1 46

**November 14, 2001**

WQSP-01-01

**MEMORANDUM**

Subject: Development and Adoption of Nutrient Criteria into Water Quality Standards

From: Geoffrey Grubbs, Director *(Signed by Geoffrey Grubbs)*
Office of Science and Technology

To: Water Directors, Regions I - X
Directors, State Water Programs
Directors, Great Water Body Programs
Directors, Authorized Tribal Water Quality Standards Programs
State and Interstate Water Pollution Control Administrators

The purpose of this memorandum is to provide additional guidance to states and authorized tribes on developing nutrient criteria plans, the role of these plans in the adoption of nutrient criteria, the flexibility available, and EPA's expectations for the timeframes both to develop a plan and to adopt nutrient criteria into water quality standards. In addition, I am including answers to questions from states/authorized tribes and other interested stakeholders regarding the development and adoption of nutrient criteria. EPA recognizes the need for additional guidance on how nutrient criteria should be consistently interpreted in assessment, TMDL, and permitting programs. EPA expects to work with states, authorized tribes and other stakeholders to develop such guidance in the near future.

On January 9, 2001, EPA announced the publication of recommended water quality criteria for nutrients under section 304(a) of the Clean Water Act (see 66 FR 1671). EPA developed these criteria with the intention that they serve as a starting point for states, authorized tribes, interstate commissions[1] and others to develop more refined nutrient criteria, as

[1] Hereafter, this guidance document refers to these entities as "states and authorized tribes." Throughout this document, reference to states and authorized tribes is intended to include interstate commissions and the important role they play in the development and implementation of water quality standards.



7314

ED_001605_00000860-00001

appropriate, using EPA waterbody-specific technical guidance manuals and other scientifically defensible approaches. In that announcement, EPA emphasized that states and authorized tribes have several options available to them in developing and adopting water quality criteria for nutrients. EPA recommended the following approaches, in order of preference: 1) wherever possible, develop nutrient criteria that fully reflect localized conditions and protect specific designated uses, using the process outlined in the technical guidance manuals; 2) adopt EPA's recommended section 304(a) criteria for nutrients, either as numeric criteria or as a translator for a state or tribal narrative criterion; or 3) use other scientifically defensible methods and appropriate water quality data to develop criteria protective of designated uses.

Nitrogen and phosphorus are the primary causes of cultural eutrophication. The most recognizable manifestations of this cultural eutrophication are algal blooms that occur during the summer. Chronic symptoms of over-enrichment include low dissolved oxygen, fish kills, murky water, and depletion of desirable flora and fauna. In addition, the increase in algae and turbidity increases the need to chlorinate water for drinking purposes. This, in turn, leads to higher levels of disinfection by-products that have been shown to increase the risk of cancer. Excessive amounts of nutrients can also stimulate the activity of microbes, such as *Pfisteria*, which may be harmful to human health.

State water quality inventories have repeatedly cited nutrients as a major cause of ambient water quality use impairments. EPA's section 305(b) reports consistently identify excessive nutrients as one of the top three leading causes of impairments of the nation's waters (along with siltation and pathogens). Under section 303(d), states identify waters that are not attaining water quality standards and submit a list of those impaired waters to EPA. These lists also consistently identify excessive nutrients as a leading cause of impairments. These 303(d) lists also frequently cite impairments such as reduced dissolved oxygen, growth of noxious plants, and increased turbidity (or decreased water clarity) that are related to nutrients. Section 303(c) of the Clean Water Act requires states and authorized tribes to adopt criteria as necessary to protect designated uses where those uses may be adversely affected by the presence of a pollutant.

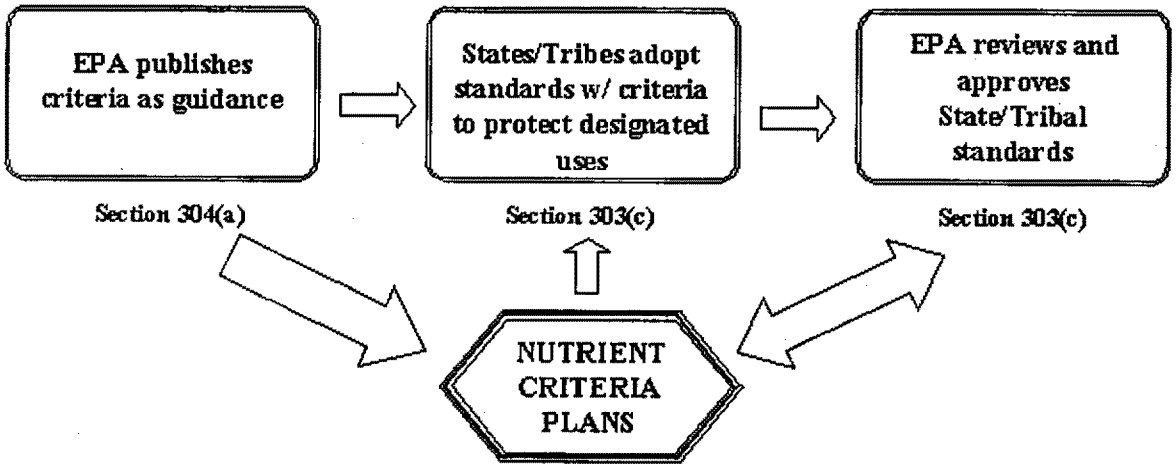
EPA's primary goal is to work with states and authorized tribes to establish the necessary quantitative endpoints to reduce excess nutrient inputs into our nation's waters and to prevent any further impairments. These quantitative endpoints will enhance state and tribal water pollution reduction programs (e.g. Concentrated Animal Feedlot Operations, Non-point source, Stormwater) by providing numeric thresholds for measuring success. States and authorized tribes can achieve this quantitative outcome by developing and adopting nutrient criteria into their water quality standards. EPA understands that development of quantitative nutrient criteria and their incorporation into water quality standards represents a significant commitment. This will be especially true for states and authorized tribes electing to develop criteria that reflect localized conditions. EPA views nutrient criteria development as a partnership. To strengthen this partnership, EPA established Regional Technical Assistance Groups to assist states and authorized tribes in developing and refining their own nutrient criteria appropriate for waters under their jurisdiction, and to provide multi-jurisdictional coordination and consistency in the

