amsa

Association of
Metropolitan
Sewerage Agencies

September 25, 2000

Mr. Robert Cantilli
Nutrient Team Leader
U.S. Environmental Protection Agency
Office of Science and Technology
Ariel Rios Building (4304)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: COMMENTS ON NUTRIENT CRITERIA TECHNICAL GUIDANCE MANUAL - RIVERS AND STREAMS, EPA-822-B00-002

Dear Mr. Cantilli:

In response to the notice provided in the Federal Register the Association of Metropolitan Sewerage Agencies (AMSA) is providing comments concerning the referenced document. As done previously with the Lakes and Reservoirs document our comments were developed in a three pronged approach including a technical review, presentation of proposed solutions, and recommendations for next steps. To further assist in the process AMSA contracted the services of HydroQual, Inc to provide their independent review of the guidance. Their comments are provided in Attachment 1.

Technical Review

1. General Comments

The authors indicate that "*the purpose for the document is to provide scientifically defensible technical guidance to assist States and Tribes in developing regionally based numeric nutrient, algal, and macrophyte criteria for river and stream systems.*" This section also recognizes that "*water quality criteria are based on scientifically derived relationships among water constituents and biological condition*". Our review of the guidance indicates that the methods fall short of these objectives. Although a variety of methods were presented, many did not represent genuine flexibility but rather expediency. In contrast to flexible methods, expedient approaches will serve to satisfy the immediate need for criteria "numbers" but will do so without regard for their technical defensibility or the associated regulatory consequences. As HydroQual states and AMSA agrees "*it is this philosophical departure from effects based criterion setting that which is most disagreeable and which creates a fundamental problem of scientific credibility for the regional nutrient criteria setting process.*"

2. Nutrient and Algal Criteria Development

The authors describe three general approaches in Chapter 7 that water quality managers "*can use to derive numeric criteria*" for their State / Tribal ecoregions: (1) use of reference streams, (2) applying predictive relationships to select nutrient concentrations that will result in appropriate levels of biomass, and (3) developing criteria from thresholds established in the literature. Each of those approaches will be reviewed below:

a. Using Reference Reaches to Establish Criteria

AMSA is deeply concerned over both the technical indefensibility of this approach and the regulatory consequences that seem inevitable as a consequence of its use. Specific comments are provided below:

<u>Lack of relationship to beneficial uses</u>

The use of the reference conditions / percentile approach relies on a flawed assumption that a trophic continuum exists where nutrient effects are generally proportional to the instream concentration and/or loading to the system. In other words, it is assumed low nutrient levels will produce minimal or no effects while greater levels of enrichment will produce adverse consequences. Although some lakes may respond in such a manner because they are generally less complex systems, rivers and streams rarely exhibit such simple relationships between nutrient loading / concentrations and associated effects on biota. For example, in many cases nutrient concentrations may be low and produce high chlorophyll values because the nutrients are consumed and incorporated into algal biomass. In other cases the grazing of phytoplankton by zooplankton or other secondary consumers may serve to complicate the understanding of the impacts of nutrient driven eutrophication. For water quality assessment and enforcement purposes establishing a criteria value which serves to separate "enrichment" from "impairment" with regard to effects on beneficial uses is essential. This same concern is indicated by HydroQual as they state "*...evaluation based on frequency distributions of primary variables from a variety of streams even within some defined ecoregion simply does not contain information about the causal relationships between those variables and the potential for impairment of biological integrity in any given stream or reach*". The authors of the guidance also apparently recognize the indefensibility of the percentile approach because they state "*frequency distributions can be used as an 'aid' to setting criteria...and other managers may consider additional options, such as developing criteria to protect the* *designated uses established for local streams*". The establishment of linkages between beneficial uses and criteria represents a requirement not an option of the Clean Water Act.

Adverse regulatory consequences will ensue from its use

Because the use of reference condition / percentile approach represents an expedient method, the data requirements and professional expertise needed to employ the method are quite minimal. All that is required are judgements regarding which areas should be considered reference along with elementary data analysis involving certain percentile values. Provided a selection of which percentiles to employ (arguably arbitary) a manager can handily develop criteria for easy use in water quality assessments, listings of impairment, and TMDLs. AMSA believes that having such a grossly over-simplified method represented as a viable option for criteria development will prove highly attractive to those States or Tribes which have little experience in eutrophication issues or lack resources. This same concern is echoed by HydroQual as they state "*even in light of the document's stated caveats, managers may view this as the simplest, least costly approach to criterion setting, without a clear understanding of the processes leading to a given stream's susceptibility for impairment or ability to assimilate nutrients without impairment.*"

On the basis of presentations at the recent National Nutrient Criteria Stakeholders meeting we believe that EPA intends to use the percentile approach to establish regional "default" criteria. This sets the stage for trouble. If used as expected, the end result will likely be a set of criteria that serve to create unnecessary 303(d) listings and TMDLs. AMSA is not alone in its concern regarding the regulatory consequences of the percentile approach. Provided in Attachment 2 are comments to the agency from the New England Interstate Water Pollution Control Commission (NEIWPCC) concerning the implications of the use of percentile based criteria on the number of potential violations. Their analysis indicated that from 50-75% of the lakes in that region would be in violation of the proposed criteria while only a small proportion of these lakes fail to meet their designated uses. This example documents the disconnect between beneficial uses and criteria developed under such a system. Obviously, the costs to the public for compliance in such a criteria scenario would be staggering while the resources devoted to meeting them would not be commensurate with benefits.

