

EPA-SAB-EPEC-LTR-94-004

November 5, 1993

Honorable Carol M. Browner
Administrator
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

Subject: Review of the Environmental Monitoring and Assessment Program's Draft
Assessment Framework

Dear Ms. Browner:

On June 21-23, 1993, the Ecological Processes and Effects Committee (EPEC) of the Science Advisory Board (SAB) met to review the draft Assessment Framework (dated May 14, 1993) for the Environmental Monitoring and Assessment Program (EMAP). EPEC has reviewed strategic aspects of the EMAP Program since its inception: evaluation of EMAP ecological indicators (EPA-SAB-EPEC-91-001), and the EMAP program plan (EPA-SAB-EPEC-91-011, EPA-SAB-EPEC-LTR-92-008). EMAP's Assessment Framework is a critical component of the program since it provides the framework for interpreting and evaluating EMAP results to answer policy-relevant questions about ecological resources.

In Future Risk: Research Strategies for the 1990's (EPA-SAB-EC-88-040) and in Reducing Risk: Setting Priorities and Strategies for Environmental Protection (EPA-SAB-EC-90-021), the SAB recommended that EPA plan, implement, and sustain a long-term monitoring and research program and report on the status and trends in environmental quality. Several years ago, partially in response to this recommendation, the Office of Research and Development (ORD) initiated EMAP. EMAP's goal is to monitor and assess the condition of the Nation's **ecological** resources and to contribute to decisions on environmental protection and management. Specifically, EMAP is intended to evaluate the Nation's ecological resources in terms of status and trends, geographic coverage and extent, and associations between stresses and ecological condition.

In June 1993, EPEC was asked by ORD to review the draft EMAP Assessment Framework with respect to the following questions:

- a) Is the proposed assessment approach consistent with EMAP objectives?
- b) Is the EMAP Assessment Framework appropriate to guide assessments in EMAP?
- c) Are the contributions and limitations of the proposed EMAP assessment approach to the Ecological Risk Assessment process clear?

We have organized our comments and recommendations under these three broad questions.

1. Is the proposed assessment approach consistent with EMAP objectives?

a) Importance of Assessment

We continue to feel that a greater priority should be placed on Assessment and Reporting within EMAP. While development of the Assessment Framework and the creation of an assessment team are positive steps, resources allocated to this component have been limited (approximately \$600,000 in Fiscal Years 1991 and 1992, and approximately \$700,000 in Fiscal Year 1993). Assessment and reporting, which entails the aggregation, interpretation, and communication of data from different resource types, locations, and scales, are the heart of EMAP and is the process which turns **monitoring data** into **information**. We urge the Agency to allocate a greater portion of the EMAP budget to the Assessment and Reporting component of the program.

b) Role of Research in EMAP

We acknowledge that the integration and assessment component of EMAP will probably require research to develop new techniques to ensure that EMAP assessment goals can be met. However, we feel that the research component of EMAP should be carefully delineated and separated from the data collection process. If the program is to deliver timely assessments of resource conditions, program managers will need to rely primarily on established indicators and analytical methods. Research into new methods and procedures at all steps of EMAP is unnecessary. EMAP should take advantage of existing state-of-the-science methods and approaches, recognize and identify the associated levels of uncertainty, and proceed with the development and analysis of monitoring data. Program managers

should, however, retain sufficient flexibility to incorporate new monitoring methods and indicators that may be developed in the future.

Nonetheless, research on methods for conducting regional assessments will be a major contribution from the EMAP Assessment and should be mentioned under Assessment Tools and Guidelines in the Assessment Framework.

c) Stressor Monitoring

Although the primary emphasis of EMAP's monitoring effort should be on effects, we agree with the incorporation of some stressor monitoring into the program. The EMAP Assessment Framework should more explicitly indicate the approach that will be used to incorporate stressor information into the assessment process. The relation of resource characteristics to potential stress is an important aspect of EMAP that can help to explain observed changes in ecological resources. Therefore, inclusion of stress indicators in the database is important and valuable. However, these data should be largely derived from other non-EMAP sources, where available.