criteria development process. These Regional Technical Assistance Groups include representatives from EPA, states and authorized tribes. Regional Technical Assistance Groups also seek input and perspectives from other federal agencies, the academic community, and other stakeholders. EPA remains committed to working with states and authorized tribes as they undertake this process.

In the January 9, 2001 Federal Register notice, EPA recommended that states and authorized tribes develop a nutrient criteria plan to outline their process for how and when they intend to adopt nutrient criteria into their water quality standards. In addition, recognizing the high priority of this effort, EPA recommended a timetable for the development and implementation of the plan. EPA also discussed the actions EPA may decide to take where states and authorized tribes do not substantially complete adoption of nutrient criteria according to their plans. For example, the Administrator might determine that new or revised standards are necessary to meet the requirements of the Clean Water Act. Any such determination by the Administrator would prompt a federal rulemaking for such criteria.

## THE NUTRIENT CRITERIA PLAN

EPA requests each state and authorized tribe to develop a nutrient criteria plan to outline the specific strategy, milestones and schedule for developing and adopting nutrient criteria, taking into consideration specific situations, needs and processes. While no state or authorized tribe is required to develop these plans, EPA strongly encourages them. EPA expects the plans to be refined iteratively as states/authorized tribes discuss their plans with EPA. The final plan should reflect a mutually agreed upon approach and schedule. EPA also expects that the specifics of the plan may change with time as some steps may take longer or shorter than originally anticipated, and as new information is considered.




Nutrient criteria plans are intended to bridge the gap between EPA's defined statutory

roles of producing criteria guidance and EPA's review and approval of standards. These plans can serve as a link among all three of the steps laid out in the figure above to ensure that EPA can readily approve state/tribal standards when they are ultimately submitted. A plan will enable EPA and the states and authorized tribes to gain a better understanding of the scope, level of effort, and time needed to accomplish the goal. By collaboratively developing these plans, states and authorized tribes can help EPA set realistic expectations, as well as ensure that EPA concurs with their approach to developing nutrient criteria as early in the process as possible. These plans will also allow states/authorized tribes to take advantage of the flexibility to develop criteria that reflect localized conditions for priority waters within an acceptable time period (as explained below).

In these plans, EPA expects states and authorized tribes to describe a systematic approach, with associated milestones and a preliminary schedule, to assess the sensitivity of state/tribal waters to over-enrichment and the need for nutrient criteria to protect designated uses. States and authorized tribes should further describe their strategy for deriving quantitative endpoints, either as numeric water quality criteria or as detailed mechanisms for translating a narrative criterion into numeric values on a case-by-case basis. States and authorized tribes should also identify the data required to develop the quantitative endpoints, describe how they will evaluate existing data, identify any data gaps, and specify how the data gaps will be filled. In addition to addressing freshwater lakes, reservoirs, rivers and streams, EPA encourages states and authorized tribes to discuss in their nutrient criteria plans, strategies to protect estuaries and/or wetlands from nutrient over-enrichment. EPA is continuing to work on wetland criteria guidance and expects criteria for wetlands to be included in states' and authorized tribes' water quality standards once the guidance is developed. Some specific questions that states and authorized tribes should address in their nutrient criteria plan include:

- Which approach will you use?
- How will you coordinate your efforts with the Regional Technical Assistance Groups?
- How will you relate criteria to use classifications?
- How will you group state/tribal waters?
  - by geographic area?
  - by physical and/or biological characteristics?
  - by type of waterbody?
  - by designated use classification?
  - other?
- How will you prioritize waters for criteria development?
  - by ecoregion where EPA recommendations are available?
  - by degree of impact and sensitivity?
  - by degree of importance to the public?
  - other?
- What data will you rely on? Will you collect new data?
- How will you analyze the data?
- What parameters will you set criteria for? Why?
- What administrative procedures will you need to go through?

Who will be involved in critical decision-making?
How will you solicit public participation and stakeholder involvement?
Will you utilize outside expertise for data collection or analysis or peer review?
How will you work to integrate your plan with adjacent states/authorized tribes when waters are shared?
What are the major milestones and the schedule for completion?

EPA does not suggest that development of the plan itself become an onerous or burdensome task. While the plan should characterize state/tribal intentions as accurately as possible, the plan does not represent a binding commitment. However, EPA intends to rely on the mutually agreed upon expectations reflected within the nutrient criteria plan to determine if the state or authorized tribe is making acceptable progress towards the goal of protecting its waters from the adverse effects of nutrient over-enrichment. Consequently, it is critical that states and authorized tribes agree, as early as possible, on the overall approach they will pursue and the key milestones, decision points, and preliminary schedule. While EPA expects that it will be necessary to modify the plans as new information becomes available or unanticipated problems arise, it is also essential that states/authorized tribes and EPA discuss and agree upon any changes to the plan, particularly since EPA intends to rely heavily on the plans to demonstrate to the public that EPA, states and authorized tribes are addressing the problems of nutrient over-enrichment as expeditiously as possible.

A suggested outline for a state or tribal nutrient criteria plan is included as Attachment A.