Another real-world example which recently has been brought to our attention and is also discussed in comments by the Los Angeles County Sanitation District, involves the establishment of nutrient limits for the Las Virgenes Municipal Water District (Las Virgenes) located in Calabasas, California. Earlier this year, Las Virgenes published the results of a nutrient study on its receiving waters which it conducted, following EPA guidelines, to assist the state of California in developing nutrient criteria. Algae levels were high in the receiving water so the state assumed the receiving water was impaired, but after the study was conducted, it was determined that high algae levels were the natural state of the receiving water. In addition, no causal relationship between effluent nutrient concentrations and algae levels could be found. Based on these findings, it was determined that nuisance algae control by reductions in effluent nutrient concentrations is not achievable, and regional board staff recommended that no limits for nutrients be developed. However, due to political pressure, the regional board told its staff it had to come up with limits, and in response, staff used a method that resembles the frequency distribution methods included in the guidance. Through statistically analyzing a group of impaired and unimpaired southern California streams, regional board staff have proposed that the nitrogen criterion be 2.5 mg/L. This number is so low that Las Virgenes will not be able to discharge effluent without the addition of advanced treatment. This chain of events concerns us because local regulators are placing more confidence in imprecise methods included in this guidance document than in site-specific scientific data.

<u>The percentile method must be relegated to a screening role</u>

The comments of HydroQual and those of the NEIWPCC should be viewed as independent validations of AMSA's technical and regulatory comments associated with the reference condition – percentile based approach. The Las Virgenes example also shows a real world example of our regulatory concerns involving POTWs.

After a consideration of all factors it is considered <u>absolutely essential</u> that the percentile based approach be presented in the guidance as only a screening tool and, therefore, unsuitable as a means to derive numerical criteria values. This recommendation is supported by ample and compelling evidence which indicates (1) the method is not technically defensible in association with the Clean Water Act, and (2) the method seems certain to create adverse and unnecessary regulatory consequences in the near future. Its limited role as a screening tool is appropriate, justified, and consistent with the issues identified by AMSA and HydroQual, as well as the actual disclaimers provided by the authors of the guidance document.

b. Using Predictive Relationships To Establish Criteria

<u>Trophic state classification</u>

The guidance indicated that there is no generally accepted system for classifying the trophic states of streams. However, a proposed system was described where the trophic state is divided into thirds based upon the cumulative frequency of the nutrient measurements. We do not view this method as being based on a predictive relationship but rather as only a variant of above reference condition / percentile approach. Given the little literature available on this method we recommend deleting it from the document.

<u>Models</u>

The guidance document provides limited references for models which have been developed to establish relationships between nutrients (TN/TP) and benthic algal biomass or phytoplankton. Provided that benthic algal biomass and desired levels of phytoplankton represent an appropriate beneficial use, AMSA supports the use of predictive models as a means to establish nutrient criteria. Also, as indicated in the guidance AMSA agrees that models are often the best approach to evaluate point and non-point source loadings and to direct their control strategies. This section of the guidance was considered too short and brief. We believe this section should be expanded to provide additional references and example applications for models. The use of predictive models represents an approach which has the greatest promise to establish defensible criteria values. Attached comments from HydroQual recommend the use of mechanistic models over the percentile approach as they state "*a mechanistic framework can explicitly consider the natural variability in the response of receiving water bodies to nutrient inputs and, therefore, is more scientifically sound than a regional numerical value determined from percentile values.*" The use of mechanistic models is a key element in AMSA's proposed solutions described in a subsequent section. HydroQual's comment section "*Metals Criteria; A Model for Criteria Development*" provides a good example of how models can be used in the process to elucidate site-specific issues.

Biocriteria

The guidance document indicates there are two ways to use biocriteria to establish water quality criteria. In the first approach the authors appear to confuse water quality for biology as they state "*This is why ecoregional and water-body specific nutrient criteria are recommended and chlorophyll a and secchi depth/turbidity, arguably biocriteria, are required*". AMSA contends that chlorophyll, secchi depth, and turbidity reflect water quality conditions but certainly not biocriteria. Chlorophyll cannot be considered a substitute of phytoplankton species composition because it reflects only an estimate of the mass of the photosynthetic standing crop and thus provides no information regarding the biological health of the phytoplankton community. Because secchi depth and turbidity is also affected by inorganic suspended solids it is generally unrelated to biology.

Regarding the second approach the authors mention relating various multi-metric indices for fish and macroinvertebrates to nutrient status. AMSA generally supports the use of biology and biocriteria in such a manner to establish nutrient criteria because living resources and a balanced ecosystem represent goals consistent with beneficial uses. However, we recommend caution in developing relationships between biocriteria and nutrients. In developing such relationships a plausible cause and effect (i.e. dose-response) relationship must be demonstrated, not just simple correlation or statistical coincidence. Refer to our review of the Case Studies in Appendix A (Tennesee Ecoregion Nutrient Criteria). In that case study, biocriteria were used inappropriately because (1) the conclusions were based on simple correlation without a reasonable analysis of co-variation, and (2) there was no demonstration made regarding a plausible mechanism for cause and effect.

c. Using Published Nutrient Thresholds or Recommended Algal Limits

Nutrients

AMSA believes that the use of nutrient thresholds contained in the literature for the purposes of nutrient criteria development be viewed with extreme caution. Many of the examples provided threshold values for the purposes of classification not criteria derivation. Also, as indicated in the guidance document, the applicability of their potential use is severely limited due to site specific constraints. As previously stated, it is essential that nutrient criteria be established upon relationships between nutrients and the beneficial uses. Because there are many different approaches each individual threshold value reported in the literature should be evaluated in the context of that objective before those data are used in the development of nutrient criteria. It is outside of the scope of our comments to review each threshold value contained in the literature.

