

June, 2001

External Expert Peer Review Comments on Draft Ecoregional Nutrient Criteria Documents (Documents for ecoregions II, VII, IX, XI were reviewed and considered representative of the set of 16 freshwater ecoregional documents. The wetlands criterion document was reviewed separately.)

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Peer Review Charge

1. Are percentiles using annual median values appropriate given data variability?
2. Are the calculated reference condition values representative of conditions within the nutrient ecoregions/subcoregions?
3. