas where we believe new or significant changes in strategies or performance measurement are most critical in helping the Agency better achieve and measure environmental and health outcomes...In developing this set of targeted areas, EPA considered data and analyses from many sources, including program priorities, trend analyses, and scientific data and reports. One important source of information was EPA's *2008 Report on the Environment* (RoE). Many of these targeted areas are supported by environmental indicator information in the RoE."

2009-2014 EPA Strategic Plan Change Document
(http://epa.gov/ocfo/plan/pdfs/strategic_plan_change_document_9-30-08.pdf)

The value of aligning ROE indicators with planning and performance measures is recognized at the Agency program level as well. An independent assessment of the Office of Pesticide Programs' (OPP's) performance measures, for example, noted that a more explicit relationship between OPP outcome measures and ROE measures would result in "greater internal alignment and a more effective communication tool with stakeholders."¹

At the same time, the connection between the ROE and EPA's strategic architecture is not yet sufficiently transparent or precise. ROE stakeholders within the Agency, as well as several external groups, have called on EPA to better use the ROE and environmental indicators to guide priority setting, strategic planning, and resource allocation (Appendix C). We agree that this connection should be clearer and more deliberate, and intend to modify the organization of the ROE to better support planning and decision-making. Specifically, we intend to more directly align ROE chapters with Strategic Plan goals, and ROE questions with Strategic Plan objectives, as described in Section 3.1. We believe that this evolution of the ROE will help support Administrator Jackson's commitment that "EPA's efforts to address the environmental crises of today are rooted in three fundamental values: science-based policies and programs, adherence to the rule of law, and overwhelming transparency."

¹ EPA Office of Pesticides Programs. Assessment of the Performance Measures Improvement Project. October 2007.

Box 2-2. ROE Purpose

The ROE:

- Presents scientifically sound indicators of status and trends and important gaps in environmental and human health conditions to answer questions that are important to EPA's mission—it does *not* analyze or diagnose the reasons for, and relationships between, trends in stressors and environmental and health outcomes.
- Provides objective, reliable information on status and trends and important scientific input to EPA planning, decision making and priority setting, however, the ROE is not intended to be the *only* scientific input needed to inform planning and decision making.
- Serves as a resource for citizens to learn more about changing condition of human health and the environment; while the focus of ROE08 was on *national* trends, the ROE will evolve to inform these activities at multiple spatial and temporal scales.

2.3 2008 ROE Framework

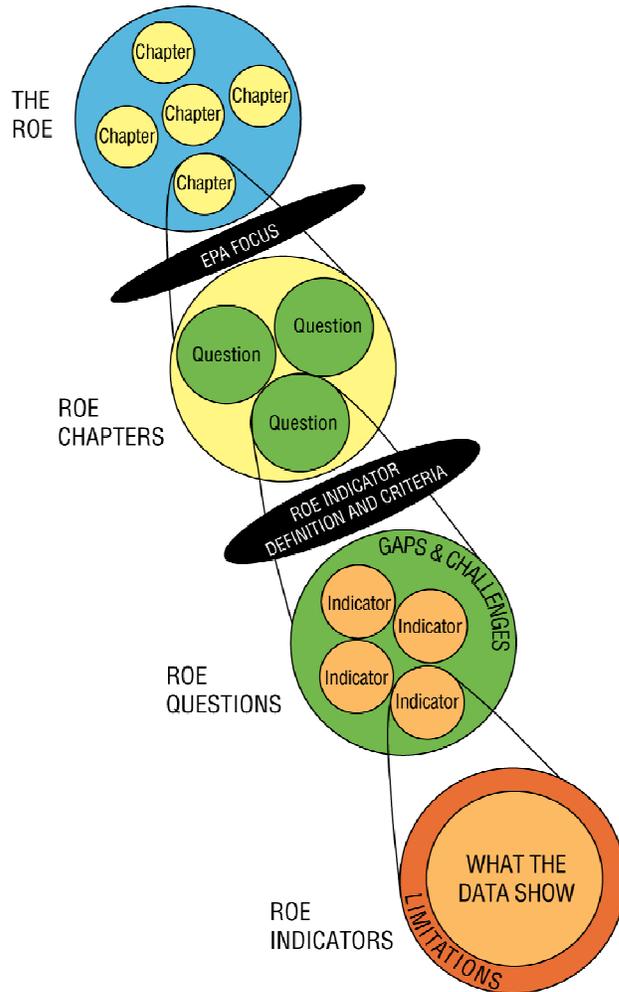
When the ROE was first conceived in 2001, a decision was made to have the ROE indicator reporting framework comprise a number of environmental questions that were fundamental to EPA's mission to protect human health and the environment. As the ROE evolved from a draft report in 2003 to its present form, the original questions were further refined and expanded through an open and transparent process. Although it might not have been explicitly stated at the time, the act of formulating the 23 ROE questions provided a structure for dialogue regarding EPA's questions and their scope and intent.

Figure 2-1 (Exhibit 1-1 from the 2008 ROE) provides the schematic framework for EPA's 2008 ROE. It shows that:

- The 2008 ROE was organized around five main chapters: Air, Water, Land, Human Exposure and Health, and Ecological Condition.
- Using the lens of EPA's mission, questions were formulated in each of the five areas. Indicators were selected and reviewed against the ROE indicator definition and criteria, ensuring that the indicators are useful, objective, transparent, and scientifically reliable.
- Each indicator describes what the data show and any limitations that generate uncertainty in the trend characterized by the indicator.

Thus, the ROE is structured around the concept of an EPA lens providing a focus for the questions, indicators and the characterization of gaps and limitations.

Figure 2-1. 2008 ROE Framework



2.4 ROE Questions and Indicators

The ROE compiles environmental indicators and associated information that help answer policy-relevant questions deemed to be critically important to the Agency's mission and national interest (see Box 2-2 above, "ROE Purpose"). The 2008 ROE asks 23 questions about trends in the nation's air, water, land, human exposure and health, and ecological condition. The questions relate to EPA's regulatory responsibilities as well as areas in which the Agency conducts or sponsors research, exerts policy leadership, provides information to the public, or shares an interest in human health and the environment with its federal state and tribal partners.

The 2008 ROE presents 85 indicators that help to address the ROE questions. The ROE indicators are based on high-quality data from databases maintained by EPA, other federal agencies, state governments, and NGOs. The 2008 ROE also identifies key limitations of these indicators and gaps where reliable indicators do not yet exist. These gaps and limitations highlight the disparity between the current state of knowledge and the goal of full, reliable, and insightful representation of environmental conditions and trends, and provide direction for future research and monitoring efforts. The information presented in the ROE is intended to help the Agency identify priorities, focus resources on areas of greatest concern, and manage work to achieve measurable results.

2.5 ROE Review Procedure

All ROE indicators are peer reviewed to meet rigorous standards for accuracy, representativeness, and reliability. (See Appendix F for additional detail about the ROE indicator definition and criteria.) The 2008 ROE indicators underwent independent external scientific peer review, as well as public review and comment, during the summer and fall of 2005. In addition, the SAB conducted an independent external peer review of the entire draft report at a July 2007 public workshop announced in the *Federal Register*. The SAB Panel's report to the Agency provided detailed comments and recommendations, many of which were addressed in the 2008 ROE. More will be addressed in the next version of the ROE with ongoing consultation and advice from the standing SAB Panel.

The draft report also underwent interagency review in 2006, and in 2007 was released for public review and comment. The 2008 ROE was revised based on the expert peer review, interagency review, and public comments.

Appendix B of this paper presents a detailed chronology of ROE reviews from 2003 to 2008.

Section 3. Restructuring the ROE

Over the coming years, EPA is implementing several changes that will allow the ROE to better fulfill its purpose and help better meet the information needs of the Agency.

First, we are restructuring the ROE to more visibly align the Report with the Agency’s Strategic Architecture. We plan to more directly align ROE chapters with EPA’s Strategic Plan goals, and ROE questions with objectives in EPA’s Strategic Plan. This change is intended to make the connection between the ROE and Agency planning more visible and transparent. Section 3.1 describes this alignment in greater detail.

Second, we propose to develop conceptual models for each of the ROE questions.²

These models would serve as communication tools for discussion among scientists, policy developers, and decision-makers to improve the overall utility of the ROE for strategic planning. The models also help to make the conceptual underpinnings of each question clearer to the reader. The models would:

- Clearly illustrate the scope of the question.
- Depict the scientific conceptual foundation of the question.
- Show the role played by each indicator in helping to answer the question, which in turn helps identify important limitations of each indicator.
- Illustrate where indicator gaps exist.
- Highlight where supplemental information might be useful to help answer the question (see “Third” below).

In the 2008 ROE, the “Introduction” section of each indicator description explains why the indicator is useful and responsive to the question and of interest to EPA and its stakeholders. For the 2012 ROE, we propose that each indicator write-up refer back to the conceptual model for the question to illustrate the role played by the indicator in answering the question, to characterize its gaps and limitations, and to capture the interrelationships among the indicators.

Two examples of conceptual models at the question level—for drinking water and outdoor air—are presented in Sections 3.2 and 3.3.

Third, we plan to include “supplemental information” in the 2012 ROE—research studies, data sets, and other sources of information that do not meet the ROE definition and criteria, but

² When the SAB reviewed the 2008 ROE, it urged that the Report incorporate a conceptual framework to show the relationship among the chapters, questions, and indicators; the relationships among indicators; and the conceptual scientific linkages among indicators and across media. Appendix E summarizes comments from the SAB’s review of the 2008 ROE regarding conceptual frameworks in the Report.

provide some insight into health and environmental trends that are relevant to the question.³ This information would help illustrate important indicator gaps and limitations and serve as possible candidates for future ROE indicators. EPA proposes creating an indicator “incubator” site, perhaps using EPA’s “Indicator Gateway” (<http://www.epa.gov/indicators/>) for this purpose. Section 4 and the examples presented in Sections 3.2 and 3.3 provide additional detail about the proposed use of supplemental information in the ROE.

3.1 Aligning the ROE with the Agency’s Strategic Architecture

EPA aspires to align the next version of the ROE more transparently with the Agency’s Strategic Plan. Any such revision of the ROE will take into account the new Administration’s long-term perspectives on strategic planning. Note that the exhibits in this paper are based on the most recent public version of a revised strategic architecture, EPA’s *2009-2014 Strategic Plan Change Document*,⁴ to illustrate the alignment opportunities. (A draft of the new Strategic Plan for 2009-2014 is scheduled for release in mid-June.) The focus of this section, therefore, is the approach and concepts presented, rather than the specifics of the examples. EPA expects that the overall architecture of the Strategic Plan (with goals, objectives, and sub-objectives) will not change, so that this generic approach will be adequate.

The chapters of the 2012 ROE will be more explicitly aligned with EPA’s Strategic Plan goals. The three media chapters (Air, Water, and Land) would align directly with the first three goals of the Strategic Plan, while a chapter addressing both Human Health and Ecological Condition would relate to Strategic Plan Goal 4.