## RELATING NUTRIENT CRITERIA TO USE CLASSIFICATIONS

States and authorized tribes establish criteria for the specific purpose of protecting the designated uses of their waters. Therefore, states and authorized tribes should address in their nutrient criteria plan how the criteria they develop and adopt relate to the use classification they are intended to protect. Some states and authorized tribes have a variety of use classifications with specific descriptions in their water quality standards (such as "headwater salmonid spawning"), whereas others have broad and general use classifications (such as "fish and wildlife"). In addition, many waters carry multiple designated uses, including aquatic life, recreation, and drinking water supply. In some cases, development of appropriate nutrient criteria will require balancing consideration of multiple uses, such as promoting a game fishery while maintaining a sustainable indigenous benthic community or maintaining water clarity that promotes recreational swimming.

There are two general ways of relating nutrient criteria to use classifications. The first is to rely on the selection of appropriate reference conditions that represent a level of water quality at which there are no known impairments of a use due to nutrient over-enrichment. EPA's 304(a) criteria recommendations attempt to characterize reference conditions on a broad ecoregion or sub-ecoregion scale irrespective of designated uses (i.e., drinking water, aquatic life) or levels of refinement within the same type of designated use (i.e., warmwater fishery, coldwater fishery). EPA considers these 304(a) criteria recommendations to be protective

against the adverse effects of excessive nutrient enrichment in these ecoregions for all assigned designated uses, in the absence of information to the contrary. However, EPA encourages states and authorized tribes to consider the designated use of waters when grouping and prioritizing waters for criteria development and characterization of reference conditions. For example, a state or authorized tribe could group medium-sized lakes in a sub-ecoregion designated for public bathing and warmwater aquatic life, and develop criteria based on a characterization of reference conditions in waters of that type. If reference conditions accurately reflect minimally disturbed conditions, then all attainable uses should be protected if water quality is equal to or better than the reference conditions.

The second way to relate nutrient criteria to use classifications is to construct quantitative relationships among nutrient criteria parameters, such as total nitrogen and total phosphorus, and parameters that are more directly related to or descriptive of the particular designated use. For example, regression analysis could help determine a threshold level for phosphorus and an index value of biological integrity developed from benthic community survey data that represents the minimally acceptable community condition for a given habitat type. Another possibility would be to use an algal species composition model which may help determine chlorophyll *a* levels that result in a significant shift that would alter the food web supporting a game fishery. As a final example, data from drinking water utilities may help determine turbidity levels that require increased chlorination and resulting levels of disinfection by-products that increase treatment expenses above a specified threshold. EPA's technical guidance manuals for nutrient criteria development for specific waterbody types contain much information of this sort from specific studies and other data analyses. States and authorized tribes that decide to pursue these types of "effects-based" approaches should first consult these manuals and other published literature. In addition, Regional Technical Assistance Group members and scientists from EPA's Office of Water and Office of Research of Development may provide valuable assistance in a consultation role.

## FLEXIBILITY

The criteria setting process and water quality standards regulations allow states to:

1) develop their own criteria which reflect more locally representative conditions;

2) use different techniques to develop criteria as long as they are protective of designated uses and scientifically defensible; and

3) conduct use attainability studies and refine their use designations.

EPA recognizes that states and authorized tribes may have their own specific priorities for nutrient criteria development. Therefore, states/authorized tribes have the flexibility to prioritize their waters in a way other than strictly by the ecoregions for which EPA has provided criteria recommendations. For example, states and authorized tribes may choose to prioritize their waters based on the need to address already impaired waters and to prevent the impairment of



7319

ED_001605_00000860-00006

waters that may be threatened when developing their nutrient criteria. If a state/authorized tribe addresses these types of priority areas first (or other defined priority areas), states/authorized tribes and EPA should work collaboratively to develop mutual expectations. These mutual expectations should be reflected in the state/tribal nutrient plans. In these plans, states and authorized tribes should define their basis for prioritization and explain why they believe this approach is a more effective way to address nutrient over-enrichment in state/tribal waters (i.e. how will this approach allow state/tribes to adopt criteria where they are needed to protect designated uses).

If a state/tribe focuses first on threatened or impaired waters, they should also address how they will ensure continued protection of waters that are not currently impaired or threatened by nutrient over-enrichment, but may be subject to increased nutrient loading or have not had time to show the effects of current nutrient loading. Regardless of the basis for prioritization, a preventive approach to water quality management through development and adoption of protective criteria, when necessary, can greatly reduce future impairments and the need for more expensive controls or the loss of important resources. Such an approach should include a mechanism for evaluating the sensitivity of all waters and determining the potential for impairing a designated use considering current and expected land use, the presence of permitted discharges, and other factors affecting nutrient loadings. As an example, a state or authorized tribe could describe the monitoring efforts in these waters and any triggers that may be used to determine if there is reasonable expectation that nutrients may threaten the designated use of that waterbody in the future. States and authorized tribes should also consider the development of antidegradation review procedures to address new/expanded discharges of nutrients to high quality waters where numeric criteria have not yet been established. To be both efficient and appropriately protective, states and authorized tribes should try to identify classes of waters that are expected to respond in a similar manner to nutrient enrichment and develop criteria for these classes. Such an approach provides broader coverage and is less labor intensive than treating each waterbody as a unique exercise in criteria development. If a state/tribe determines that there is a subset of waters for which they believe nutrient criteria are not needed (e.g. water quality and designated uses are not affected by nutrients now and unlikely to be affected by nutrients in the future), they should provide a rationale for excluding these waters.