Algal biomass

AMSA has general concerns with relating nutrient criteria too heavily on "desirable" algal biomass or chlorophyll values. Considered alone, various levels of algae and/or chlorophyll may or may not be directly related to beneficial uses. In other cases, however, we recognize that if levels are too high they can lead to aesthetic problems, nuisances, or impacts on living resources (i.e. impairments). In order to defensibly use these response variables as a means to establish nutrient criteria there must be associations demonstrated between the target algal biomass levels (which drive the criteria) and the beneficial uses. In the absence of that determination management goals and associated actions could be driven by arbitrary or meaningless targets and would be inconsistent with Clean Water Act requirements.

Provided that algal biomass targets are found appropriately based on beneficial uses, predictive models have been shown to be effective in relating nutrient concentrations to algal levels and other associated responses (DO, pH, etc). The comments of HydroQual, however, indicate that caution should be exercised in interpreting the results and show a need to demonstrate an adequate level of predictive power in those assessments. They also stress that other multiple factors besides nutrients (grazers, shading, substrate) must be considered to obtain credible results with predictive tools.

3. Review of Nutrient Criteria Case Studies

Appendix A of the guidance provides five case studies intended to *"provide the reader with real-world examples of how nutrient criteria can be developed on a practical level and process"*. Our review of these case studies indicated that only two of the five represented actual examples of attempts at criteria derivation ("Tennessee Ecoregional Nutrient Criteria" and Clark Fork River – Scientific Basis of a Nutrient TMDL for a River of the Northern Rockies). The remaining case studies were considered research information.

The case studies involving those referenced for Tennessee and Montana's Clark Fork River provide excellent examples of both what should and what should not be done to establish nutrient criteria.

a. Tennessee Ecoregional Nutrient Criteria

The Tennessee case study provides a good example to illustrate the dangers and pitfalls of using the reference condition / percentile approach to establish criteria. Although successful in developing criteria "numbers," consistent with EPA guidance, the methods have not been linked to beneficial uses, and consequently are viewed as indefensible in relation to the requirements of the Clean Water Act. In fact, the terms "beneficial uses", "designated uses", or "uses" are never mentioned in this case study. Further, their own analysis indicates the confounding influence of other parameters and potentially biased National data sets (refer to HydroQual comments for details.)

Another disturbing aspect of this case study in criteria development involves inappropriate assessments involving biocriteria. In the analysis the authors evaluated the nitrate values of their data set relative to the North Carolina Biotic Index (NCBI) by correlation analysis. Their correlation analysis found an increasing index with increasing nitrate + nitrate concentration. In association with these results the authors conclude that "*such correlations could be used to strengthen a criteria justification and insure that potential criteria values will be protective of biological integrity*." AMSA strongly disputes this finding because there have been no reasonable cause and effect demonstrations made between the nitrate values and biological communities. Statistical correlation does not indicate cause and effect but rather coincidence. It is much more likely that the response with the index scores are due to other variables that co-vary with higher nitrate values such as physical conditions, habitat factors, etc. The effects of co-varying parameters as well as plausible biological mechanisms for cause and effect should have been investigated in this case study before drawing conclusions. *AMSA urges the agency to either remove this case study from the document or clearly articulate the problems and potential solutions involving this case study.*

However, as previously stated AMSA supports the proper use of biocriteria in the establishment of nutrient criteria in concept provided that they are employed in an appropriate manner.

b. Clark Fork River – Scientific Basis of a Nutrient TMDL for a River of the Northern Rockies

In contrast to the Tennessee example, this particular case study was viewed as a reasonable approach to the establishment of nutrient management measures. It also demonstrates that strict nutrient criteria are not needed in cases where cooperative programs are already in place to address nutrients. In this particular case study a problem associated with beneficial uses was identified that involved massive algal growth and low dissolved oxygen. In response to those problems a Council was established which was composed of a group of stakeholders representing cross section of the community (including dischargers).

Over a relatively short period of time a model was developed to assess various management strategies involving nutrient reductions from various sources and their effects on restoring the beneficial uses. The end result of this process was a voluntary nutrient reduction plan (VNRP) which the EPA accepted as a TMDL provided that progress is made towards the goals. Although not mentioned in the case study, but should be, the use of voluntary reductions instead of permit limits probably saved considerable resources for the public. This program (similar to the Chesapeake Bay Program in the mid Atlantic) serves as an excellent example of how nutrients can be reduced and successfully managed on a national scale through stewardship. The elements of this case study are consistent with our proposed solutions which follow in the section below.

Proposed Solutions

The guidance document indicates there is a large body of research and literature that can be used to support criteria development process for the waters in question. However, as our technical review indicated, AMSA does not believe the technical approaches have been structured in a manner that is defensible in the context of water quality criteria / standards derivation. An alternative approach is described below to address the concerns outlined in our technical review. We have developed a flow chart to illustrate the structure and the steps that are involved in that approach. The reader should refer to the attached Figure 1 while reviewing this particular section. Each of the topics below provide further elaboration and explanation of the blocks represented in that diagram.

<u>Classify water body</u>- Consistent with present methods of the guidance, rivers and streams are classified according to their condition.