In addition, future versions of the ROE will more directly align the ROE questions with objectives in the Strategic Plan. For illustrative purposes, Appendix D of this paper compares the 2008 ROE questions with Agency objectives in the *2009-2014 Strategic Plan Change Document*. Three possibilities can arise as we further align questions and objectives:

- The ROE already includes a question directly aligned with a Strategic Plan objective (for example, the 2008 ROE drinking water question aligns with the current Strategic Objective 2.1—see Figure 3-2 in the next section). Here, the objectives can help us refine the scope of the question and select appropriate indicators.
- The Strategic Plan could include an objective for which an ROE question might need to be developed (for example, no ROE question currently exists for Objective 1.4 addressing radiation).

³ In its advisory on the 2008 ROE, the SAB Panel advised EPA to relax the indicator criteria to enable use of valuable long-term monitoring data or regional indicators, by classifying indicators according to completeness or rigor, adjusting indicators, or providing caveats about methodology. Appendix F presents additional detail on these SAB recommendations.

⁴ *2009-2014 Strategic Plan Change Document*, http://www.epa.gov/ocfo/plan/pdfs/strategic_plan_change_document_9-30-08.pdf

- The ROE might include questions that are not part of the Strategic Plan, but that nevertheless address issues of importance to EPA’s mission and the nation’s environment (for example, the 2008 ROE includes questions about land use and land cover). Such questions might bring trends to light that inform future Agency planning and decision-making.

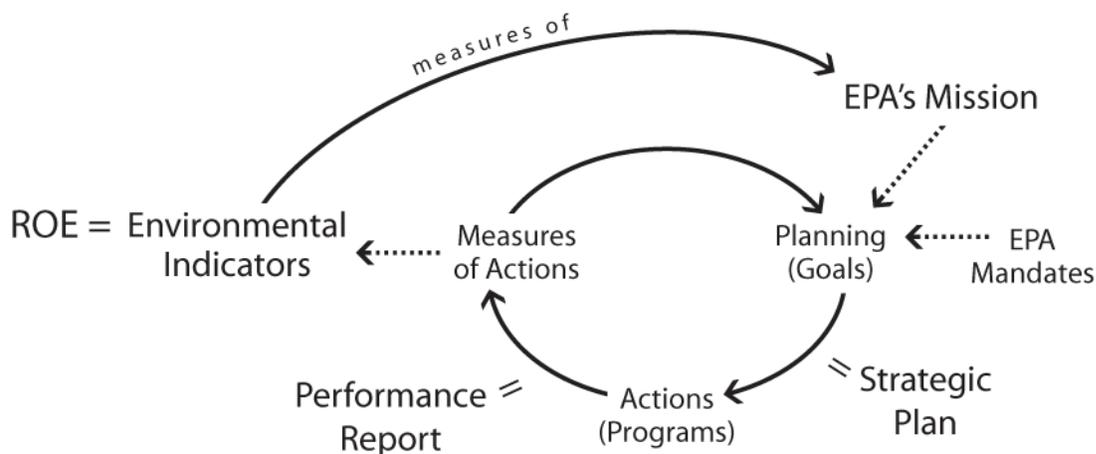
In moving toward more visible alignment in this way, we recognize that the ROE will be most valuable to decision-makers and planners if it is flexible enough in content and structure to accommodate the changing priorities and information needs of the Agency.

Table 3-1 compares some important attributes of EPA’s Strategic Plan and the 2008 ROE. Figure 3-1 provides a schematic representation of the ROE’s relationship to Agency planning, programs, and assessment.

Table 3-1. Comparison of EPA Strategic Plan and the 2008 ROE

	EPA Strategic Plan	2008 ROE
Organization	Goals with objectives and sub-objectives	Chapters with policy questions
Metrics	Performance measures	Indicators
Time Frame	Five-year window	Period of record
Targets	Yes	No
Scope	Agency’s road map (what EPA does); guides EPA in establishing its annual goals	Answers EPA’s broad environmental questions
Governance	Office of the Chief Financial Officer (OCFO)	Cross-Agency Executive Steering Committee (SC)
Frequency	Three years	Four years

Figure 3-1. ROE and EPA Strategic Planning



3.2 Example One: Drinking Water

3.2.1 ROE and the EPA Strategic Architecture

EPA's Strategic Objective 2.1 (Protect Human Health) includes the sub-objective "Water Safe to Drink." The objective establishes EPA's intention to protect human health by reducing exposure to contaminants in drinking water, including source waters. This sub-objective corresponds to the 2008 ROE question, "What are the trends in the quality of drinking water and their effects on human health?" (see Figure 3-2). In this example, we will compare details of the Strategic Plan sub-objective with the corresponding 2008 ROE question and its associated indicators and gaps to show how we might use this information, together with a conceptual model for the question, to better align the question with the Strategic Plan, and to guide discussion and consideration of indicators that would be most useful for the Agency. We also will offer an example of supplemental information that could be included in the ROE to help answer the question in the absence of indicators that meet the ROE definition and criteria.

Figure 3-2. Example: Alignment of ROE Policy Question and EPA Strategic Objective



To provide some context for this example, we first include a brief summary of EPA’s responsibilities for drinking water protection (see Box 3-1). Our discussion of the ROE and Strategic Plan content is framed by the information presented in Table 3-2, which juxtaposes specific components of the ROE drinking water question (including indicators and explicitly identified gaps) and the **strategic measures** in EPA’s proposed (2009-2014) Strategic Plan that address the sub-objective “Water Safe to Drink.” These strategic measures reflect specific targets that EPA has chosen to emphasize over the five-year period covered by the plan. They include performance measures relating to populations served by community water systems that have no health-based violations, the percent of community water systems providing drinking water that meets health-based standards, actions taken to protect source water, and safe drinking water for tribal populations. In addition, related measures are included under Goal 4 of the Strategic Plan, “Healthy Communities and Ecosystems,” pertaining to safe drinking water in the United States–Mexico border area and the Pacific Island Territories. (Goal 4 focuses on specific communities, rather than nationwide water quality goals.)

Box 3-1. EPA’s Responsibilities for Protecting Drinking Water Under the Safe Drinking Water Act

EPA has authority to regulate public water systems, which are systems that have 15 service connections or which serve 25 or more of the same people. Public water systems that supply water to the same population year-round are referred to as community water systems (CWS). In fiscal year 2008, roughly 96 percent of the U.S. population was served by CWS.

EPA has established health-based standards for more than 90 contaminants. Health-based standards include Maximum Contaminant Levels (MCLs) and Treatment Techniques (TTs). An MCL is the highest level of a contaminant that is allowed in drinking water. A TT is a required treatment process (such as filtration or disinfection) intended to prevent the occurrence of a contaminant in drinking water (U.S. EPA, 2004b). TTs are adopted where it is not economically or technologically feasible to ascertain the level of a contaminant, such as microbes, where even single organisms that occur unpredictably or episodically can cause adverse health effects. States are required to report violations on a quarterly basis.

The proposed 2009-2014 Strategic Plan also identifies several proposed **“changes in strategies”** for Goal 2 that draw attention to possible new Agency information needs:

- Addressing contaminants of emerging concern (e.g., pharmaceuticals, personal care products, nanomaterials) found in the aquatic environment.
- Obtaining contaminant occurrence information to support the assessment of drinking water health-based measures—a microbial measure to assess reductions in cryptosporidiosis cases as a result of the Surface Water Treatment Rule, and a chemical measure to assess reductions in bladder cancer cases as a result of the Disinfection Byproduct Rule.

Turning to the relevant sections of the ROE, we see in Table 3-2 that for the drinking water question in the 2008 ROE, “What are the trends in the quality of drinking water and their effects on human health?” the ROE presents only one indicator: “Population served by community water systems with no reported violations of health-based standards.” This is not because only one indicator is needed, but because no other indicators were available that met the ROE indicator definition and criteria. We also note that while the ROE indicator is of the same form as the corresponding strategic target, it is slightly different for several reasons: it treats violations of standards not included in the original baseline differently, it covers the entire period of record (rather than the five-year window of the Strategic Plan, including some years in the future), and it has no associated target value.

Table 3-2. ROE Components and EPA Strategic Measures

Report on the Environment	EPA Strategic Plan (2009-2014)⁵
<p>ROE Indicators, Supplemental Information, and Identified Gaps</p> <p>INDICATOR: Population served by community water systems with no reported violations of health-based standards</p> <p>PROPOSED INDICATOR: Expanded coverage of ROE indicator to include tribal populations</p> <p>GAP: Trends in quality of drinking water from non-community water systems GAP: Quality of drinking water from non-public supplies (e.g., bottled water, private wells)</p>	<p>EPA Strategic Measures</p> <p>Sub-objective 2.1.1: Water Safe to Drink</p> <p>By 2014, 93 percent of the population served by community water systems will receive drinking water that meets all applicable health-based drinking water standards through effective treatment and source water protection. (2005 baseline: 89 percent.)</p> <p>By 2014, 90 percent of community water systems will provide drinking water that meets all applicable health-based drinking water standards through approaches including effective treatment and source water protection. (2005 baseline: 89 percent.)</p> <p>By 2014, community water systems will provide drinking water that meets all applicable health-based drinking water standards during 97 percent of person months (i.e., all persons served by community water systems times 12 months). (2005 baseline: 95.2 percent.)</p> <p>By 2014, 88 percent of the population in Indian country served by community water systems will receive drinking water that meets all applicable health-based drinking water standards. (2005 baseline: 86 percent.)</p> <p>By 2014, minimize risk to public health through source water protection for 50 percent of community water systems and for the associated 62 percent of the population served by community water systems (i.e., "minimized risk" achieved by substantial implementation, as determined by the state, of actions in a source water protection strategy). (2005 baseline: 20 percent of community water systems; 28 percent of population.)</p> <p>By 2015, in coordination with other federal agencies, reduce by 50 percent the number of homes on tribal lands lacking access to safe drinking water. (2003 baseline: Indian Health Service data indicate that 12 percent of homes on tribal lands lack access to safe drinking water (38,637 homes lack access).) (FY 07 end-of-year result is 36,575 homes; 11.5 percent of homes on tribal lands lacking access to safe drinking water.)</p>

⁵ 2009-2014 Strategic Plan Change Document, http://www.epa.gov/ocfo/plan/pdfs/strategic_plan_change_document_9-30-08.pdf

The 2008 ROE also identifies the key **indicator gaps** for answering the drinking water question, including trends in drinking water quality from community water systems *with* reported violations (i.e., the nature, extent, and duration of the violations); trends in drinking water quality from non-community water systems, private wells, and bottled water; and trends in endemic waterborne disease illness and acute waterborne disease outbreaks.