EPA's regulations at CFR Part 131.10(b) require that in "designating uses of a waterbody and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters." Therefore, if a state or authorized tribe identifies waters that are not threatened or impaired from nutrient over-enrichment, they should also consider whether the nutrient levels in this waterbody could contribute to an impairment downstream before determining that nutrient criteria are not needed. If it is likely that a downstream impairment is occurring, yet quantified criteria in downstream waters have not been established, then a state/tribe should consider employing nutrient load reduction strategies for the upstream waters working with agricultural and other interests. These nutrient load reduction strategies are effective ways of reducing the effects on downstream uses, prior to adopting any specific nutrient criteria values.

EPA's recommended parameters for nutrient assessment are total phosphorus, total nitrogen, chlorophyll-*a*, and some measure of water clarity (e.g., Secchi depth or photometer for lakes and reservoirs and turbidity for rivers and streams). Nitrogen and phosphorus are the main causal agents of enrichment, while the two response variables, chlorophyll-*a* and water clarity, are early indicators of system over-enrichment for most waters. EPA believes that nutrient criteria, to be effective, should address causal and response variables in a manner that results in quantifiable measures. States and authorized tribes have the flexibility to address nutrients using parameters other than those EPA recommends, if shown to be appropriate and protective of designated uses. However, if a state or authorized tribe shows that one causal variable (nitrogen or phosphorus) is the limiting nutrient, the state/tribe should develop criteria for at least the limiting nutrient. If the non-limiting nutrient is likely contributing to a downstream impairment, source reduction strategies should be implemented in advance of developing quantified limits where specific downstream criteria are not yet adopted.

If a state or authorized tribe wishes to develop nutrient criteria at a large ecoregion level, then EPA recommends a comprehensive approach where total nitrogen, total phosphorus, chlorophyll *a* and a measure of water clarity are appropriate variables. At a sub-ecoregion or site-specific level of classification, EPA recognizes that more flexibility is appropriate. For example, a state or authorized tribe may demonstrate that in a deepwater reservoir some phosphorus enrichment may be consistent with particular game fishery designated use. In cases where chlorophyll *a* is incorporated into a mathematical model, a state or authorized tribe may determine that total phosphorus and dissolved oxygen adequate ly protect the deep reservoir or lake's designated uses (i.e. chlorophyll *a* is not required as an independent criterion). In waters that experience dissolved oxygen deficiency, dissolved oxygen should be added as a response variable. In some streams, algal growths may develop into nuisance levels but the stream may not have a dissolved oxygen problem, especially if physical aeration occurs at a high level. In oligotrophic lakes, attention should focus on nutrient enrichment causing a shift in the food web leading from a cold water to a warm water fishery. Although chlorophyll *a* is often an early warning indicator of such shifts, algal species composition often indicate the shift before chlorophyll *a*. In some freshwater systems, nutrient enrichment may lead to macrophyte problems and in these situations dry vegetative biomass or ash-free dry weight per unit area may be useful response variables. States and authorized tribes may also elect to combine causal and response variable information into a single index value of nutrient over-enrichment. In all cases, the state or tribe should explain why a substitution of EPA's recommended variables or a combination of causal and response variables result in a better measure to protect designated uses.

States and authorized tribes also have the flexibility to adopt numeric criteria to protect designated uses or to adopt methods and procedures that translate narrative criteria to protect designated uses. For example, a state or authorized tribe could establish numeric criteria for response variables such as dissolved oxygen, chlorophyll-*a*, and a measure of water clarity and also adopt a procedure to quantitatively address causal parameters (i.e., nitrogen and phosphorus) and determine nutrient loads in specific water body segments that will achieve the response

variable criteria. This procedure could be a mathematical loading/response model that is referenced in the state or tribal water quality standards as a "translator" of narrative criteria for water quality parameters that are not otherwise easily related to a pollutant source. This translator procedure, together with numeric criteria for response variables, would provide a state or authorized tribe with the means to set targets for permit limits, assessment, and total maximum daily loads.

## EXPECTED TIMEFRAMES

The January 9, 2001 FR notice specifically tied EPA's expectations for nutrient criteria adoption to both the need to protect designated uses and the state/tribal nutrient criteria plans for developing and adopting nutrient criteria. In keeping with the intent of the FR notice, states and authorized tribes should begin drafting a nutrient criteria plan and discussing the specifics of the plan with EPA within the next few months. EPA expects states and authorized tribes to continue to refine their plans based on their discussions with EPA, particularly with respect to the approach the state/authorized tribe will employ in adopting nutrient criteria and the milestones/schedule it expects to achieve. The final plan should reflect a mutually agreed upon approach, milestones, and schedule.

The FR notice specifically stated that "EPA intends to propose to promulgate nutrient water quality criteria, relying substantially on EPA's section 304(a) water quality criteria, by the end of 2004, where States and authorized tribes have not substantially completed their adoption of such criteria according to the plan completed by the end of 2001, if the Administrator determines that such new or revised standards are necessary to meet the requirements of the Clean Water Act." The timeframe for the adoption of nutrient criteria may vary from state to state and tribe to tribe depending upon the approach outlined in the nutrient criteria plans and the specific needs for designated use protection. For example, if a state or authorized tribe decides it would be more appropriate to prioritize their waters to address impaired waters first, the timeframe may coincide with their schedule for developing Total Maximum Daily Loads for those waters. As mentioned earlier, EPA intends to work collaboratively with the states and authorized tribes to develop mutually agreed upon schedules for adopting nutrient criteria that reflect the approach chosen and the state/tribal situation. Therefore, by the end of 2004, EPA will evaluate the progress of the state or authorized tribe and determine how it compares to the agreed upon schedule in the nutrient criteria plan:

> If the state/authorized tribe has developed a plan and met the mutually agreed upon milestones by the end of 2004, EPA would likely conclude that the state/tribe is making substantial progress, according to their plan, towards adopting nutrient criteria and that a promulgation would not be necessary, at that time, to meet the requirements of the Clean Water Act.
>
> If the state/authorized tribe has not met the milestone/schedule laid out in the plan by the end of 2004, EPA would evaluate whether a federal promulgation would be appropriate. At that time, the Administrator may choose to exercise her discretion under the CWA

section 303(c)(4)(B) to make a determination that new or revised nutrient standards are necessary to meet the requirements of the CWA.