<u>Establish target use</u>- Beneficial uses are the foundation of the water quality criteria program. The target use represents the specific "end point" or objective that is intended for protection and/or restoration by the criteria. Examples include living resources, biological condition indexes, established nuisance levels of algae, or other established water quality standards such as dissolved oxygen or pH that directly relate to effects on living resources. *Note: Unless at defined nuisance levels, chlorophyll a, secchi depth, turbidity, etc, do not directly represent target uses. They represent potential response variables that may or may not be related to beneficial uses.* In cases of competing uses (e.g. fisheries vs drinking water), decisions need to be made regarding which use is "target". The public and stakeholders should be involved in the process of the establishment of target uses and the associated objectives that the nutrient criteria are intended to address. The important point is that the target beneficial use or uses need to be clearly articulated up front as the basis and goal element for the criteria.

<u>Establish flag value</u>- Statistical evaluations and statistical demarcations of data distribution (i.e. percentiles) are established relative to reference conditions and/or other no-reference lakes using the methods described in the guidance. Flag values may be developed for nitrogen, phosphorus, chlorophyll a, periphyton, turbidity, or other response variables associated with nutrients. <u>*Note*</u>*: Flag values are used*

in the first level of site screening. Flag values are not to be converted directly into criteria because their relationship to impairment of the use is uncertain.

Does site exceed flag value?- Site data are evaluated relative to flag values and a determination is made regarding whether they exceed them.

Is target use impaired by N or P?- Employing cause and effect assessments a determination is made regarding whether the established target use (i.e. living resources, biological condition indexes, established nuisance levels of algae, or other established water quality standards such as dissolved oxygen or pH that directly affect living resources) has been impaired by nitrogen and/or phosphorus. Note that clear distinctions are made in this analysis between "nutrient enrichment" and "nutrient impairment".

Next, dependent upon the outcomes of the above screening steps, there are three potential outcomes for which a given river / stream can be categorized and prioritized for nutrient criteria development. For discussion purposes they are color coded in the attached diagram (**Figure 1**).

Green - The site is not considered enriched because the flag values were not exceeded. Because nutrient values or intermediate response variables are low it is logically assumed there is also lack of nutrient impairment. This condition represents a low priority for criteria development. Site monitoring continues to periodically re-assess its priority for criteria development. Existing anti-degradation tools may be used to prevent enrichment. The development of criteria values to prevent impairments to beneficial uses are re-visited as a third priority after the completion of high and medium priority waters. *Note: Eventual criteria may be greater than flag values given that these sites were not defined as impaired. When appropriate, mechanistic methods similar to the red condition should be used to establish those criteria.*

Yellow- The site may be enriched because the flag value was exceeded. Because the flag value was exceeded an analysis of impairment was required, but showed no apparent impairment. This condition represents a medium priority for criteria development. Site monitoring continues to periodically re-assess its priority for criteria development. Existing anti-degradation tools may be used to prevent further enrichment. The development of criteria values to prevent impairments to beneficial uses are re-visited as a second priority after the completion of high priority waters. *Note: Eventual criteria may be greater than flag values given that these sites were not defined as impaired. When appropriate, mechanistic methods similar to the red condition should be used to establish those criteria.*

Red - Because the flag was exceeded an analysis of impairment was required, which indicated impairment. Due to the presence of nutrient related impairments the site is also considered enriched. This represents a high priority for criteria development. Given a combination of flag values being exceeded and a finding of nutrient impairment, additional analyses (mechanistic models or other tools) are developed and employed. These tools are used to determine the level of nutrient reductions needed to remove the impairment to the use on a site specific basis. The feasibility / use attainability and socio-economic impacts associated with this criteria value are evaluated. Subsequently, criteria are established (and modified as needed by the use attainability and socio-economic analyses) and considered for adoption into water quality standards.

Note: The major elements of the flow chart should apply in all circumstances. However, it was designed as a process to be used in the absence of additional information. In some cases many of the elements (target use, demonstrations of impairment, loading reductions needed to attain use) may be already known. In such cases a duplication of existing efforts should be avoided.

Benefits of the proposed solutions

AMSA believes that the approach described above represents a workable framework and compromise to address the issues that AMSA (and others) have identified as weaknesses in the present criteria guidance. The major benefits of the proposed approach are as follows:

1. The basis of the criteria on beneficial uses is consistent with the intent of the water quality standards program. It improves the defensibility of the criteria because without a firm basis in beneficial uses the criteria are subject to challenge at their most fundamental level. The focus on beneficial uses provides a clear path and goal oriented basis for the development of nutrient criteria that the public can understand and support.

2. The use of flag values benefits the program by providing an appropriate application for the work that EPA and others have placed in developing a reference and statistical (percentile) based methods. A screening role is viewed as a good use for these methods considering their severe limitations relative to determinations of impairment. This recommendation is consistent with comments provided by HydroQual which indicated "*instead of using these empirical tools as a means of establishing criteria, for which they have little power, they were used to establish screening values for particular ecoregional stream types, the guidance would be more acceptable*".

3. The prioritization of nutrient criteria development on the basis of flag values and beneficial use impairment analyses serve to ensure that (1) the 303 (d) listings are not needlessly increased, (2) the resources available to nutrient criteria development are properly focused and commensurate to the level of problem, or a lack of one, and (3) those sites truly in need of attention are identified and corrected sooner because the resources are directed properly towards them. In rivers and streams without impairments due to nutrients existing anti-degradation procedures prevents further enrichment and protects water quality.