Comparing the current ROE indicator, identified gaps, and proposed supplemental information with EPA strategic measures and proposed strategy changes (Table 3-2) suggests areas in which ROE indicators could be developed to support the Agency's information needs (e.g., indicators of drinking water provided to tribal populations and other sub-populations, health effects of emerging contaminants, occurrence of *Cryptosporidium* and disinfection byproducts). Identified ROE indicator gaps can also highlight areas in which additional strategic measures could be considered (e.g., quality of drinking water from private wells and bottled water). Consideration of a conceptual model, as described below, can help guide further discussion of these topics.

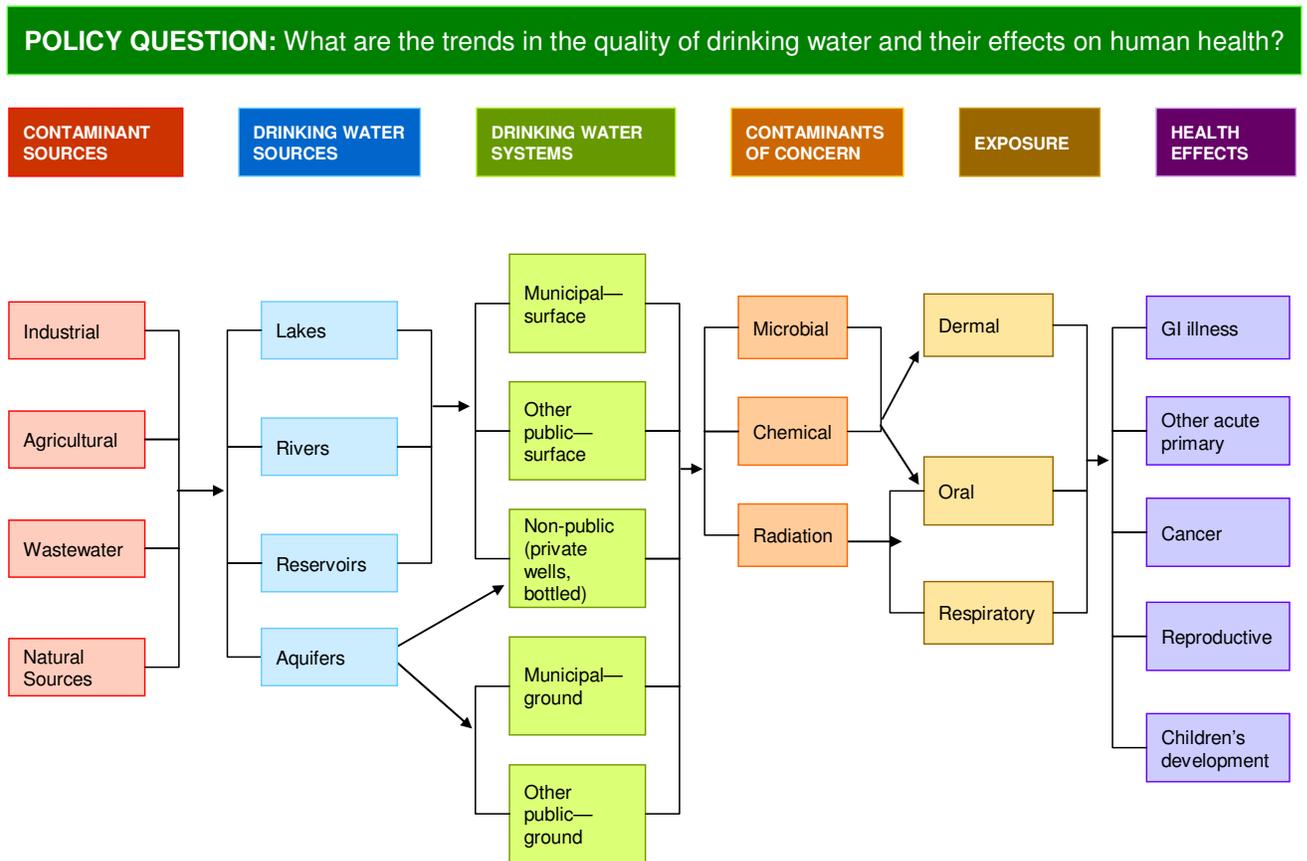
3.2.2 Using a Drinking Water Conceptual Model to Support Planning, Problem Formulation, and Decision-making

Figure 3-3 presents a generalized **conceptual model** for the 2008 ROE drinking water question. Key components of the model include contaminant sources, the condition of source waters, the influence of drinking water treatment and delivery systems (which remove or reduce concentrations of some contaminants, but potentially increase concentrations of others), human exposure through various pathways, and ultimately a range of possible human health effects.

In keeping with the stated scope of the ROE question, the model includes different types of drinking water systems—municipal (both surface and ground water), other public systems, and private wells—as well as bottled water. It also shows a range of contaminant sources that could be considered—industry, agriculture, wastewater, natural sources, as well as potential contaminants introduced through treatment and distribution. The model also depicts some of the specific health outcomes linked to various drinking water contaminants—gastrointestinal illness, other acute primary illnesses, cancer, reproductive effects, and children's neurodevelopmental effects.

Initially, the process of developing the model serves as a tool to discuss and build consensus about the scope and intent of the question. The model also provides a common framework for focused discussion on prioritizing and selecting indicators, including supplemental information, and identifying gaps. In this example, the ROE presents only one indicator for the drinking water question—population served by systems with no reported violations of health-based standards. Thus, the conceptual model helps communicate the message that additional indicators—particularly indicators of levels of contaminants in drinking water, and of trends in health effects of concern—are necessary to answer the question. Overlaying the Agency strategic measures on this conceptual model also could help reveal areas in which ROE indicators and other information are needed—for example, the strategic objectives with respect to drinking water in Indian country highlight the need for expanded coverage of the ROE drinking water indicator to tribal populations.

Figure 3-3. Example of a Possible Conceptual Model for the 2008 ROE Drinking Water Question



Note to SAB: This is an illustrative example for purposes of discussion.

While the conceptual model depicts generic linkages among contaminant sources, contaminants, exposures, and effects, it is not intended to show underlying causal/associative or descriptive/structural relationships. If more detailed models are needed, they can be added for important issues and linked to the more general conceptual model. For example, a detailed model could be developed to show the details of disinfection byproducts formation, the delivery of the chemicals to humans through finished drinking water, and the possible biological mechanism(s) resulting in human cancer. Detailed models could also address a subset of drinking water systems (e.g., small and rural communities), exposure and effects among sub-populations (e.g., tribal populations, children), and specific geographic areas (e.g., the Mexico border area) of interest in Agency planning and decision-making.

These more specific models would help support problem identification and help inform policy formulation in the Agency by thoroughly identifying the suite of stressors, sources, receptors,

exposure pathways, and potential adverse effects EPA should consider when assessing, for example:⁶

- Whether a problem exists (e.g., What is the rate of neurodevelopmental effects in children and is it increasing?).
- What caused the problem (e.g., Is there a possible link between neurodevelopmental effects in children and chemical contaminants in drinking water?).
- Potential consequences of specific management actions (e.g., How would actions to mitigate climate change affect source water quality issues?).
- Whether environmental management actions are effective (e.g., Has the Disinfection Byproduct Rule reduced the rate of bladder cancer? Has the Surface Water Treatment Rule affected the rate of cryptosporidiosis? How can changes be effectively measured?).

These types of assessments are not the purview of the ROE itself. The ROE presents indicators of status and trends and identifies important gaps and limitations in trend data relative to a question—it does *not* analyze or diagnose the reasons for, and relationships between, trends in stressors and environmental and health outcomes. However, when developed together with the intended users of the ROE information, the conceptual models can help ensure that the question scope, indicators, and associated information are useful for and consistent with the needs and expectations of Agency planners and decision-makers. The models also help identify research needs and provide a scientifically sound basis for selecting indicators and supplemental information and prioritizing the development of new indicators.

With appropriate input, the conceptual model can also provide a framework for evaluating the need for changes to the existing scope of an ROE question based on additional identified information needs. For example, to assess Agency progress toward meeting its strategic goals, EPA produces an annual Performance and Accountability Report. The 2008 Report identifies a specific **challenge** in meeting Strategic Objective 2.1: water scarcity. Section 1 of the report⁷ notes that “Population growth and climate factors are causing concern about water scarcity. Communities across the country are facing challenges in securing reliably safe supplies of drinking water. Small drinking water systems, including those supplying drinking water to tribes, are particularly challenged by the need to improve infrastructure and develop the capacity to meet new and existing standards.”

This issue of the amount or extent of drinking water, including its effect on quality, is not currently addressed directly in either the ROE or the Strategic Plan, but should be included, along with source water quality, in the conceptual model, since water amounts and their effects on quality warrant consideration as climate change moves to the forefront of the Agency’s environmental assessment and protection efforts.

The conceptual model can also help EPA identify gaps in ROE indicators available to answer a question. The draft model in Figure 3-3 addresses the full range of drinking water systems, and

⁶ Cormier, SM and GW Suter. A framework for fully integrating environmental assessment. *Environmental Management* (2008) 42:543-556

⁷ EPA’s *FY 2008 Performance and Accountability Report*, Section 1, Management’s Discussion and Analysis. <http://www.epa.gov/ocfo/par/2008par/par08mda.pdf>

further examination of the 2008 ROE drinking water content (Table 3-2) shows a gap in this regard: there are no currently available indicators of drinking water quality for non-community water systems or bottled water that meet the ROE indicator definition and criteria. In response to advice from the SAB and others, EPA proposes to include supplemental information in order to augment the information available from the indicators. For example, the U.S. Geological Survey (USGS) recently published a study of concentrations of contaminants in 2,100 private drinking wells across the United States.⁸ The study sampled private wells in most of the major groundwater aquifers in the United States. EPA proposes to include this study in the ROE as **supplemental information** that provides insight into the drinking water question (showing the range of contaminants that can occur in private well water) and pointing to it as a possible candidate for a future ROE indicator or an important study that helps to answer the question. (See Section 4 for additional discussion of the topic of supplemental information).