In cases where stressor information is deficient or non-existent, carefully selected indicators of stress should be monitored by EMAP. In the case of forests, for example, it may be appropriate for EMAP to include some wet and dry deposition monitoring for atmospheric contaminants. Forest floors can provide extended term records of persistent chemicals such as heavy metals and chlorinated organic compounds. In addition, EMAP monitoring of rural/forest ozone may be the only means to obtain remote ozone exposure values.

2. Is the EMAP Assessment Framework appropriate to guide assessments?

Overall, the draft EMAP Assessment Framework clearly communicates the directions of the EMAP program and provides an appropriate mechanism for information management and evaluation. We commend the authors for the critical thinking that is evident in the document and for the progress this represents. We recommend, however, that the Agency revise the document to address the following issues:

a) Diagnosis: The Great Lakes Example

The Assessment Framework indicates that EMAP will utilize "weight of evidence" and "process of elimination" approaches to identify the most likely associations between effects and causal agents. The weight of evidence criteria listed in Table 6 of the document are appropriate and well-tested factors. Careful application of these criteria will allow consideration of a wide array of data analyses, both parametric and non-parametric, when characterizing temporal and

spatial associations. However, the results from a process of elimination are highly dependent on the scale at which temporal and/or spatial associations are sought. For example, the Assessment Framework includes a case study where the process of elimination is used to narrow the list of factors responsible for the widespread biotic changes in the Great Lakes over the last four decades. The choice of scale (the entire Great Lakes system), and the fact that toxic chemicals are broadly distributed across all six of the Great Lakes, led to the conclusion that impacts of toxic chemicals should be a dominant factor in the observed degradation of the biotic communities. However, this spatial association analysis does not consider concentration, exposure, effects, etc.

In fact, we know from direct observation that the ecological impacts to the Great Lakes were caused by different factors in different lakes, e.g.: demise of the Atlantic salmon in Lake Ontario was caused by habitat destruction; the perturbation of Lake Erie was due to eutrophication caused by phosphorus loadings; and the declines of the fish stocks in Lakes Huron, Michigan and Superior were due to overfishing and introduction of exotic species (e.g., sea lamprey and alewives). None of these events was caused by the impacts of xenobiotic chemicals.

The lesson learned from this example is that temporal and spatial associations should be considered **preliminary** hypotheses of causal relationships. Empirical validation, through literature surveys, professional interviews, and historical case studies, should be established before further analyses and/or final conclusions are drawn. Rigorous application of the criteria for inferring causality (particularly criteria four through eight in Table 6 of the Framework) would have drastically modified the conclusions presented in the Great Lakes case study.

Another concern with the Great Lakes assessment is that different ecological resources (e.g., fish, mammals, and birds) were assessed in relation to a common set of stressors. This approach ignores the fact that different ecological resources can be (are) at risk due to very different kinds of stresses.

b) Nominal vs. Subnominal Condition

The draft EMAP Assessment Framework discusses classification of resource condition into nominal and subnominal categories (pp 33-34). This section of the document should be revised to reflect the role of both societal values and ecological variability in this classification. For example, the definition of nominal vs. subnominal condition is based on a decision as to the desired state for ecological resources. The Assessment Framework should describe how the definition of nominal/subnominal conditions in EMAP relates to similar decisions under other Agency programs (e.g., definition of reference condition under the Biocriteria Program).

In addition, the Framework should discuss the effect of natural variability on the definition

of nominal/subnominal conditions. The terms "nominal condition" and "subnominal condition", as defined in the draft Framework, do not necessarily equate with "natural" and "anthropogenically altered" conditions, respectively. In other words, many natural conditions can result in uninhabitable, or "subnominal", environments. Such environments are not undesirable, but rather are an integral part of the natural world.

