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

May 29, 2008

OFFICE OF WATER

MEMORANDUM

SUBJECT: Request for Advisory from the U.S. Environmental Protection Agency Science Advisory Board Ecological Processes and Effects Committee regarding recommendations for the Mode of Action "Methodology" for Deriving Water Quality Criteria for the Protection of Aquatic Life.

FROM: Edward Ohanian PhD, Director, Health and Ecological Criteria Division, Office of Science and Technology
Office of Water

To: Thomas Armitage, Designated Federal Official
USEPA Science Advisory Board Staff Office

This memorandum is to request an advisory from the U.S. Environmental Protection Agency Science Advisory Board regarding recommendations prepared by the EPA Office of Water/Office of Research and Development Emerging Contaminants Workgroup regarding a Mode of Action "Methodology" for deriving ambient water quality criteria (AWQC) for the protection of aquatic life. This white paper is intended to discuss some of the major issues that challenge development of AWQC for contaminants of emerging concern (CECs), as well as present recommendations that address those issues and may allow progress with respect to derivation of AWQC for CECs. This document was prepared by the Office of Water and the Office of Research and Development in consultation with experts and partners from the Office of Pollution Prevention and Toxics. The document has been made available for public comment as of June 3, 2008 at http://www.epa.gov/waterscience/criteria/aqlife.html#guide.

It will serve as the foundation for decision-making for the subsequent development of AWQC for CECs when the need arises. It does not supercede the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* or "*Guidelines*" (Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman and W.A. Brungs, PB85-227049, (available through NTIS or http://www.epa.gov/waterscience/criteria/library/85guidelines.pdf), rather it serves as supplemental information to guide the problem formulation and effects characterization of the ecological risk assessment paradigm as applied to ambient water quality criteria development for aquatic life.

Attached are the charge and questions to the Science Advisory Board that provide background information as well as questions that are requested as the focus of the SAB review committee's advisory on this white paper.

Attachments:

1. Ecological Processes and Effects Committee Charge and Questions

2. AQUATIC LIFE CRITERIA FOR CONTAMINANTS OF EMERGING CONCERN: PART I - GENERAL CHALLENGES AND RECOMMENDATIONS

3. AQUATIC LIFE CRITERIA FOR CONTAMINANTS OF EMERGING CONCERN: PART II - ILLUSTRATION OF RECOMMENDATIONS USING DATA FOR 17α-ETHYNYLESTRADIOL (EE2)

Background

The U.S. Environmental Protection Agency (EPA), Office of Water, is charged with protecting aquatic life, wildlife and human health from adverse anthropogenic, water-mediated effects under the purview of the Clean Water Act (CWA). In support of this mission, the Office of Water's Office of Science and Technology (OST) develops ambient water quality criteria (AWQC) that serve as guidance to states and tribes to assist them in their adoption of water quality standards. In 1985, EPA published *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and Their Uses* or "*Guidelines*" (Stephan, C.E., D.I. Mount, D.J. Hansen, J.H. Gentile, G.A. Chapman and W.A. Brungs, PB85-227049, National Technical Information Service, Springfield, VA). The majority of EPA's currently recommended AWQC for aquatic life (aquatic life criteria or ALC) have been derived using the methods outlined in the *Guidelines*, which specify various data and procedural recommendations for criteria derivation, and also define general risk management goals for criteria. Section 2 in Part I of the white paper provides a brief description of the *Guidelines* procedures and identifies several areas particularly relevant to this advisory.

The Agency's Emerging Contaminants workgroup has prepared the accompanying white paper to address some of the challenges facing the development of ALC for contaminants of emerging concern (CECs). The term CEC has been used to identify chemical compounds that have no regulatory standard (e.g., ambient water quality criteria), have been recently "discovered" in the natural environment because of improved analytical chemistry detection levels, and potentially cause deleterious effects in aquatic life at environmentally relevant concentrations. In general, widespread uses, some indication of chemical persistence, effects found in natural systems, and public concerns over some CECs, have made clear the need for EPA to develop criteria that can be used to help assess and manage their potential risk in the aquatic environment. The Agency is particularly concerned about pharmacologically active ingredients and personal care products commonly discharged at wastewater treatment plants that are designed to stimulate a physiological response in humans, plants, and animals. Many of these compounds are known (or suspected) to disrupt endocrine function in animals, and thus are referred to as endocrine disrupting chemicals, or EDCs. The synthetic hormone ethynylestradiol used for birth control is an example of one such EDC that demonstrates a reasonable potential to adversely affect aquatic life.

EPA is seeking advice from the Science Advisory Board (SAB) Ecological Processes and Effects Committee (*Committee*) regarding the technical soundness of the white paper as the basis for future development of water criteria for CECs. The white paper discusses how principles in the *Guidelines* could be interpreted and adapted to develop ALC for CECs. Technical challenges and recommendations are described in the first part of the white paper (Part I), entitled "General Challenges and Recommendations." The second part of the white paper (Part II), "*Illustration of Recommendations Using Data for 17α – Ethynylestradiol (EE2)*," explores the workgroup recommendations in the context of an example CEC, ethynylestradiol (EE2), a synthetic pharmaceutical estrogen.