3.3 Example Two: Outdoor Air

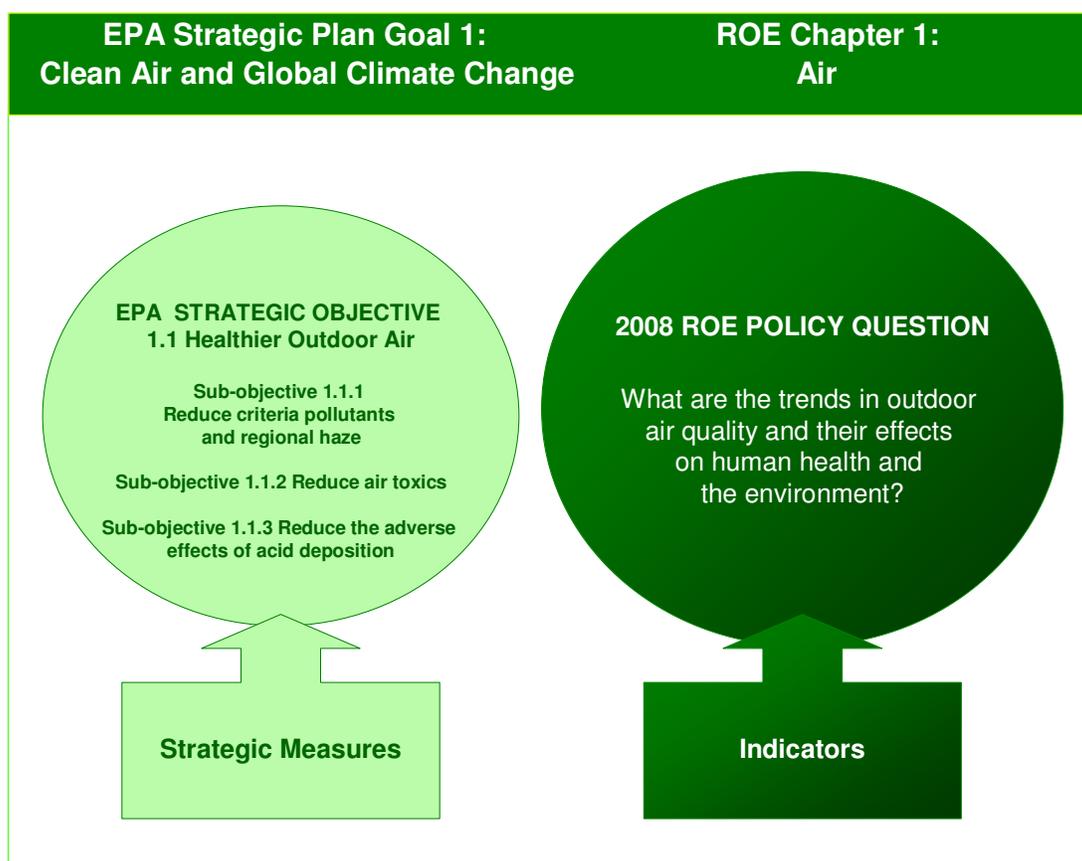
3.3.1 ROE and the EPA Strategic Architecture

This section presents a second example using the following question from the 2008 ROE Air Chapter: “What are the trends in outdoor air quality and their effects on human health and the environment?” EPA’s current Strategic Plan Objective 1.1, “Healthier Outdoor Air,” establishes EPA’s intention to protect human health and the environment by including three specific sub-objectives for attaining and maintaining health-based air quality standards, reducing the risk from toxic air pollutants, and reducing the number of chronically acidic water bodies in acid-sensitive regions (Figure 3-4). Although not explicitly stated in the single, broad ROE question that addresses trends in outdoor air quality and their effects on human health and the environment, the ROE chapter text explains that the full scope of this ROE question also includes these same specific sub-components as outlined in the Strategic Plan. The ROE outdoor air question also encompasses the issue of stratospheric ozone, which is covered under a different Strategic Objective, 1.3—“Protect the Ozone Layer.”

As in the drinking water example, we will compare details of the Strategic Plan sub-objective with the 2008 ROE question and its associated gaps and indicators. This section shows how we might use this information, together with a conceptual model for the question, to better align the question with the Strategic Plan, and to guide a search for the indicators that would be most useful for the Agency. It also offers an example of supplemental information that could help answer the question in the absence of data that meet the criteria for an ROE indicator.

⁸ http://water.usgs.gov/nawqa/studies/domestic_wells/

Figure 3-4. Example: Alignment of ROE Policy Question and EPA Strategic Objective



Once again, it is useful to review EPA’s overall responsibilities for protecting outdoor air quality (See Box 3-2), and then to compare the Strategic Plan and the ROE question. Table 3-3 shows the relationship between specific components of the ROE outdoor air section (including indicators and explicitly identified gaps) and the strategic measures in EPA’s (2009-2014) Strategic Plan that address the objective “Healthier Outdoor Air.” The Strategic Plan includes short-term strategic measures related to reducing emissions and concentrations of various air pollutants, as well as measures related to decreasing deposition of sulfur and nitrogen oxides that acidify surface waters. The strategic objective includes strategic measures related to a sub-population of particular interest—tribal populations—for which there were no indicators in the 2008 ROE. EPA’s 2008 Performance and Accountability Report⁹ also notes following, of interest for potential indicator development:

“Measuring annual progress toward EPA’s research goal of reducing uncertainties in linking pollutant sources to health outcomes is a difficult challenge. However, in FY

⁹ <http://www.epa.gov/ocfo/par/2008par/index.htm>.

2008, EPA sought advice from an independent expert panel and is now focusing on air pollutants in three particular areas: near roadways, near specific sources of air pollution, and in specific geographical areas impacted by multiple sources of pollution.”¹⁰

Box 3-2. EPA’s Responsibilities for Protecting Air Quality Under the Clean Air Act

The Clean Air Act directs EPA to identify and set national ambient air quality standards for commonly found air pollutants that adversely affect public health and the environment. EPA has set national air quality standards for six common “criteria” air pollutants: ground-level ozone (smog), carbon monoxide, lead, nitrogen dioxide, sulfur dioxide, and particulate matter. For each of these six pollutants, EPA has set health-based, or “primary,” standards to protect public health as well as environment-based, or “secondary,” standards to protect the public welfare (e.g., crops, vegetation, wildlife, buildings and monuments, and visibility). The Clean Air Act requires EPA to review the health- and environment-based standards at least once every five years and revise them as necessary to continue to protect public health and the environment. Under the Clean Air Act, EPA can also limit emissions of hazardous air pollutants that are known to, or are suspected of, causing cancer or other serious health effects.

The Agency also oversees numerous state, local, and tribal permitting programs and operates market-based programs to address problems such as acid rain. Under the Clean Air Act, EPA is also charged with phasing out production and use of chemicals that destroy the stratospheric ozone layer. A new EPA finding proposed in April 2009 could lead the Agency to regulate greenhouse gases under the Clean Air Act, based on the human health and welfare implications of climate change.

Unlike the drinking water question in the 2008 ROE, for which there was only one indicator, the 2008 ROE presents 23 indicators related to outdoor air—21 pertaining to “Healthier Outdoor Air” and two pertaining to stratospheric ozone. The ROE also identifies the key indicator gaps for answering the outdoor air question. One notable gap described in the ROE text is the lack of indicators of emissions and ambient concentrations of numerous air toxics. Some of these air toxics are emitted widely (e.g., from mobile sources), while others are emitted from just a few large point sources, leading to more local-scale issues. More generally, the ROE text notes that many of the ambient concentration indicators suffer from limited monitoring coverage. The ROE explains that information on a few topics of interest—particulate matter speciation and mercury deposition—is not available yet but could become available in the future.

¹⁰ EPA’s FY 2008 Performance and Accountability Report, Section 1, Management’s Discussion and Analysis. <http://www.epa.gov/ocfo/par/2008par/par08mda.pdf>

Table 3-3. ROE Components and EPA Strategic Measures

Report on the Environment	EPA Strategic Plan (2009-2014)¹¹
<p>ROE Indicators, Supplemental Information, and Identified Gaps</p> <p>INDICATOR: Ambient Concentrations of Ozone INDICATOR: Ozone and Particulate Matter Concentrations for U.S. Counties in the U.S./Mexico Border Region</p> <p>INDICATOR: Ambient Concentrations of Particulate Matter INDICATOR: Ozone and Particulate Matter Concentrations for U.S. Counties in the U.S./Mexico Border Region</p> <p>INDICATOR: Particulate Matter Emissions</p> <p>INDICATOR: Nitrogen Oxides Emissions</p> <p>INDICATOR: Volatile Organic Compounds Emissions</p> <p>INDICATOR: Regional Haze</p> <p>INDICATOR: Regional Haze</p>	<p>EPA Strategic Measures</p> <p>Sub-objective 1.1.1: Reduce Criteria Pollutants and Regional Haze</p> <p>By 2015, reduce the population-weighted ambient concentration of ozone in all monitored counties by 14 percent from the 2003 baseline, compared to the eight percent cumulative reduction expected by 2008.</p> <p>By 2015, reduce the population-weighted ambient concentration of PM2.5 in all monitored counties by 6 percent from the 2003 baseline, compared to the 4 percent cumulative reduction expected by 2008.</p> <p>By 2014, reduce emissions of fine particles from mobile sources by 51,000 tons from a 2009 baseline level of 417,000 tons.</p> <p>By 2014, reduce emissions of nitrogen oxides (NOx) from mobile sources by 2.1 million tons from a 2009 baseline level of 9.3 million tons.</p> <p>By 2014, reduce emissions of volatile organic compounds from mobile sources by 1.1 million tons from a 2009 baseline level of 5.9 million tons.</p> <p>By 2018, visibility in eastern Class I areas will improve by 15 percent on the 20 percent worst visibility days, as compared to visibility on the 20 percent worst days during the 2000-2004 baseline period.</p> <p>By 2018, visibility in western Class I areas will improve by 5 percent on the 20 percent worst visibility days, as compared to visibility on the 20 percent worst days during the 2000-2004 baseline period.</p> <p>By 2014, with EPA support, 47 additional tribal air quality emission inventories will be completed, for a cumulative total of 84. (FY 2007 baseline: 37 tribal emission inventories.)</p>

¹¹ 2009-2014 Strategic Plan Change Document, http://www.epa.gov/ocfo/plan/pdfs/strategic_plan_change_document_9-30-08.pdf

Report on the Environment	EPA Strategic Plan (2009-2014) ¹¹
<p>INDICATOR: Carbon Monoxide Emissions INDICATOR: Ambient Concentrations of Carbon Monoxide INDICATOR: Lead Emissions INDICATOR: Ambient Concentrations of Lead INDICATOR: Ambient Concentrations of Nitrogen Dioxide INDICATOR: Ozone Injury to Forest Plants INDICATOR: Percent of Days with Air Quality Index Values Greater Than 100 GAP: Particulate matter speciation GAP: National-level exposure and effects indicators GAP: Understanding the connections between air pollution and human health outcomes PROPOSED SUPPLEMENTAL INFORMATION: Trends in cardiorespiratory disease and life expectancy linked to outdoor air pollutants (epidemiological evidence)</p> <p>INDICATOR: Air Toxics Emissions GAP: Nationally representative indicators for most air toxics and other air pollutants</p> <p>INDICATOR: Air Toxics Emissions INDICATOR: Mercury Emissions GAP: Nationally representative indicators for most air toxics and other air pollutants</p> <p>INDICATOR: Ambient Concentrations of Benzene INDICATOR: Ambient Concentrations of Manganese Compounds in EPA Region 5 GAP: Nationally representative ambient air monitoring data on air toxics GAP: Mercury deposition data</p>	<p>By 2014, with EPA support, 12 additional tribes will possess the expertise and capability to implement the Clean Air Act in Indian country (as demonstrated by successful completion of an eligibility determination under the Tribal Authority Rule), for a cumulative total of 22. (FY 2007 baseline: 10 tribes.)</p> <p>Sub-objective 1.1.2: Reduce Air Toxics</p> <p>By 2014, reduce toxicity-weighted (for cancer risk) emissions of air toxics to a cumulative reduction of 34 percent from the 1993 non-weighted baseline of 7.24 million tons, maintaining the 34 percent cumulative reduction expected by 2006.</p> <p>By 2014, reduce toxicity-weighted (for non-cancer risk) emissions of air toxics to a cumulative reduction of 59 percent from the 1993 non-weighted baseline of 7.24 million tons, compared to the 58 percent cumulative reduction expected by 2006.</p>