Recommendations for Next Steps

AMSA has been working with the EPA with regard to the development of nutrient criteria since its inception. Our efforts on this project have been associated with attendance at various stakeholder meetings, submission of comments to EPA, and attending meetings with EPA staff. AMSA is interested in continuing this cooperative dialogue with the EPA. Although we do not have all of the answers in this set of comments, we feel strongly that our comments have been fair and the recommendations which we have described are reasonable. The similarity of our comments in comparison to other independent reviews by HydroQual and the New England states serves to increase our level of confidence in these matters. As the next step in this process we respectfully request that EPA respond to our comments and offer to meet with AMSA representatives to further deliberate on the issues. AMSA staff would be pleased to arrange the logistics. Please contact Mark Hoeke, AMSA at 202/833-9106.

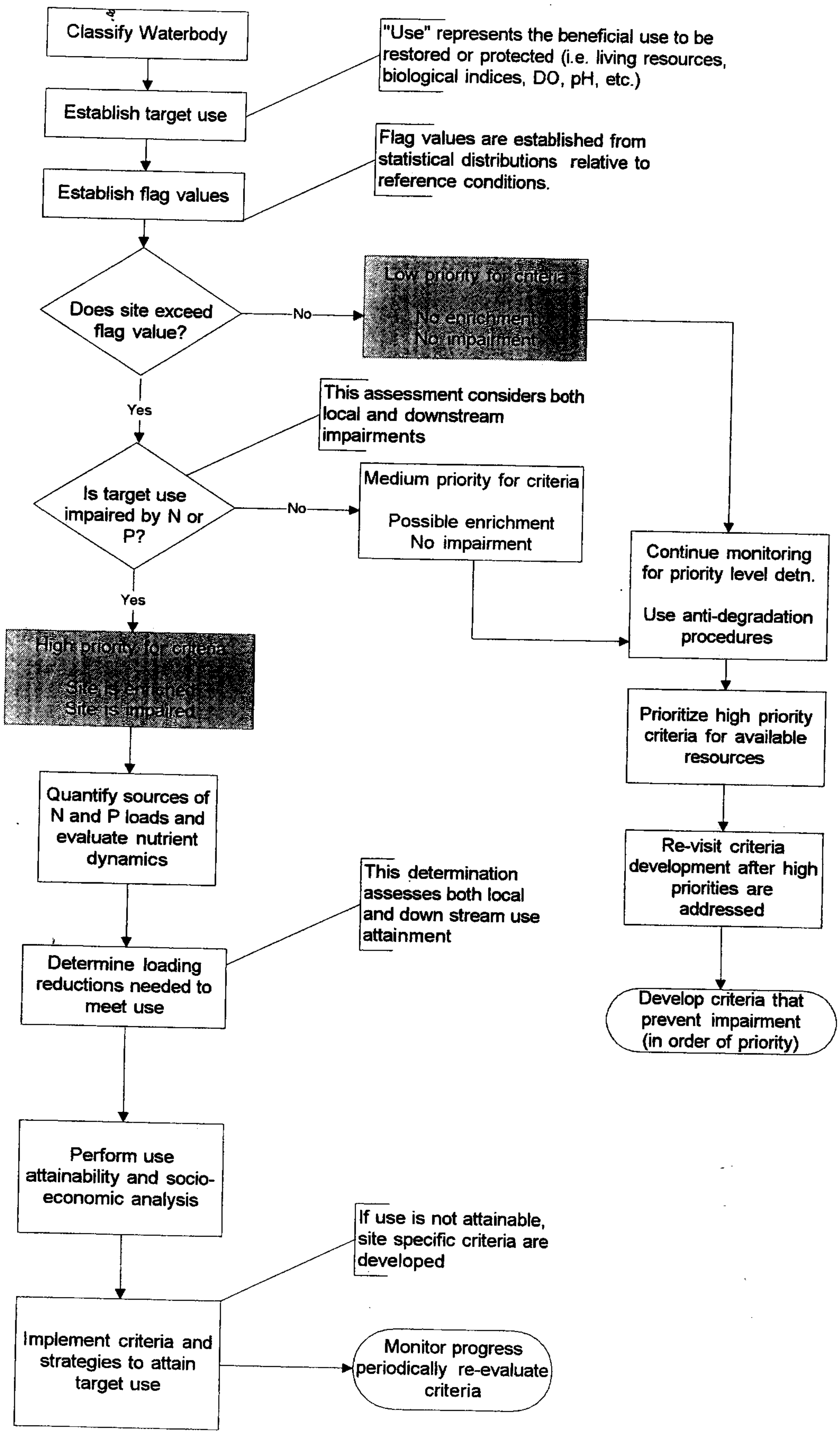
Sincerely,

Ken Kirk
Executive Director

cc: Geoffrey Grubbs, U.S. EPA
Norman LeBlanc, Hampton Roads Sanitation District
William Hunley, Hampton Roads Sanitation District
Dave Taylor, Madison Metropolitan Sewer District
Roberta Savage, ASIWPCA
Tom Morrisey, Connecticut DEP
Ron Poltak, NEIWPCC
Dominic DiToro, HydroQual, Inc.
Mark Meyers, HydroQual, Inc.
Tom Gallagher, HydroQual, Inc.
Jim Fitzpatrick, HydroQual, Inc.