If the state/tribe has not developed a plan, EPA expects the state/tribe to have begun the administrative process (i.e. provided public notice of proposed nutrient criteria adoption) to adopt nutrient criteria into its water quality standards by the end of 2004. If they have, EPA would likely conclude that a promulgation is not necessary at that time. If not, EPA would evaluate whether a federal promulgation would be appropriate. At that time, the Administrator may choose to exercise her discretion under the CWA section 303(c)(4)(B) to make a determination that new or revised nutrient standards are necessary to meet the requirements of the CWA.

## QUESTIONS AND ANSWERS

EPA received a number of questions from various stakeholders. These questions and their answers will assist states and authorized tribes in preparing their nutrient criteria plans. These questions and answers are presented in Appendix B.

Thank you for your ongoing help in assisting us in this important national effort to protect our surface water quality. If you have further questions, please contact me or have your staff contact the EPA Regional Water Quality Standards Coordinator. A list of EPA Regional contacts is provided as Attachment C.

cc: Tracy Mehan, Assistant Administrator for Office of Water
Mike Cook, Director, Office of Wastewater Management
Robert Wayland, Director, Office of Wetlands, Oceans and Watersheds
Thomas Morrissey, President, ASIWPCA
Roberta Savage, Executive Director, ASIWPCA
Regional WQS Branch Chiefs, Regions I - X
Regional WQS Coordinators, Regions I - X

Attachment A: Example Outline of a Nutrient Criteria Plan
Attachment B: Questions and Answers
Attachment C: EPA Regional Contacts



7323

ED_001605_00000860-00010

Attachment A: Example Outline of a Nutrient Criteria Plan for Adoption of Nutrient Water Quality Criteria

1. Criteria Development Process
   - A. Conceptual Approach
     1. Use EPA's Approach to Criteria Development as outlined in the appropriate EPA Technical Guidance Manual **or**
     2. Use EPA's 304(a) Criteria Recommendations **or**
     3. Use Another Scientifically Defensible Method
        - a. Empirical approaches
        - b. Loading models
        - c. Cause and effect based studies or relationships
        - d. Other
   - B. Relation to State/Tribal Use Classifications
     1. General Applicability to All Uses
     2. Applicability Tailored to Specific Categories
        - a. General Aquatic Life Uses
        - b. Specialized Aquatic Life Uses (e.g., coldwater fishery)
        - c. Primary Contact Recreation (may be seasonal)
        - d. Secondary Contact Recreation
        - e. Drinking Water Supply
     3. Development of Refined Use Classifications
   - C. Relation to Physical Classification
     1. Lake Type (e.g., size and depth)
     2. Stream Order
     3. Ecoregion Sub-scales
     4. Other natural geographic boundaries
   - D. Prioritization of Waters
     1. By ecoregion where EPA recommendations are available
     2. By degree of impact and sensitivity (e.g. impaired and threatened waters)
     3. By degree of importance to public
     4. Other priorities
   - E. Inventory of Existing Data (Input from RTAG)
     1. National Nutrient Data Base
     2. Other Data
     3. Identification of Data Distribution and Gaps
     4. Identification of Data Base Management Needs
     5. Representativeness of Data
   - F. Requirements for New Data Collection
     1. Physical, Chemical, and Biological Measurement Variables
     2. Sampling and Analysis Plan
     3. Data Quality Objectives



7324

ED_001605_00000860-00011

2. Schedule for Development and Adoption
   A. Items to Consider
      1. Administrative Procedures and Process
      2. Stakeholder Input and Public Participation
      3. RTAG Coordination
      4. Scientific Review

Attachment B: Questions and Answers

**1. What are 304(a) criteria recommendations for nutrients?**

Section 304(a) of the Clean Water Act (CWA) directs EPA to develop and publish criteria guidance to assist states and authorized tribes in developing water quality standards that are protective of designated uses. Water quality criteria developed under section 304(a) are based solely on data and scientific judgments and do not consider economic impacts or the technological feasibility of meeting any specific level of water quality in ambient water. The intent of EPA's recommended ecoregional nutrient criteria is to represent water quality conditions that are minimally impacted by human activities and to provide for the protection and propagation of aquatic life and recreation. They provide guidance for states and authorized tribes in adopting water quality standards that ultimately provide a basis for controlling discharges or releases of pollutants.

EPA's section 304(a) nutrient criteria recommendations are intended to protect against the adverse effects of cultural eutrophication. Cultural eutrophication (i.e., over-enrichment of nutrient levels associated with human activities) of United States surface waters is a long-standing problem. States and authorized tribes consistently identify excessive levels of nutrients as a major reason why as much as half of the surface waters surveyed in this country do not meet water quality objectives. The problem is national in scope, but specific levels of over-enrichment leading to these problems vary from one region of the country to another because of factors such as geographical variations in geology, vegetation, climate and soil types. For these reasons, EPA is developing its recommended nutrient water quality criteria on an ecoregional basis.