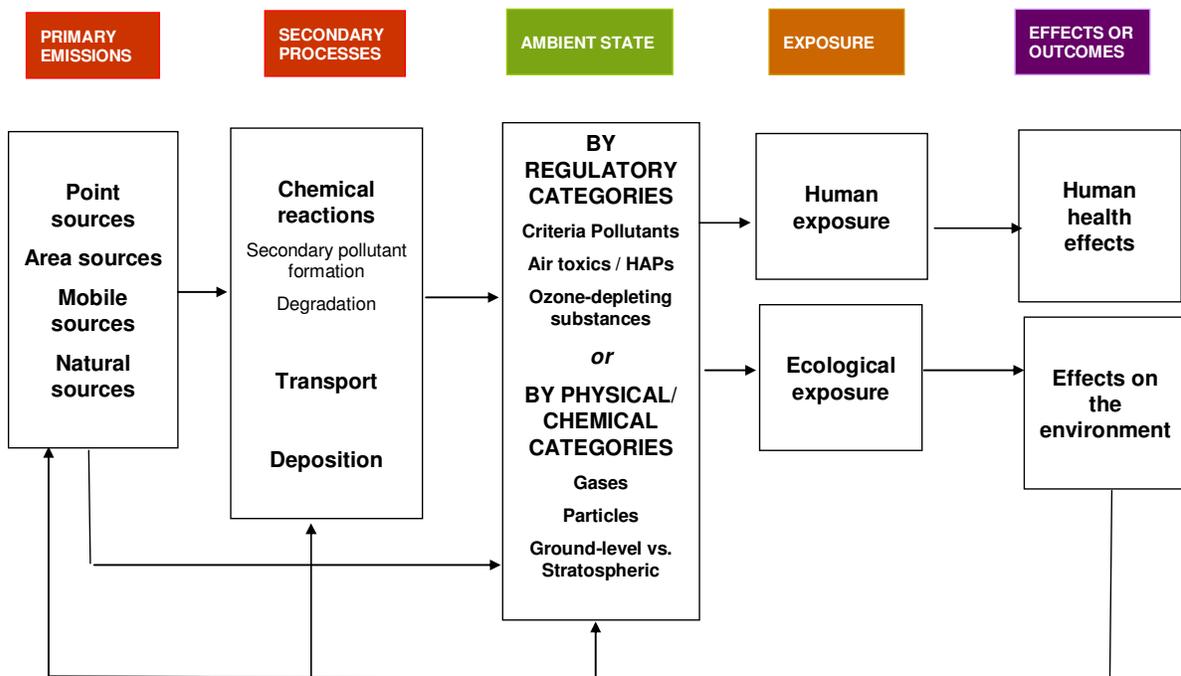
Report on the Environment	EPA Strategic Plan (2009-2014) ¹¹
<p>PROPOSED SUPPLEMENTAL INFORMATION: Trends in mercury concentrations in bald eagles on the shores of Lake Michigan</p> <p>INDICATOR: Lake and Stream Acidity</p> <p>INDICATOR: Sulfur Dioxide Emissions</p> <p>INDICATOR: Acid Deposition</p> <p>INDICATOR: Acid Deposition</p>	<p>Sub-objective 1.1.3: Reduce the Adverse Effects of Acid Deposition</p> <p>By 2014, due to progress in reducing acid deposition, the number of chronically-acidic water bodies in acid-sensitive regions of the northern and eastern United States should be maintained at or below the 2001 baseline of approximately 500 lakes and 5,000 kilometers of stream-length in the population covered by the Temporally Integrated Monitoring of Ecosystems/Long-Term Monitoring Survey. The long-term target is a 30 percent reduction in the number of chronically-acidic water bodies in acid-sensitive regions by 2030.</p> <p>Through 2015, maintain the national annual emissions of sulfur dioxide (SO₂) from utility electric power generation sources at a level below 8.95 million annual tons, compared to the 1980 level of 17.4 million tons per year.</p> <p>By 2014, reduce total annual average sulfur deposition by 20 percent from 2001 monitored levels of up to 15 kilograms per hectare for total sulfur deposition.</p> <p>By 2014, reduce total annual average nitrogen deposition by 30 percent from 2001 monitored levels of up to 9 kilograms per hectare for total nitrogen deposition.</p> <p>Proposed changes in strategies for Goal 1</p> <p><i>All proposed changes relate to climate change, which is outside the scope of Strategic Objective 1.1, "Healthier Outdoor Air."</i></p>

3.3.2 Using an Outdoor Air Conceptual Model to Support Planning, Problem Formulation, and Decision-making

Following the reasoning laid out for the drinking water question, we present a second conceptual model (Figure 3-5) intended to encompass the scope of the ROE question “What are the trends in outdoor air quality and their effects on human health and the environment?” Based loosely on a model proposed by a panel of air quality experts convened by the ROE project to explore and potentially fill important data gaps, this figure offers a generalized example of a conceptual model for the outdoor air question.

Key components of the model include primary emissions, secondary processes, ambient concentrations of air pollutants (e.g., transport, ozone formation, deposition on land surfaces), exposure to humans and ecosystems, and ultimately a range of possible human health and ecological effects. The panel stated the importance of explicitly including ecological as well as human effects in any conceptual model of this question.

Figure 3-5. Example of a possible conceptual model for the 2008 ROE Outdoor Air Policy Question



Note to SAB: This is an illustrative example for purposes of discussion.

Although the draft model shown in Figure 3-5 is a useful starting place for developing an outdoor air conceptual model(s), it was readily apparent from our initial analysis that the draft model does not explicitly capture the full scope of the broad ROE question. Our initial analysis

of the draft model provided useful information which we are using to develop more refined models that will be presented to the Advisory Panel at the June meeting.¹² The analysis showed:

- The model was appropriate and useful for depicting situations that involved direct exposure to toxic pollutants (e.g., criteria pollutants and air toxics where the exposure pathway is direct atmospheric exposure).
- The conceptual model was not appropriate for outdoor air pollutants that exert their primary effects through another media (e.g., acid deposition, mercury, and lead).
- Conceptual models for this question should accommodate the concepts of human welfare so that these effects also are recognized and included as explicit outcomes of interest (e.g., regional haze impacting scenic vistas).

As with the drinking water question, the process of developing and analyzing the model serves as a tool to build internal consensus about the scope of the question. Our analysis, combined with the realization that such a broadly stated outdoor air question does not adequately portray the full specifics of the ROE scope as described in the report text, has led us to consider whether the ROE should perhaps use more questions, each focused on a more circumscribed part of the original ROE question, and each with its own conceptual model.

Breaking out the existing outdoor air question into subcomponents and framing those questions to more closely parallel the three sub-objectives of the Strategic Plan would also help make the connection between the ROE and the Strategic Plan more explicit. When realigning the ROE with the strategic architecture questions of appropriate scope could be established such that questions do not require multiple conceptual models.¹³

The conceptual model for the outdoor air question also provides a common framework for selecting indicators, including supplemental information, and for identifying gaps. As in the drinking water sub-objective, the healthier outdoor air objective identifies sub-populations of particular interest for which there were no indicators in the 2008 ROE (e.g., relating to tribal lands and territories).

Future editions of the ROE could fill some important gaps and answer the ROE questions more fully by presenting supplemental information. For example, the current Air Chapter cites a lack of indicators of exposure to air pollutants and trends in health effects that can be explicitly related to trends in outdoor air pollutants—gaps that reflect some of the same challenges identified in the 2008 Performance and Accountability Report. While there are no national indicators available that track over time the occurrence of health effects attributable solely to exposure to one or more air pollutants, there is a substantial epidemiologic evidence base linking specific diseases to these exposures, supporting the inclusion of several cardiorespiratory diseases as environmentally related health outcomes in the Human Exposure and Health Chapter. The information could be presented in the following format:

¹² We are unable to present the details in this white paper, but will demonstrate with interactive graphics at the panel meeting.

¹³ The same may be true for objectives and sub-objectives in the strategic architecture, but that is not the topic of this consultation.

“With respect to human health effects associated with outdoor air pollution, the Harvard Six Cities Study and the American Cancer Society Cancer Prevention Study II have contributed decades of epidemiologic research across multiple geographic areas. These and other studies provide convincing scientific evidence linking exposure to outdoor air pollutants with risk of human cardiorespiratory diseases and even decreased life expectancy. For example, Pope et al.¹⁴ recently published an analysis using data from 51 U.S. metro areas showing that over the period of record, overall life expectancy has increased by 2.7 years, and reduction in exposure to PM_{2.5} accounted for as much as 15 percent of that increase.”

This sort of supplemental information shows that changes in air pollutants can directly impact and be linked to positive changes in life expectancy and other health outcomes, when analyzed at an appropriate level. The information reinforces the fact that there is indeed a quantitative relationship between the exposures and outcomes of interest when studied with appropriate statistical tools and using spatially and temporally compatible data sets, even if national-level indicators are not yet available.

EPA could further enhance its response to the outdoor air question by including supplemental information on air pollutant exposure and effects in wildlife. For example, a recent study found that mercury in bald eagles has decreased over a 15-year period in four locations on the shores of two of the Great Lakes.¹⁵ This data set would not meet the current indicator criteria because it is not representative of eagles across the United States or even the Great Lakes region in general. However, the supplemental information provided by this study could still help EPA answer the outdoor air question in the ROE, particularly the part of the question related to effects on the environment. This information could be included in the ROE with text such as:

“There are, however, limited data on exposure of wildlife to air toxics, most notably mercury. Indicators in the water chapter have nationally representative concentrations for mercury in coastal and lake fish tissues, which do relate to human exposure through consumption of fish. Bioaccumulation of mercury is also important in top predators. While there are insufficient data on which to base a national indicator, the state of Michigan has monitored mercury in the feathers of juvenile bald eagles on the shores of and tributaries to the Great Lakes. Geometric mean mercury levels in bald eagle feathers between 1985 and 1989 and 1999 and 2004 showed a slight decrease between the two sampling periods, which correspond to the time periods before and after the significant reductions in mercury emissions. These data are not necessarily representative of eagle populations nationwide, however, and therefore, do not meet the criteria for an indicator in the ROE.”