Attachments

Figure 1. Prioritizing Nutrient Criteria Development



ATTACHMENT 1

HydroQual, Inc. Comments on Nutrient Criteria Technical Guidance Manual Rivers and Streams, EPA-822-B00-002

Review of

Nutrient Criteria Technical Guidance Manual: Rivers and Streams

USEPA-822-B-00-002 (July 2000)

The Technical Guidance Manual is a good resource for defining certain elements with which States/Tribes can develop nutrient and algal criteria for rivers and streams. The document defines many approaches for first classifying the physical environment and stream types, then choosing variables for a water quality assessment, then data analysis for criteria setting followed by implementation. Depending on resources, data gathering prior to criteria setting and monitoring and, likewise, re-evaluation afterward may occur. While the flexibility incorporated in this document is commendable, the incorporation of less-rigorous approaches may lead to criteria setting by some parties that is not scientifically defensible, a stated goal of the document. The comments below address suggested approaches within the guidance document which fall short of providing credible means of setting criteria.

The response of a water body to nutrient inputs is highly variable. Many factors — hydrology, geology, stream morphology, degree of canopy cover, land use, grazing organisms — influence a particular water body's assimilative capacity for dissolved nutrients. Thus, trophic status is not uniquely determined by nutrient load. As a result, the use of a single numeric nutrient criterion applied to a given region is likely to be under- or overprotective for a given water body. Scientifically defensible regulation of nutrients should focus on prevention or control of the undesirable effects of nutrient over-enrichment rather than on absolute nutrient limits.

In general, the establishment of criteria for so-called "primary" or "causal" variables such as nutrient element concentrations represents a departure from the modern process of developing standards based on definitive cause-and-effect relationships. For example, there is no criterion for biological oxygen demand (BOD); rather, there are waterbody-type-specific criteria for dissolved oxygen (DO). This is because the level of BOD itself does not determine the level of impairment within an individual waterbody, although indeed it may contribute to impairments. The proximate factor leading to the loss of biological integrity in an ecosystem is a depletion of DO, with chronic and acute effects on specific kinds of desirable or keystone organisms. Levels of BOD can be used to develop permit limits in a system-wide waste load allocation so as to protect the DO criterion, based on site-specific evaluations of the interaction of BOD with other processes which determine DO concentrations. It is this philosophical departure from effects-based criterion setting which is most disagreeable and which creates a fundamental problem of scientific credibility for the regional nutrient criteria setting process. It is strongly suggested that the process be revised to specifically address cause-and-effects factors.

The present guidance document contains many approaches for what may be called exploratory data analysis. These procedures are designed to uncover patterns in the primary variables from regionally aggregated data. However, the inability of such analyses to establish causal effects places constraints on their efficacy. The suggested procedures can be used to locate water bodies which may be susceptible to impairment. Statistical analyses based on regional or national data should be used only as screening tools to initiate further site-specific investigations, not for establishing criteria. The distinction between criteria versus screening-level warning flags is legally significant and needs to firmly established in the technical guidance documents.

In order to demonstrate the disconnect between primary variables (i.e., nutrients) and specific ecosystem (or use) impairments, several areas where we feel the Technical Guidance Document fails to establish scientifically credible interpretations will be discussed. Most of these issues could be resolved if it is recognized that the suggested solutions for gathering and evaluating data are extremely effective means for establishing screening values for flagging potential impacted systems rather than for establishing numeric nutrient criteria. These comments address the following components or approaches contained in the Technical Guidance Document:

(1) the frequency distribution approach to criteria setting,
(2) the ecoregional approach to classification,
(3) interpretations of relationships between dissolved nutrients or total nutrient element pools, e.g., total nitrogen (TN) or total phosphorus (TP), and algal biomass based on nationwide data, and
(4) a model for criteria development.

<u>Frequency Distributions and Criteria Setting</u>

In Section 7.5 "Methods for Establishing Nutrient and Algal Criteria," three approaches are outlined for defining a "reference reach" for establishing nutrient concentrations or algal biomass levels which would protect a stream's "natural biological integrity." While one relies on establishing reference conditions based on "best professional judgement (BPJ), the other two approaches use frequency distributions of available data for the primary variables (nutrients, algal biomass, water clarity as secchi depth, turbidity, or a measure of total suspended solids). One of these two methods suggests criteria-setting at the 75^{th} percentile of a data population from reference streams (presumably identified via BPJ), while the other sets a criterion level at the 5th or 25th percentile of data from all streams within an ecoregion. Lastly, it is suggested that a criterion value might be set at some level in between these reference and all-stream percentiles.

There is a strong caveat to the manager about using this approach at the end of this section. The document acknowledges the ambiguity and difficulty in picking a criterion level from this approach ("A single criterion forces the manager to make decisions about the number of streams that will be in unacceptable condition....", p. 97). In fact, such decision-making will have no basis in whether a given stream in fact has had its biological integrity compromised by a criterion level established from some lumped distribution of nutrient data from many streams and locations. Uncertainties about the relative distribution of data from reference versus impacted sites within the database may lead to criteria which are either too stringent or not stringent enough. More importantly, evaluation based on frequency distributions of primary variable data from a variety of streams even within some defined ecoregion simply does not contain information about the causal relationships between those variables and the potential for impairment of biological integrity in any given stream or reach. Even in light of the document's stated caveats, managers may view this is the simplest, least-costly approach to criterion setting, without a clear understanding of the processes leading to a given stream's susceptibility for impairment or ability to assimilate nutrients without impairment.