**2. What is a nutrient ecoregion and how is a nutrient ecoregion defined?**

Ecoregions are a system of classification that are based on similarities of natural geographic features and land use patterns. These features include geology, physiography, vegetation, climate, soils, wildlife, and hydrology. The relative importance of each characteristic varies from one ecoregion to another. Ecoregions can be defined at multiple scales. For example, there are 14 nutrient ecoregions and 84 level III ecoregions in the conterminous United States.

Nutrient ecoregions are aggregations of level III ecoregions where the characteristics affecting nutrient levels are expected to be similar. The nutrient ecoregions can form the basis for initial development of nutrient criteria. EPA strongly encourages states and authorized tribes to further subdivide these regions when deriving their own protective criteria.

**3. What are reference conditions and how are they used to develop nutrient criteria recommendations?**

Reference conditions describe the characteristics of waterbody segments least impacted by human activities. Reference conditions can be based on an assemblage of data from reference

sites that represent the least-impacted condition for a particular waterbody type in an ecoregion, subecoregion, or watershed. A characterization of the reference condition provides a basis for developing criteria that are protective of designated uses. Water quality representing minimally impacted conditions should provide for the protection and propagation of aquatic life and recreation, and reflect conditions that will not adversely affect the biological community. EPA developed nutrient criteria recommendations using empirically derived reference conditions (discussed below). The EPA waterbody specific technical guidance documents discuss other approaches (e.g., direct observation of sites meeting specific requirements, regression modeling) for determining reference conditions, and states and authorized tribes may use these or other approaches in developing their own criteria.

Characterization of the reference conditions is just one of 5 suggested elements that EPA recommends for developing nutrient criteria. The others are: consideration of historical data, use of predictive models, expert judgement, and evaluation of potential downstream effects. We believe this provides for a sound, scientifically defensible approach that takes into account the characteristics of different types and locations of water bodies.

**4. Why did EPA select a reference condition approach?**

The adverse effects of excessive nutrients do not lend themselves to criteria development using laboratory tests with individual species as traditionally done for toxic pollutants. The adverse effects of nutrients are strongly affected by regional and seasonal conditions and their effects are ultimately expressed on ecosystems as a whole. Whereas a toxic pollutant may cause similar toxic effects on algal, invertebrate and vertebrate species, excessive nutrients may first promote algal growth followed by a cascade of ecological impacts that ultimately impair benthic invertebrates and fish species. Because every ecosystem has unique species, climatological, hydrological, and soil conditions, EPA determined that the development of nutrient criteria could most efficiently be achieved using a reference condition approach as a main feature. This methodology is a practical and scientifically defensible solution to a very complex challenge.

**5. How did EPA develop its specific nutrient criteria recommendations?**

EPA used available data from waterbodies in each ecoregion to determine a best estimate of minimally impacted conditions and developed criteria for causal and response variables from seasonal and annual median values. The method is based on an approach for quantifying reference conditions originally endorsed for biological criteria development by EPA's Science Advisory Board (1992). Conditions that represent minimal impacts provide a baseline that should protect assigned designated uses. The term "minimally impacted" implies a condition in waterbodies where some enrichment is allowed, but not enough to cause adverse effects.

EPA's Technical Guidance Manual for Developing Nutrient Criteria for Lakes and Reservoirs describes two ways for states/authorized tribes to establishing a reference condition. EPA advocates selecting the 75$^{th}$ percentile of a distribution of reference condition values as a recommended target for a sufficiently protective value that provides an appropriate margin of

safety and excludes the effects of outliers (EPA's preferred approach). Reference condition waters that would exceed criteria based on this 75th percentile are good candidates for site-specific criteria. EPA, however, did not have information about "minimally impacted sites" available on a national scale and, therefore, used a second method to develop reference conditions. Namely, when reference sites are not identified, EPA's technical guidance suggests using the 25th percentile of a distribution of samples from the entire population of waterbodies within a given physical classification (e.g., an ecoregion). The 25th percentile of a sample distribution from the entire population serves as a surrogate for the 75th percentile of a sample distribution from reference sites. Data analyses available to EPA indicate that the 25th percentile of data from the entire population roughly approximates the 75th percentile of data from reference sites. Specific case studies documenting this correlation are cited in the criteria documents.

**6. How can a state or authorized tribe use EPA's nutrient criteria recommendations?**

The criteria recommendations presented in EPA's documents are guidance that states, territories, and authorized tribes may use as a starting point for developing their own nutrient. EPA will work with states and authorized tribes as they adopt water quality criteria for nutrients into their water quality standards. EPA strongly encourages states, territories and authorized tribes to refine these recommendations based on the key elements of nutrient criteria development (historical information, reference conditions, models, consideration of downstream effects, and expert judgment) discussed in EPA's published Technical Guidance Manuals (Lakes and Reservoirs: EPA-822-B00-001; Rivers and Streams: EPA-822-B-00-002). EPA recognizes that states and authorized tribes have several options available to them and recommends the following approaches, in order of preference:

(1) Wherever possible, develop nutrient criteria that fully reflect localized conditions and protect specific designated uses using the process described in EPA's Technical Guidance Manuals for nutrient criteria development. Such criteria may be expressed either as numeric criteria or as procedures to translate a state or tribal narrative criterion into a quantified endpoint in state or tribal water quality standards

(2) Adopt EPA's section 304(a) water quality criteria for nutrients, either as numeric criteria or as procedures to translate a state or tribal narrative nutrient criterion into a quantified endpoint

(3) Develop nutrient criteria protective of designated uses using other scientifically defensible methods and appropriate water quality data.