Finally, statistical methods that have been developed to estimate expected values are not necessarily applicable for estimating the extreme values used to define subnominal conditions of EMAP indicators. The Assessment Framework should reference statistical methods (e.g., extreme event analysis) designed for this purpose.

c) Consideration of Uncertainty

We feel strongly that the Assessment Framework should include a discussion of the sources and nature of uncertainties inherent in EMAP assessments. A critical component of ecological risk assessment that differentiates this activity from traditional assessment is the explicit consideration of uncertainties. These uncertainties are propagated through the assessment towards an ultimate expression of risk. Assumptions and uncertainty issues will affect the accuracy of predictions and correlations made in all phases of EMAP, and will ultimately have a major influence on the ability of the program to achieve its objectives. Readers, user groups, and researchers should all be made aware of the limitations inherent in the process. An early and full discussion of these issues should be included in future drafts of the Framework.

d) Integration Across Resource Groups

We agree that the monitoring and assessment should be applied across the basic resource groups (agroecosystems, arid ecosystems, etc.), as well as across landscapes. (Note, however, that the preferred term for the broad scale group is "landscapes" rather than "landscape ecology," as contained in Figure 5 of the draft Framework.) In keeping with this emphasis, we urge that the integration aspects of EMAP assessment be given sufficient visibility and resources as a distinct task. There are cross-cutting issues and integration methodologies that are of sufficient importance to warrant the focus of a specific unit within EMAP. Currently, much of the integration and assessment activity is occurring within the individual resource groups. We recommend that EMAP establish a centralized group,

including representatives from each resource group, with the mission of integration and assessment.

3. Is the relation between the proposed EMAP Assessment Approach and EPA's Ecological Risk Assessment Framework clear?

EMAP is an example of the application of the Framework for Ecological Risk Assessment (Ecorisk Framework, EPA/630/R-92/001) at regional and national scales. As such, the EMAP Assessment Framework should incorporate the terminology and diagrams used in the Ecorisk Framework, rather than portraying the EMAP assessment approach as an alternative to the Ecorisk Framework. For example, the steps in EMAP assessments (assessment questions, data analysis, and interpretation and communication) correspond directly to the components of ecorisk assessment (problem formulation, analysis and risk characterization), the selection of nominal/subnominal conditions corresponds to the selection of endpoints, etc. Since the Ecorisk Framework will lead to the over-arching Ecological Risk Assessment Guidelines, all Agency programs should adopt the Ecorisk Framework nomenclature when possible. The use of different terminology in the EMAP Assessment Framework is confusing and unnecessary, and should be corrected in future drafts.

In order to further clarify the relationship between the EMAP Assessment Framework and the Ecorisk Framework, we recommend the following changes to the Assessment Framework:

- a) Delete references to the Ecorisk Framework as being predictive rather than retrospective. In fact, the Ecorisk Framework is designed for both predictive and retrospective ecological risk assessments. Thus, EMAP's emphasis on retrospective assessment fits within the Ecorisk Framework.
- b) Indicate that EMAP assessments are not external to the ecorisk assessment process, and include all phases of ecorisk assessment. This point might best be made by revising Figure 4 in the Assessment Framework, and substituting Ecorisk Framework terminology for that used in Figures 6, 7, 10 and 14 of the Assessment Framework.

These changes are more than cosmetic, for they emphasize the relation between the two efforts.

Final Comments

We appreciate the opportunity to review the draft EMAP Assessment Framework. As the conceptual guide to assessments within EMAP, we feel the Framework document is important and well-conceived. We understand that work is now underway to develop an EMAP Assessment Methods Manual. The development of EMAP assessment tools and guidelines will provide an important opportunity to couple the EMAP Assessment Framework with other related EPA efforts (e.g., biocriteria, bioindicators, ecorisk issues, and habitat characterization) which are focusing on operational techniques. Developments from these related programs must be incorporated into the EMAP assessment guidelines, either directly or by reference, to provide a consistent and compatible approach to ecological assessment for the Agency. We hope to have an opportunity to review the EMAP Assessment Methods Manual which is being developed, and we look forward to your response to the issues raised in this letter.

Sincerely,

/signed/

Dr. Raymond C. Loehr, Chair
Executive Committee
Science Advisory Board

/signed/

Dr. Kenneth L. Dickson, Chair
Ecological Processes and
Effects Committee

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ROSTER

June 21-23, 1993

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