¹⁴ Pope et al. 2007. Fine-Particulate Air Pollution and Life Expectancy in the United States. *N Engl. J Med* 360:376-86; D. Krewski. 2009. Evaluating the Effects of Ambient Air Pollution on Life Expectancy. *N Engl J Med*;360:413-415; <http://content.nejm.org/cgi/content/full/360/4/413>; D.W. Dockery, et al. 1993. An Association between Air Pollution and Mortality in Six U.S. Cities. *New Engl J Med* 329:1753-1759; <http://content.nejm.org/cgi/content/abstract/329/24/1753>; Jerrett et al., 2009. Long-Term Ozone Exposure and Mortality. *N Engl J Med*;360:1085-95; <http://content.nejm.org/cgi/content/abstract/360/11/1085>)

¹⁵ Exhibit 20 in http://www.michigan.gov/deq/0,1607,7-135-3307_7255-11648--,00.html

Section 4. Proposed Use of Supplemental Information

EPA required that sub-national indicators, like national-level indicators, meet the indicator criteria to be included in the 2008 ROE. The ROE, therefore, does not include “case studies” that are not representative of a target population or data sets that do not meet other criteria (e.g., consistent collection methodologies, comparability over time and space). EPA did not include such case studies for the following reasons:

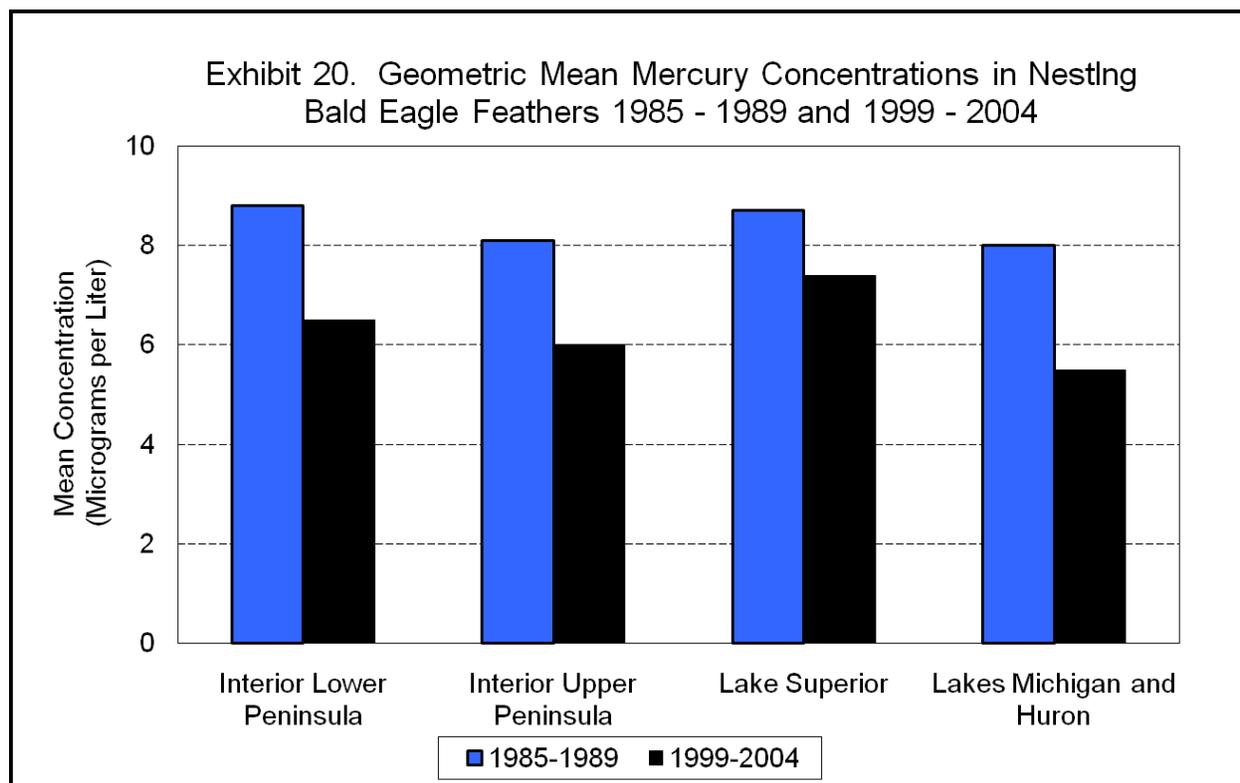
- Non-representative data sets (data from a single site or several non-representative sites) would not serve the purpose of the ROE. Trends observed at a small number of locations might indicate potentially more widespread trends, and they might identify the desirability of conducting representative monitoring at a larger scale. They do not necessarily identify a national or sub-national problem requiring a policy response.
- Including case studies that do not meet the indicator criteria creates thorny issues about which data to include and why—that is, how to select indicators on an objective basis without “cherry picking” data to support particular projects or positions.
- Including many sub-national non-indicator data sets that are not necessarily of national significance could dilute the national focus of the Report.

At the same time, EPA agrees that potentially valuable “supplemental information” on trends in human health and the environment deriving from special studies would be useful in addressing the ROE questions. Selection of this material would be informed by the conceptual models for the questions and related indicators. These materials would also help illustrate important indicator gaps and limitations and serve as possible candidates for future ROE indicators. Examples of supplemental information for inclusion in future reports are described in the examples presented in Section 3 of this paper: for the drinking water question, a USGS study of contaminants in private drinking wells, and for the outdoor air question, a study of fine-particulate air pollution and life expectancy in the United States, and a study of mercury in bald eagles on the shores of the Great Lakes.

As a way of including this kind of supplementary information, EPA proposes creating an indicator “incubator” site, perhaps using EPA’s “Indicator Gateway” (<http://www.epa.gov/indicators/>). The eROE could point readers to long-term data sets and other epidemiological and spatial analyses that, while not meeting the ROE indicator criteria, provide some insight into health and environmental trends that are relevant to the question. Figure 4-1 shows an example of what these materials might look like, along with explanatory text, for the bald eagle example discussed in Section 3.3.2 for the outdoor air question. Appropriate criteria would have to be developed for inclusion of these materials to avoid providing potentially biased or misleading information to the reader and to policymakers.

See Appendix F for additional discussion of ROE indicator criteria.

Figure 4-1. Mercury Levels in Bald Eagles in the Great Lakes



The bald eagle's position at the top of the food chain makes it a good indicator species for monitoring changing trends in levels of contaminants in the environment, such as mercury. The use of the bald eagle in this manner has been recognized by the International Joint Commission, the United States-Canadian entity charged with overseeing Great Lakes water quality protection. Building on an earlier research program, a consortium composed of the Michigan Department of Environmental Quality (MDEQ), U.S. Fish and Wildlife Service (USFWS), and researchers from Michigan State University (MSU) and Clemson University initiated the Bald Eagle Contaminant Monitoring Project in 1999. Under the project, eagle blood and feather samples were collected (using non-lethal procedures) from permanent inland nests, from nests in additional inland watersheds being assessed as part of the MDEQ's five-year rotating watershed schedule, and from Great Lakes and connecting channel nests.

Exhibit 20 compares the geometric mean mercury levels in bald eagle feathers between 1985 and 1989 and 1999 and 2004. Mercury concentrations showed a slight decrease between the two sampling periods, which correspond to the time periods before and after the significant reductions in nationwide mercury emissions shown in Exhibit 2-39 of the ROE. This trend also is related to an increase in the fledging success of bald eagles in nests in Michigan over the period. An important limitation of this study is that atmospheric mercury deposition trends were not monitored consistently in this region until 1998, so the decline in mercury in feathers cannot be attributed with known certainty to trends in atmospheric deposition over the period.¹⁶

¹⁶ http://www.michigan.gov/deq/0,1607,7-135-3307_7255-11648--,00.html

APPENDIX A. TEXT OF MEMO FROM EPA ADMINISTRATOR CHRISTINE TODD WHITMAN, NOVEMBER 13, 2001

TO: Assistant Administrators
General Counsel
Inspector General
Deputy Chief Financial Officer
Associate Administrators
Regional Administrators

On many occasions over the past months you have heard me outline my goals for the Agency, to make our air cleaner, our water purer, and our land better protected. These are the results that we, together with state and tribal partners, are working hard to achieve, and our progress toward these goals will be the measure of our success.

Of course, to know whether we are in fact making progress toward these goals, we need high quality information about the state of the environment. Therefore, I have asked the Office of Environmental Information in partnership with the Office of Research and Development to lead an agency-wide "Environmental Indicators Initiative" to gather and develop the information that will help us understand where we are and where we need to go in order to make sound, strategic decisions. I am pleased to announce that the President's Council on Environmental Quality (CEQ) has agreed to convene a federal interagency work group to support our indicators effort by inventorying and evaluating current indicators work across federal agencies. This effort will contribute significantly to EPA's ability to report health and environment conditions beyond the purview of our Agency.

It is also important that we hold ourselves accountable to the American public and report to them our progress in reaching the goals we have set for ourselves. Therefore, I am directing the Agency to prepare a State of the Environment Report, which will bring together national, regional and program office indicator efforts to describe the condition of critical environmental areas and human health concerns. To perfect this report will be a multi-year process, but I believe it is important to begin the process now, and commit to continuous improvement over time. The first Report, due in Fall 2002 will provide an inventory of EPA indicators, identify promising indicators that allow us to report on the environment, as well as identify data gaps and discuss the challenges we face in filling these gaps.

The indicators work and the State of the Environment report are critical steps in our more comprehensive approach to identifying priorities, focusing resources on areas of greatest concern, and managing our work to achieve measurable results. Concurrently, to ensure that our management processes are as effective as they can be, the Office of the Chief Financial Officer is leading a Managing for Improved Results Initiative that will examine a number of our current management practices, including priority-setting, planning and budgeting, performance tracking, measuring and reporting.

In the future, all of these efforts must converge into a single management system. Therefore, I am asking the Office of Environmental Information to develop a proposal by March, 2002 for an integrated, agency-wide information system for reporting key measurements, both activities and outcome measures, that reflect our progress in reporting about the environment. This system should better inform the Agency's policy and regulatory decision-making, provide more accurate and timely information, and easier public access.

These new initiatives will be guided by two agency-wide advisory groups, comprising senior leaders from several regional and national program offices. OCFO has already assembled a Steering Group, working with Deputy Administrator Linda Fisher, to support its work on improved results. I am asking Chief of Staff Eileen McGinnis to use the same Steering Group, adding other members as necessary, to guide the Agency's Environmental Indicators Initiative and oversee development of the State of the Environment Report.

I am fully committed to these efforts and will be working closely with the Steering Group to identify and implement improvements. However, this important work is not for managers alone. If we are to be successful, it is important that all EPA employees see how their work contributes, directly and indirectly, to the achievement of environmental results. I urge you to share information on these two new efforts with your staffs and solicit their ideas and feedback. Thank you for your support of these efforts, and I look forward to working together to achieve improved results.