Ecoregional Classification of Waterbodies

The classification of water bodies in a hierarchical manner is presented so that managers have a means to compare data and make extrapolations among streams with common features and presumed similar functionality. Approximately half a dozen geologically, hydrologically, and/or biologically based schemes are presented. While Omernik's ecoregional classification scheme represents a starting point in this process, the final procedures for establishing meaningful sub-regions is left to the States and Tribes. Examples provided suggest several important interactions of factors which influence the primary nutrient, biomass, and light variables of concern, including underlying geology, land use, substrate type, and dominant primary producer (e.g., Table 1, p. 21). In the end, the determinants of a given stream's trophic state (Table 2, p. 27) may be either natural or human-induced, with little means of determining the causality. Because such classification schemes impact choice of monitoring sites, reference sites, and criterion-setting, this lack of a causal link between a stream's primary variables and the underlying processes which determine a stream's trophic state, incorrect inferences may be drawn about what nutrient concentration or algal biomass level is protective of a particular stream's designated and beneficial uses.

Interpretations of Relationships Between Nutrients and Algal Biomass

The document states that predictive relationships between nutrients and algal biomass are required to identify critical or threshold nutrient levels that produce nuisance algal blooms (p. 76). However, the simplest approach of regressing algal biomass versus nutrient element concentration (as either TN or TP), as stated, provides only moderate explanatory power, accounting for one-third or less of the observed variance in periphyton biomass. Suggested regression equations for suspended algae yielded somewhat better correlations, up to 73% of the variability, if the catchment area for the stations is known. As the document goes on to state, "critical and highly variable factors other than nutrient—shading, [substrate], scour, water level fluctuations..., grazing intensity—have major effects on algal biomass" (p. 76-77). In fact, as shown in Figure 7 of the document (p. 78), at 20 ug/L TP, mean algal biomass as chlorophyll a varied by two orders of magnitude while at 500 ug/L TN, mean biomass varied by a factor of 25. Those nutrient values are within suggested criteria ranges for nutrients presented in Table 4 (p. 101). In an investigation of 26 sites in seven streams, much of the control on periphyton biomass was influenced by macroinvertebrate grazers, riparian shading, and substrate (Welch et al., 1992). Without consideration of the multiple factors that influence algal biomass and species composition and ultimately influence dissolved oxygen and pH levels, nutrient-based criteria cannot be established with scientific credibility for a given stream environment.

The "Tennessee Ecoregional Nutrient Criteria" case study presented in Appendix A does serve as a good example of the use of approaches recommended in the guidance document to data analysis and the process of establishing numeric nutrient criteria. Unfortunately, it also shows the difficulty of actually ascertaining impairment or degrees of protection offered by even sub-ecoregionally applied numeric criteria. According to the Tennessee plan, "[s]treams with nutrient levels higher than the reference stream database range [at the 90^{th} or 75^{th} percentile, to be determined] will be considered in violation of the narrative [nutrient] criteria" (p. A-7). Such streams will be placed on the state 303(d) list. Yet, in an analysis of data relationships, nutrients were extremely poor predictors of response variables, such as total organic carbon (TOC) or turbidity. Thus, nutrients alone were not indicators of impaired uses.

Further analysis comparing data from the national database with recent monitoring data from identified reference streams demonstrated a potential for bias in the national database. EPA draft Nutrient Aggregate Ecoregion IX data, covering western Tennessee, had TP values ten-fold that found at the reference sites. The authors postulated that the national database stations may either have been biased by locations with high-phosphorus content soils or with sampling data targeted to quantity worst-case nutrient loading events. Without sufficient meta-data or local knowledge to stratify the data sets for such biases, procedures such as analysis of frequency distributions are likely to generate criterion values which may be under- or over-protective.

If, instead of using these empirical tools as means of establishing criteria, for which they have little power, they were used to establish screening values for particular ecoregional stream types, the guidance would be more acceptable.

Metals Criteria: A Model for Criteria Development.

Over the past two decades, national criteria for certain metal toxicants has progressively moved from a single numeric value to varying stages of site-specific values based on local environmental factors, such as water hardness, pH and dissolved organic carbon concentration, that influence a metal's bioavailability (e.g., Renner, 1997). Specific laboratory and statistical procedures have been developed to quantify effects in view of environmental factors. Lessons learned from metals criteria development should be applied to nutrient criteria development.

The importance of site-specific factors in determining appropriate pollutant limits is not unique to nutrients. The impacts of some toxics are also modified by receiving water characteristics. For example, the toxicity of metals, including Cd, Cu, Ni, Pb and Zn, to aquatic organisms typically range over several orders of magnitude for a single organism (Chapter 5; Meyer, 1999). In the natural environment, various processes that modify metal toxicity have been identified. In response to these problems the US EPA has allowed the use of site-specific adjustments to the ambient criteria for metals (e.g., the water-effect ratio procedure - WER; United States Environmental Protection Agency, 1994). The use of WER procedures to modifiy numeric criteria for metals, however, requires time-consuming and expensive bioassay testing. Recently, an alternative approach has been developed using a model of metal bioavailability and toxicity (Di Toro et al., 2000; Santore et al., 2000). The Biotic Ligand Model (BLM) uses a mechanistic understanding of the effects metals have on aquatic organisms and the way these effects are modified by the physical and chemical characteristics of a receiving water body. The use of a mechanistic model for determining criteria provides a scientifically defensible approach for considering the complex site-specific factors that determine the impact of metals in the environment.