**7. Can a state or authorized tribe develop its own nutrient criteria?**

Yes. In fact, EPA strongly encourages states and authorized tribes to refine the published criteria to better reflect local conditions. Specific procedures for refining the criteria are presented in the Technical Guidance Manuals. Additional data and analysis that states and authorized tribes can bring to the process of nutrient criteria development include refined physical classification,

reference site data, quantified relationships between nutrient levels and biological effects, nutrient loading analyses, and hydrologic and aquatic life effects modeling.

**8. Must the state's or authorized tribe's nutrient criteria be as stringent as EPA's recommendations?**

No. Criteria adopted in water quality standards must protect the designated use and be based on a sound scientific rationale. EPA recognizes the variability within ecoregions and has set initial recommendations at a level that should protect against adverse effects of cultural eutrophication for most waters within an ecoregion. However, EPA expects that criteria developed by states and authorized tribes may in many cases be higher, and in some cases lower, than those initially recommended in our 304(a) guidance. The specific level or "stringency"of a nutrient criterion does not in itself determine the level of protectiveness. EPA will determine the protectiveness based on the data analysis and scientific rationale presented with the criteria.

**9. How can a state or authorized tribe account for variability within an ecoregion when developing nutrient criteria?**

States and authorized tribes should ideally use the flexibility built in to the reference condition approach to divide their waters into smaller groups that reflect similar waterbody size, physical and geographic characteristics, and other natural features. These smaller groups of waters will likely exhibit far less variability in nutrient reference conditions than the broader scale ecoregions that EPA used to derive its starting point criteria recommendations. Despite reduced variability achieved through greater subdividing of waters, the remaining variability may still be too large to accurately reflect conditions in some waters. States and authorized tribes should strongly consider adopting authorizing provisions for site specific criteria in their water quality standards, and adopt streamlined procedures for deriving such criteria where necessary and appropriate.

**10. How can a state or authorized tribe relate nutrient criteria derived using a reference condition approach to the designated uses of their waters?**

Broadly speaking, if the reference conditions accurately reflect least impacted conditions, the water quality associated with reference conditions should be sufficient to maintain and protect attainable designated uses. The level of certainty in this assumption depends upon how closely the selected reference conditions match the description of the designated use. At a minimum, reference conditions should be characterized from sampling in waters where the designated use is attained. For an aquatic life use, evaluations of the health of the aquatic biological community at reference sites may be critical to determine whether or not the designated use is attained. For a recreational use, user perception surveys of water quality attributes desirable for recreation may be helpful. States and authorized tribes that classify aquatic life uses very broadly, for example into one or two categories, may find it beneficial to establish different reference conditions and develop separate criteria for different physical classifications and waterbody-types within a single aquatic life use category. States and authorized tribes with numerous refined aquatic life use categories may find it feasible to develop a single set of criteria for each refined use.

**11. How will the designated uses of downstream waterbodies be protected?**

EPA's regulations at CFR Part 131.10(b) require that in "designating uses of a waterbody and the appropriate criteria for those uses, the State shall take into consideration the water quality standards of downstream waters and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of downstream waters." Appropriate application of the reference condition approach should ensure that criteria adopted for specific waters protect the water quality necessary to maintain designated uses in the immediate downstream waters (e.g., in the near field). For example, criteria established for tributary streams should be consistent with criteria necessary to protect the receiving lake. The term "near field" may be defined as the distance where nitrogen and phosphorus can reasonably be treated as conservative pollutants (i.e., removal from the system does not occur). The reference condition approach is not expected to specifically address far field effects, such as in an estuary hundreds of miles downstream. However, adoption of criteria that represent "minimally impacted" conditions and that are sufficiently protective of near field downstream effects should ultimately achieve a far field benefit. If the cumulative impact of multiple "minimally impacted" conditions in the watershed results in adverse effects on far field estuary conditions, then further nutrient load reduction may be necessary, and would likely be phased in over a period of time based on specific load reduction targets for the ultimate receiving water body.

**12. What is a Regional Technical Assistance Group (RTAG) and what is their role in the development of nutrient criteria recommendations?**

Regional Technical Assistance Groups (RTAGs) are scientists and resource managers from EPA, other Federal agencies, and state and tribal governments who have particular expertise in water quality management with respect to nutrients. There are 10 RTAGs that correspond to EPA's 10 regional offices, and each is chaired by a representative of EPA's regional office. Members of academia and stakeholders are also involved, however decision making authority rests with Federal, state and tribal representatives. EPA created RTAGs to assist states and authorized tribes in developing and refining their nutrient criteria by providing multi-jurisdictional coordination and consistency in the technical process of developing nutrient criteria. RTAGs also function to facilitate dialogue among stakeholders through pubic and technical meetings.

As the nutrient criteria program evolves, the RTAGs will shift emphasis from data collection and analysis to implementation and management. The details of the composition, roles and responsibilities of RTAGs are provided in Nutrient Criteria Technical Guidance Manual for Lakes and Reservoirs (document #: EPA-822-B00-001). RTAGs will play a key role in EPA's collaboration with states and authorized tribes to develop the mutually agreed upon expectations reflected in nutrient criteria plans.

**13. Is EPA planning on publishing nutrient criteria recommendations for all ecoregions in the U.S.?**

EPA is planning on developing nutrient criteria for all freshwater lakes, reservoirs, rivers and

streams, where ecoregions are defined, during the 2001-2002 time period. EPA also intends to publish technical guidance for developing criteria for estuaries and coastal waters, and work collaboratively with other programs to develop nutrient criteria for specific estuaries and coastal waters that can, in turn, become models for efforts in other areas. A schedule for developing specific estuarine criteria has not been established yet. However EPA intends to focus on estuaries which have been well studied, and conduct regional workshops to foster the development of estuarine criteria. For wetlands, EPA expects to publish a guidance on how to assess and develop criteria for nutrients. Currently, sufficient data are not available for wetlands, but EPA will encourage the monitoring of nutrients and response variables so that states, authorized tribes and EPA can work together to develop criteria.