/signature/

Christine Todd Whitman

cc: Linda Fisher
Eileen McGinnis
Kim Nelson
Paul Gilman
John Howard (CEQ)

APPENDIX B. CHRONOLOGY OF ROE REVIEWS, 2003-2008

June 2003	EPA publishes <i>the Draft Report on the Environment (ROE)—Technical Document</i> (ROE TD).
June 2005	EPA holds an external peer review meeting on the proposed indicators for EPA's 2007 ROE TD.
July 2005	EPA holds a public peer review workshop on the proposed indicators.
October 2005	EPA announces a second public peer review and public comment period for additional and updated proposed indicators for EPA's 2007 ROE TD
February 2006	EPA hosted an Agency review of the draft document, EPA's 2007 ROE TD.
March 2006	EPA releases the updates to the Indicators and the External Peer Review Comments with EPA's Response to Comments.
October 2006	EPA hosts an Interagency review of the draft document, EPA's 2007 ROE TD.
April 2006	EPA renames the Report from Technical Document to Science Report
May 2007	EPA releases the draft <i>EPA's 2007 ROE: Science Report</i> for a public review and comment.
July 2007	EPA's Science Advisory Board (SAB) hosts a public teleconference and public meeting of the SAB Panel for the Review of EPA's 2007 Report on the Environment to conduct a peer review of the draft <i>2007 ROE: Science Report</i>
October 2007	EPA hosts a public teleconference of the SAB Panel for the Review of EPA's 2007 Report on the Environment.
May 2008	EPA releases the final report, <i>EPA's 2008 Report on the Environment</i>

APPENDIX C. EXCERPTS FROM EXTERNAL COMMENTS ON ROE/INDICATOR INFORMATION AND AGENCY PLANNING

Government Accountability Office (GAO)

“...EPA’s effort [to develop and use environmental indicators] thus far has not functioned as a key component of an agency-wide comprehensive approach for managing EPA’s work to achieve measurable results. EPA has not initiated or planned an institutional framework with clear lines of responsibility and accountability for developing and using environmental indicators, and no processes, procedures, or work plans exist to link the results of the initiative with EPA’s strategic planning and performance reporting cycle.”

--*Environmental Indicators: Better Coordination Is Needed to Develop Environmental Indicator Sets That Inform Decisions*. November 2004. <http://www.gao.gov/new.items/d0552.pdf>

“EPA has generally agreed with our recommendations, and has made some progress in trying to obtain and use improved environmental information over the past several years. However, the agency’s efforts have been sporadic and spread among the various EPA offices. As such, the environmental information initiatives at EPA have been incomplete and lack a high-priority, coordinated, strategic approach that is necessary to link limited resources with the most critical data needs.”

--*Environmental Protection Agency: Major Management Challenges*. March 2009. <http://www.gao.gov/new.items/d09434.pdf>

National Advisory Council for Environmental Policy and Technology (NACEPT)

“NACEPT has for some time urged EPA to link its strategic plan with its other planning documents, particularly its Report on the Environment, proposed budget, and Performance and Accountability Reports. Such integration would help readers understand the Agency’s priorities more clearly.”

“A number of topical areas such as agriculture, fertilizer use, and sea surface temperatures that are mentioned in the Introduction of the Change Document as problems do not seem to appear in the performance measures section of the document. This appears to reflect a lack of connection between some of the issues identified as emerging from the Report on the Environment and the details of the planned activities of the Agency. More discussion of this apparent disconnect would help readers of the Strategic Plan to understand how EPA anticipates addressing these important issues. Alternatively, the appearance of performance measures for these issues would complete the process.”

--*NACEPT’s Comments on EPA’s Draft 2009-2014 Strategic Plan Change Document*. December 30, 2008. http://www.epa.gov/ocempage/nacept/reports/pdf/2008_1230_nacept_advice_letter.pdf

APPENDIX D. EXAMPLE: ALIGNMENT OF ROE QUESTIONS AND AGENCY OBJECTIVES¹⁷

GOAL 1: Clean Air and Global Climate Change

Protect and improve the air so it is healthy to breathe and risks to human health and the environment are reduced. Reduce greenhouse gas intensity by enhancing partnerships with businesses and other sectors.

Relevant 2008 ROE Questions	Strategic Plan Objective
<p><i>What are the trends in outdoor air quality and their effects on human health and the environment?</i></p> <p><i>What are the trends in human exposure to environmental contaminants including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in human diseases and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p>	<p>1.1 Healthier Outdoor Air: Working with partners, protect human health and the environment by attaining and maintaining health-based air-quality standards and reducing the risk from toxic air pollutants</p>
<p><i>What are the trends in indoor air quality and their effects on human health?</i></p> <p><i>What are the trends in human exposure to environmental contaminants including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in human diseases and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p>	<p>1.2 Healthier Indoor Air: Working with partners, reduce human health risks by reducing exposure to indoor air contaminants through the promotion of voluntary actions by the public.</p>
<p><i>What are the trends in human diseases and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p>	<p>1.3 Protect the Ozone Layer: Continue efforts to restore the earth's stratospheric ozone layer and protect the public from the harmful effects of UV radiation.</p>
	<p>1.4 Radiation: Working with partners, minimize unnecessary releases of radiation and be prepared to minimize impacts to human health and the environment should unwanted releases occur.</p>
<p><i>What are the trends in greenhouse gas emissions and concentrations?</i></p>	<p>1.5 Reduce Greenhouse Gas Emissions: Continue to reduce greenhouse gas emissions through voluntary climate protection programs that accelerate the adoption of cost-effective greenhouse gas reducing technologies and practices.</p>
	<p>1.6 Enhance Science and Research: Provide sound science to support EPA's goal of clean air by conducting leading-edge research and developing a better understanding and characterization of human health and environmental outcomes.</p>

¹⁷ 2008 ROE questions and objectives in 2009-2014 Strategic Plan Change Document

GOAL 2: Clean and Safe Water

Ensure drinking water is safe. Restore and maintain oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants, and wildlife.

Relevant 2008 ROE Questions	Strategic Plan Objective
<p><i>What are the trends in the quality of drinking water and their effects on human health?</i></p> <p><i>What are the trends in the condition of consumable fish and shellfish and their effects on human health?</i></p> <p><i>What are the trends in the condition of recreation al waters and their effects on human health and the environment?</i></p> <p><i>What are the trends in human exposure to environmental contaminants including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in human diseases and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in the extent and condition of ground water and their effects on human health and the environment?</i></p>	<p>2.1 Protect Human Health: <i>Protect human health by reducing exposure to contaminants in drinking water (including protecting source waters), in fish and shellfish, and in recreational waters.</i></p>
<p><i>What are the trends in the extent and condition of fresh surface waters and their effects on human health and the environment?</i></p>	<p>2.2 Protect Water Quality: <i>Protect the quality of rivers, lakes, and streams on a watershed basis and protect coastal and ocean waters.</i></p>
	<p>2.3 Enhance Science and Research: <i>Conduct leading-edge, sound scientific research to support the protection of human health through the reduction of human exposure to contaminants in drinking water, fish and shellfish, and recreational waters and to support the protection of aquatic ecosystems—specifically, the quality of rivers, lakes, and streams, and coastal and ocean waters.</i></p>

GOAL 3: Land Preservation and Restoration

Preserve and restore the land by using innovative waste management practices and cleaning up contaminated properties to reduce risks posed by releases of harmful substances.

Relevant 2008 ROE Questions	Strategic Plan Objective
<i>What are the trends in wastes and their effects on human health and the environment?</i>	3.1 Preserve Land: Reduce adverse effects to land by reducing waste generation increasing recycling and ensuring proper management of waste and petroleum products at facilities in ways that prevent releases.
<i>What are the trends in contaminated land and their effects on human health and the environment?</i>	3.2 Restore Land: Control the risks to human health and the environment by mitigating the impact of accidental or intentional releases and by cleaning up and restoring contaminated sites or properties to appropriate levels.
	3.3 Enhance Science and Research: Provide and apply sound science for protecting and restoring land by conducting leading-edge research, which, through collaboration, leads to preferred environmental outcomes.
<p><i>What are the trends in land cover and their effects on human health and the environment?</i></p> <p><i>What are the trends in land use and their effects on human health and the environment?</i></p>	

GOAL 4: Healthy Communities and Ecosystems

Protect, sustain, or restore the health of people, communities, and ecosystems using integrated and comprehensive approaches and partnerships.

Relevant 2008 ROE Questions ¹⁸	Strategic Plan Objective
<p><i>What are the trends in chemicals used on the land and their effects on human health and the environment?</i></p> <p><i>What are the trends in human exposure to environmental contaminants including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in human diseases and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in biomarkers of exposure to common environmental contaminants in plants and animals?</i></p>	<p>4.1. Chemical and Pesticide Risks: Prevent and reduce pesticide and industrial chemical risks to humans, communities, and ecosystems.</p>
<p><i>What are the trends in human exposure to environmental contaminants including across population subgroups and geographic regions?</i></p> <p><i>What are the trends in human disease and conditions for which environmental contaminants may be a risk factor, including across population subgroups and geographic regions?</i></p>	<p>4.2 Communities: Sustain, clean up, and restore communities and the ecological systems that support them.</p>
<p><i>What are the trends in the extent and condition of wetlands and their effects of human health and the environment?</i></p> <p><i>What are the trends in the critical physical and chemical attributes of the nation's ecological systems?</i></p> <p><i>What are the trends in the ecological processes that sustain the nation's ecological systems?</i></p> <p><i>What are the trends in the diversity and biological balance of the nation's ecological systems?</i></p> <p><i>What are the trends in the extent and distribution of the nation's ecological systems?</i></p>	<p>4.3 Ecosystems: Protect sustain and restore the health of natural habitats and ecosystems</p>
	<p>4.4 Enhance Science and Research: Identify and synthesize the best available scientific information, models, methods, and analyses to support Agency guidance and policy decisions related to the health of people, communities, and ecosystems. Focus research on pesticides and chemical toxicology; global change; and comprehensive, cross-cutting studies of human, community, and ecosystem health.</p>

¹⁸ Note that the indicators included to answer the 2008 ROE Question “*What are the trends in health status in the United States?*” can provide contextual information for this entire goal area.

APPENDIX E. EXCERPTS FROM SAB COMMENTS¹⁹ ON CONCEPTUAL FRAMEWORKS IN THE 2008 ROE

In the final Report, EPA should incorporate a conceptual framework into the introduction to illustrate the connectedness between the media, human health, and ecological condition chapters. Development of the conceptual framework will enable selection of better indicators by identifying the key stressors (drivers), responses, and outcomes that should be tracked to understand trends in the condition of air, water, land, human health, and ecosystems. The conceptual framework could be a short but comprehensive description and figure that demonstrates scientific understanding of relationships between the stressors, responses, and outcomes to human health and ecosystem condition.

The conceptual framework should address relationships between source, transport, and fate of human and environmental health hazards, as well as exposure to receptors, dose, and impact....The figure could be included in the introduction with appropriate similar figures at the beginning of each chapter to provide overall context for the chapter and illustrate how the chapters are connected. For example, in each chapter the relevant parts of the figure that show the role and importance of a given chapter could be highlighted in the graphic. This would provide the clear basis for the use and prioritization of specific indicators, the choice of scale and boundaries in regional indicators, and selection of metrics (i.e., thresholds, benchmarks, etc.) The choice in scale and metrics would provide the appropriate context for future monitoring and assessment of status and trends.