Charge to SAB

1. The following recommendations have been developed to address important technical challenges and issues in deriving water quality criteria for CECs. Please comment on the technical merit, practicality, and implementability of the recommendations addressing the following issues as described in Part I of the white paper and the EE2 Case study in Part II .

    a. Relevance of Acute Toxicity Effect Concentrations in Setting ALC for CECs:

Criteria consist of a Criterion Maximum Concentration (CMC), intended to address acute lethality and a Criterion Continuous Concentration (CCC), intended to address effects of chronic exposures on survival, growth, and reproduction. Many CECs are physiologically active at concentrations orders of magnitude lower than those causing acute lethality, and the high concentrations sufficient to cause lethality may never occur in the environment. Rather than rotely require a robust acute toxicity data set for such chemicals, the workgroup recommends that aquatic life criteria consist of only a CCC and that no CMC be derived, when sufficient information demonstrates risks of acute lethality are negligible.

b. Defining Minimum Data Requirements Regarding Taxonomic Coverage:

If an acute criterion is not calculated, then the CCC cannot be calculated using the acute to chronic ratio (ACR) approach and must be instead calculated directly from chronic toxicity data. Procedures for this are included in the *Guidelines* (pages 40-42), but they require that acceptable chronic toxicity tests be conducted for a broad range of taxonomic groups. In the case of many CECs, toxicological research tends to focus on organisms for which the MOA is most relevant (e.g., vertebrates for estrogen mimics) and may have limited data coverage for other taxonomic groups that will likely be less sensitive. To avoid generation of resource-intensive chronic toxicity data for insensitive species that will have little impact on the final criterion, the workgroup recommends interpreting the minimum data requirements for taxonomic coverage as <u>information</u> requirements instead of <u>toxicity test</u> requirements. By this we mean that, rather than requiring an acceptable chronic toxicity test, the data requirement for certain taxonomic group expected to be insensitive might be met by a body of information demonstrating insensitivity of the taxon.

c. Use of Non-Resident Species in Criteria Development:

Historically, EPA has not used data derived from toxicity testing with non-resident species in the actual criteria derivation process. Excluding species simply because they are not resident may be unnecessarily restrictive for the purposes of deriving national criteria, and may actually increase rather than decrease uncertainty. The workgroup recommends that non-resident species be considered for use in criteria derivation calculations, focusing on those species with widely used and standardized test methods and for which there is no reason to believe would misrepresent the sensitivity of comparable resident species. Furthermore, the workgroup specifically suggest accepting data for zebrafish (*Danio rerio*) and Japanese medaka (*Oryzias latipes*), to reflect international efforts toward data equivalency.

d. Defining Appropriate Chronic Toxicity Data:

For fish, the *Guidelines* allow the use of early life stage (ELS; egg to juvenile) exposures in lieu of full life-cycle (F_0 egg to F_1 offspring) or partial life-cycle (F_0 adult to F_1 juvenile) exposures for determining chronic toxicity of chemicals, unless there is reason to believe this is inappropriate. Current understanding of many CECs, particularly EDCs, is that important effects of these chemicals may not occur, or at least not be expressed, until after the ELS exposure window; in fact, partial life-cycle exposures may also miss important effects, such as those on sexual development. For such chemicals, it is clear that the definition of an acceptable chronic test must include consideration of key windows of exposure and effect (e.g., to include sexual development and reproduction in assessments of steroid hormone agonists/antagonists). However, even more broadly, the workgroup recommends that the Office of Water consider amending the chronic data acceptability

requirements in the *Guidelines* to require at least one full life-cycle test for a fish (for invertebrates, life-cycle tests are already required) unless there is a compelling body of information indicating that life processes outside the early life stage or partial life-cycle exposure/observation window are not critical to capturing the biologically important effects of chronic exposure to the chemical. This amended requirement would include all chemicals, not just EDCs/CECs.

e. Selection of Effect Endpoints Upon Which to Base Criteria:

Aquatic life criteria typically are based on direct measures of survival, growth, and reproduction; other measures of response are generally not included unless they can be shown to be closely linked to expected changes in population dynamics. The workgroup supports this existing guidance, but recognizes that many CECs, particularly those with very specific modes of action like steroid hormone agonists/antagonists, will have data for a wide variety of histological, biochemical, physiological, or behavioral endpoints that may warrant consideration as measures of biologically important effects. The degree to which such measures can be used to infer population level effects is likely endpoint-, chemical-, and/or organism-specific, and developing a universal list of recommended endpoints is therefore beyond the scope of the workgroup to make specific, comprehensive recommendations. Rather, the recommendation here is simply that criteria development more thoroughly explores such possibilities.

f. Involvement of an Expert Panel:

While not addressed explicitly in the *Guidelines*, the complexities involved in the assessment of many CECs, and the reliance on professional judgment in making some of the determinations required under the workgroup's recommendations, make clear the need to bring the best scientific knowledge to bear in the development of criteria for CECs, as well as other chemicals. The workgroup supports the recommendation from a SETAC Pellston workshop (2003) that criteria development involve recruitment of an expert panel early in the process to insure that all relevant issues are considered during initial development of the criterion and to provide scientific perspective on decisions that are made as part of the process. Such a panel would not undermine the authority of the Agency to make policy decisions regarding criteria, but would ensure that such policy decisions are made from the best possible technical foundation. It is envisioned that expert panels would be formed around specific chemicals, or perhaps groups of chemicals with chemical or toxicological similarities (e.g., same MOA).

2. Please comment on whether EPA has identified the appropriate issues to be addressed in deriving ALC for CECs. Are there additional important issues that EPA has not identified?

3. Part II of this white paper was specifically developed as a companion to Part I and focuses on the use of ethynylestradiol as a model chemical to illustrate the technical issues presented by the workgroup, as well as providing a basis for understanding the recommendations. Does the *Committee* have suggestions that may improve the utility of Part II of this white paper for the purposes stated above?

4. Does the *Committee* have suggestions that would assist EPA in implementing the proposed recommendations discussed in the white paper, particularly with respect to developing the necessary scientific data and information and/or providing expert scientific input at the appropriate stages of the risk assessment process?