The approach for establishing nutrient criteria in receiving water bodies should address many of these same concerns. A modeling approach for setting nutrient criteria can be designed to incorporate complex site-specific factors. Furthermore, a mechanistic framework will provide a direct linkage of nutrient loads with ecosystem response. This linkage will allow a proposed criteria to be based on the prevention or control of harmful effects such as low dissolved oxygen concentrations or trophic status rather than on nutrient concentrations per se. This type of mechanistic framework can explicitly consider the natural variability in the response of receiving water bodies to nutrient inputs and, therefore, is more scientifically sound than a regional numerical value determined from percentile values.

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ATTACHMENT 2

New England Interstate Water Pollution Control Commission Comments on Nutrient Criteria Development

May 8, 2000

Geoffrey H. Grubbs, Director
Office of Science and Technology
US EPA (4503)
401 M Street, SW
Washington, DC 20460

Dear Mr. Grubbs,

The New England Interstate Water Pollution Control Commission (NEIWPCC), on behalf of the New England states, respectfully submits the following comments on the national and regional strategies for developing nutrient criteria. These comments were developed using a workgroup process in order to ensure that they are representative of NEIWPCC's Compact member states' views and opinions. NEIWPCC's role is to coordinate the individual efforts of its compact states to improve and maintain water quality. With this in mind, the needs of the state are of particular concern to the Commission.

The work of NEIWPCC's Nutrient workgroup has focused, to this point, on the regional development of nutrient criteria in lakes, with the acquisition of water quality data and the identification of reference lakes. This effort is aided by, welcome and beneficial funding support from EPA. As outlined in EPA's Nutrient Criteria Technical Guidance Manual for lakes, the New England states have been working with assistance from NEIWPCC to gather data on nutrients in lakes and recently on rivers, to support development of regional nutrient water quality criteria. This work has been coordinated in large part by the ENSR Corporation under a contract through NEIWPCC with funding from EPA. The effort has been very useful in collecting and organizing nutrient data for lakes in the New England area. The database provides not only a convenient and useful resource, but also is helping to identify gaps that need to be filled through additional monitoring.

However, with the initial outcome of this effort, the New England States have encountered several concerns regarding the Environmental Protection Agency's (EPA) national strategy to develop regional nutrient criteria for lakes, rivers and estuaries. While the States certainly agree that nutrient enrichment is a serious problem for waterbodies in our region, there is concern that regionally developed nutrient criteria assumes a commonality of waterbody conditions and management needs that clearly do not exist in our region. For decades, the states have established environmental goals tailored to site-specific conditions which consider the diversity of the ecosystems in the region.

To simplify management of lake trophic conditions based on "one size fits all" or even a range of regionally developed numbers, we feel, would result in some states being forced to develop TMDLs for waterbodies that are meeting their designated uses and showing no evidence of pollutant stresses. The data analyses conducted by ENSR, on behalf of the nutrient workgroup, clearly demonstrates this to be the case when implementing the statistical approach to nutrient criteria development. Similar concerns apply to nutrient criteria for rivers and estuaries in the region.

Under the Clean Water Act, water quality criteria are supposed to protect and support the designated uses of the water body, based on sound scientific rationale. The most basic concern with the statistical approach to nutrient criteria development, as demonstrated in this effort, is that it leads to criteria that have no direct relationship to designated uses or ecological condition. For example, use of the 75th percentile of the total phosphorus distribution for reference lakes leads to an eco-region criterion that, by definition, would place 25% of the highest quality reference lakes, and an even larger percentage of all lakes, in violation of the criterion. This would be true regardless of whether these lakes vere supporting their designated uses.

The technical work of the Nutrient Workgroup was conducted consistent with EPA guidance, and the results for our region clearly illustrate our concerns about the statistical approach to nutrient criteria. The December 1999 draft report by ENSR Corp. provides preliminary nutrient criteria for the three main lake eco-regions in New England. The midpoints of the criteria ranges result in the following proposed total phosphorus values.

Ecoregion	Proposed Phosphorus Criterion
Laurentian Plains and Hills	10.5 ug/L
New England Highlands	8.8 ug/L
New England Coastal Zone	10.9 ug/L

If the New England states were required by EPA to adopt either these criteria or stricter values, then the majority of the lakes in the region would be in violation of state water quality standards. Whereas, only a small percentage of the lakes in each state currently fail to support their designated uses. The situation by state is shown below:

State	Percent of monitored lakes that would violate the proposed criteria
Connecticut	58%
Maine	50-69%
New Hampshire	64%
Rhode Island	75%

Vermont	70%
Massachusetts	50%

The current draft EPA technical guidance manual on nutrient criteria for lakes and reservoirs includes an appendix with case studies of lake criteria development in several states and provinces. These case studies illustrate a broad variety of technical approaches that have proven useful. Unfortunately, the EPA guidance document itself makes little reference to these existing programs, many of which would be precluded by the guidance. The states urge EPA to broaden the technical guidance for lake nutrient criteria so that a more comprehensive list of scientifically sound approaches will be available to the states.

Therefore, we are asking EPA to give consideration to the other methodologies noted in the guidance before proceeding with further efforts on rivers and estuarine waters. We ask that EPA solicit input from the States to determine an approach that works for individual states on protecting lakes, rivers and estuaries from advancing trophic conditions and nutrient over-enrichment.

Please do not hesitate to contact me, or Beth Card of my staff, at (978) 323-7929 with any questions.

Sincerely,

Ronald Poltak
Executive Director

Cc: Ron Manfredonia, Roger Janson, and Matt Liebman. EPA Region 1
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NEIWPCC Nutrient Assessment Teams
ASIWPCA
Carolyn Jenkins and Beth Card, NEIWPCC