In the final Report, EPA should explicitly state how each question in the Report is related to a conceptual framework. The Panel recognizes that in the Report EPA has included “policy relevant” questions that are important to the Agency’s program offices. However, the conceptual framework that demonstrates understanding of the relationships between stressors, responses, and outcomes to human health and ecosystem condition should be the basis for developing questions to be answered in the Report. Once the appropriate questions are developed, EPA can consider their relevance to Agency policy.

A science framework consisting of a process model and discussion is needed in the final Report to provide context for the components by showing the interaction within, between, and among media and indicators as well as the effects on human health and ecosystem condition. The lack of such a framework is a significant problem. It is critically important for EPA to understand that data presented in isolation are not science. It is only when the data are explained as well as appropriately interrelated across factors and chapters that one gains the scientific understanding of what the data mean.

¹⁹ SAB Advisory on EPA’s Draft *Report on the Environment 2007: Science Report*. April 18, 2008. [http://yosemite.epa.gov/sab/sabproduct.nsf/8C1FFB16B9B182D085257432006369D0/\\$File/EPA-SAB-08-007-unsigned.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/8C1FFB16B9B182D085257432006369D0/$File/EPA-SAB-08-007-unsigned.pdf)

In the final Report, EPA should provide a clear description of why each indicator is important, the rationale for selecting the indicator, what it tells, and the documented relationship between the indicator and human health and ecological condition... For each indicator, the description could be provided in an introductory section that refers to the conceptual model or framework. This is critical in order to enable the reader to interpret the meaning of the indicator relative to the question. The primary stressors (e.g., air emissions data) are important indicators but the Report should more fully explain how these stressors contribute to answering questions in the Report.

APPENDIX F. ROE INDICATORS

This Appendix presents excerpts from the SAB advisory on the 2008 ROE regarding indicator criteria and selection. It then briefly discusses EPA's rationale for indicator selection in the 2008 ROE, and proposed changes going forward.

Excerpts From SAB Comments²⁰ on Indicator Criteria in the 2008 ROE

The Report on the Environment can be strengthened by selecting additional indicators to inform the stated questions... The Panel finds that, with some exceptions, appropriate indicators were selected. However, the rigid application of indicator selection criteria, particularly national representativeness, has resulted in the exclusion of valuable and relevant information.

In future Reports on the Environment, EPA should consider relaxing the restrictive indicator selection criteria so that additional indicators can be included. The use of restrictive indicator criteria resulted in selection of indicators supported by nationally representative data. However, long-term data were not available for many of these indicators, and thus trend analysis was not possible. Relaxing the restrictive criteria will enable EPA to use additional indicators in order to better evaluate trends and answer questions in the Report. In this regard, regional indicators supported by long-term data sets may be particularly useful. The Panel appreciates that EPA's indicator selectivity is in response to the 2004 SAB review, but the Panel feels the selection criteria have been made too restrictive and rigid such that useful data have been excluded. One way to revise the selection criteria in order to identify useful regional indicators and data sets would be to classify indicators according to completeness or rigor. This could supplement the current approach of classifying the data as national or regional. For example, indicators could be classified as high, medium, or low with respect to confidence in the ability to detect trends based on data continuity.

In future Reports on the Environment, it is recommended that EPA identify and use, with appropriate caveats, more regional indicators and data bases to illustrate trends when national data sets are not available. The Panel notes, however, that such regional data are not a substitute for national or even representative national data and can be misleading if not carefully presented. Regional indicators should also be used in future Reports on the Environment when they have national importance or are of particular significance to local populations. Long-term, well-supported data sets are available for such regional indicators. Examples include data available from the National Science Foundation's Long-term Ecological Research Program sites, U.S. Geological Survey (USGS) ground water basins, state agencies, and data collected on Lake Tahoe, Lake Mendota, and the Great Lakes.

²⁰ SAB Advisory on EPA's Draft *Report on the Environment 2007: Science Report*. April 18, 2008.
[http://yosemite.epa.gov/sab/sabproduct.nsf/8C1FFB16B9B182D085257432006369D0/\\$File/EPA-SAB-08-007-unsigned.pdf](http://yosemite.epa.gov/sab/sabproduct.nsf/8C1FFB16B9B182D085257432006369D0/$File/EPA-SAB-08-007-unsigned.pdf)

[T]here are many monitoring programs of EPA, other federal agencies, and states that have long-term data sets. These data sets may not be based on probabilistic surveys and the statistical approaches that meet the indicator selection criteria. However, they may provide good long-term data and, if appropriate, should be incorporated into future Reports on the Environment. The sampling deficiencies associated with the data should be discussed in the section on gaps and limitations. Ignoring decades of prior monitoring information because methodologies were not “up to” current standards results in the inability to see trends in many important parameters. The Panel notes that it is important to show trends and include caveats about methodology. As methods, indices, and statistical design continue to improve, EPA should not discard the present measurements in favor of the new and improved indices. When methods are changed, there should be a time when both the old and new methods are used in order to establish their comparability.

In future Reports on the Environment, it is recommended that EPA develop clear and transparent criteria that are uniformly used for the selection of regional indicators and case studies, with the recognition that not all data will meet the criteria for these regional indicators. For example, regional indicators should have long-term well supported data sets, be of particular national or local significance, or represent an assessment approach that that could be replicated.

EPA’s Rationale for 2008 ROE Indicator Selection and Proposed Changes

EPA understands the context of the review panel recommendations regarding “relaxing” the indicator criteria to be that the current criteria preclude the inclusion of potentially useful information based on sub-national data or even site-specific databases. EPA agrees that such information, if selected objectively and transparently, could play a useful role in answering the ROE questions. First, it would be helpful to review the rationale behind the current ROE indicator criteria and the selection of regional pilot indicators in the 2008 ROE.

The first four indicator criteria (see Box F-1) are based on EPA’s Information Quality Guidelines for information expected to have a significant impact on policy (<http://www.epa.gov/quality/informationguidelines/>). EPA included the fifth criterion (trend data are available and latest available data are timely) because trends in indicators draw more attention than status, and old data might not necessarily represent current status. The sixth criterion (comparability across time and space, representativeness of target population) is important for the ROE because noncomparable data can be mistakenly interpreted as showing spatial or temporal trends, and because nonrepresentative data can mask the true distribution of current conditions and trends. Figure F-1, for example, shows that 303(d) data on attainment of water quality criteria shift abruptly at state boundaries, and thus are not comparable across states or regions.

Box F-1. ROE Indicator Definition And Criteria

The ROE defines an indicator as “a numerical value derived from actual measurements of a stressor, state or ambient condition, exposure, or human health or ecological condition over a specified geographic domain, whose trends over time represent or draw attention to underlying trends in the condition of the environment.”

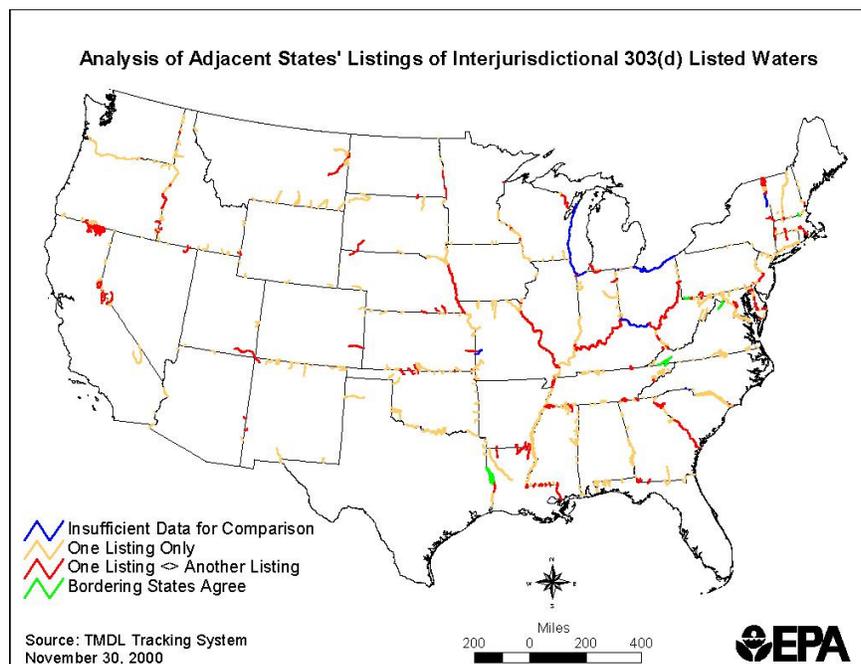
The ROE indicator definition intentionally excludes some categories of indicators—drivers; economic, social, and psychometric indicators; and administrative indicators. Indicators based on results predicted by environmental fate and transport models or risks to people or ecological systems are excluded as well.

The ROE emphasizes indicators that can be tracked over time; therefore, one-time studies are not included unless they serve as baselines for future trends.

All indicators presented in the ROE were peer reviewed against the definition and the following criteria, which ensure that the indicators are useful, objective, transparent, and scientifically reliable:

1. The indicator is useful. It answers (or makes an important contribution to answering) one of the 23 questions in the ROE. For example, “What are the trends in outdoor air quality and their effects on human health and the environment?”
2. The indicator is objective. It is developed and presented in an accurate, clear, complete, and unbiased manner.
3. The indicator is transparent and reproducible. The specific data used and the specific assumptions, analytic methods, and statistical procedures employed are clearly stated.
4. The underlying data are characterized by sound collection methodologies, data management systems to protect their integrity, and quality assurance procedures.
5. Data are available to describe changes or trends, and the latest available data are timely.
6. The data are comparable across time and space, and representative of the target population. Trends depicted in this indicator accurately represent the underlying trends in the target population.

Figure F-1. Lack of Comparability in State Water Quality Data



EPA believes that relaxing any of the ROE criteria could potentially lead to policy decisions based on indicators that are based on unreliable or questionable data, that are not broadly representative of the populations or resources that they describe, or are not objective and transparent. EPA believes that classifying indicators by completeness or rigor (in order to include data of lower quality) would also compromise the ROE’s credibility as a science-based indicator report with potential policy implications for the Agency.

EPA does not believe, however, that commitment to the indicator criteria precludes the addition of many sub-national indicators or of “supplemental” information that points to areas where data to support indicators would be highly desirable. (Section 4 of this paper provides additional discussion of the use of supplemental information in the ROE.)

Nor do the ROE indicator criteria prohibit adjusting indicator data or showing breaks at data discontinuities (as was done, for example, in the indicators of Submerged Aquatic Vegetation in the Chesapeake Bay and COPD rates). In addition, the ROE includes indicators that do not fully meet all the criteria, and the Report notes “limitations” for those indicators. EPA proposes to continue this approach.