**14. Are there situations where specific components of EPA's recommended nutrient criteria may not be necessary?**

Yes. EPA believes that nutrient criteria, to be effective, should address the causal and response variables in a manner that results in quantifiable measures. In general, however, EPA is receptive to specific case studies and wishes to promote flexibility as long as the goal of protection of the designated use in all waters is achieved. For example, if a state or authorized tribe demonstrates that the algal growth in certain waters and the immediate downstream waters are all limited by phosphorus, then criteria could be initially established for phosphorus and appropriate biological and physical response variables (e.g., chlorophyll *a* and turbidity) to protect designated uses in those waters. For large river systems that drain into estuaries far downstream, nitrogen loading limitations may be necessary to attain downstream estuarine criteria. However, if nitrogen levels in the watershed far exceed what would be considered "reference conditions" or "natural background" based on comparison to EPA's recommended criteria or other analyses, then nitrogen load reduction strategies should be employed in advance of adoption of a specific nitrogen criterion for the farfield downstream water (e.g. estuary). If a state or authorized tribe has identified nitrogen load reduction strategies at the time the nutrient plans are developed, EPA encourages them to discuss the strategies in their plans.

**15. How should a state or authorized tribe determine whether nutrient criteria are attained?**

Nutrients, unlike toxics, typically manifest their effects over an extended period of time, like a growing season or flow year. Therefore, when evaluating criteria attainment, it is important to ensure that the sampling period and frequency of sampling are adequate to reflect long term conditions, and to use an averaging period that represents that used for criteria development (e.g. a weekly, monthly, or seasonal median measurement taken over a year). EPA would not consider a single sample representative of the longer-term conditions that nutrient criteria are designed to reflect and protect.

In prioritizing waters for evaluation and developing corresponding monitoring strategies and sampling frequencies, states and authorized tribes may wish to consider the vulnerability of a waterbody, the potential degree of impact from likely sources, and the relative importance of the

water to the people of the state or authorized tribe. EPA's office of Wetlands, Oceans and Watersheds (OWOW) is currently developing guidance on making listing decisions. EPA expects it to be available for public review in November 2001. More information is available at: http://www.epa.gov/owow/monitoring/calm.html

Decisions to list waters as impaired for nutrients under Clean Water Act section 303(d) should ideally occur prior to the highly visible responses such as algal blooms to facilitate a more pro-active approach to management. In considering available information, the causal variables of nitrogen and phosphorus should factor into the decision. One approach is to consider excessive levels of nitrogen or phosphorus as a basis for listing regardless of the status of early response variables such as chlorophyll *a* or turbidity. Another approach is to combine information obtained from measures of causal and response variables into an overall "enrichment index" that is more comprehensive and reflects a "weight of evidence". The Nutrient Criteria Technical Guidance Manual for Lakes and Reservoirs (EPA-822-B00-001, April 2000) provides additional details and a simple example on page 7-16.://www.epa.gov/owow/monitoring/calm.html

**16. How is EPA supporting states and authorized tribes in development, adoption and implementation of nutrient criteria?**

RTAGs as a resource The purpose of the Regional Technical Assistance Groups (RTAGs), which are made up of EPA, other Federal Agencies, state and tribal representatives, academia and stakeholders, is to assist states and authorized tribes in developing and refining their own nutrient criteria. Using RTAGs as a resource will help states and authorized tribes develop coordinated and consistent nutrient criteria. RTAGs will play a key role in the collaborative efforts between states, tribes and EPA and function to facilitate dialogue among stakeholders through public and technical meetings.

Funding - EPA administers grants through its 10 regional offices to support the states and tribes as they develop their nutrient criteria programs. On average, approximately $120,000 per region was granted each year during 1998 - 2001 and similar funding is expected for 2002 and the near future. In addition, there are many other financial avenues available to States and authorized tribes such as grants under Clean Water Act, Section 104(b) and 106, and STAR grants provided by our Office of Research and Development.

National Stakeholder Meeting -This annual meeting, hosted by EPA Headquarters, provides an opportunity for all stakeholders to discuss the science behind nutrient criteria as well as any issues related to implementation of the criteria. All stakeholders are invited and attendees often include state governments, environmental groups, agricultural interests and other interest groups.

Regional Stakeholder Meetings - Each EPA Region hosts a Regional Stakeholder Meeting on an annual basis similar to the National meeting. These meetings

provide stakeholders with a forum to discuss nutrients issues on a regional specific basis. Please contact your Regional nutrient coordinator for the next Regional Nutrient meeting in your area (See Attachment C)

Technical Guidance Documents Currently three technical guidance documents are available to assist in nutrient criteria development: Lakes and Reservoirs (EPA-822-B00-00), Rivers and Streams (EPA-822-B-00-002), and Estuarine and Coastal Waters (EPA-822-B-01-003). Information these documents as well as the documents themselves may be obtained from our website at www.epa.gov/ost/criteria/nutrient/guidance. The intent of these documents is to provide states and authorized tribes with methods to assess waterbody nutrient impairment and develop ecoregion-specific nutrient criteria. In addition to these guidance documents, EPA plans to publish technical guidance documents for additional freshwaters, wetlands and estuaries.

National Nutrient Database The National Nutrient Database allows any user to download state and ecoregional nutrient data to assist in conducting their own analysis. The database has been made available to each state and the general public through internet access.

Water Quality Standards Academy - EPA added a module on nutrient criteria to its flagship week-long basic training course designed primarily to inform and educate state and tribal officials involved in administering water quality standards programs.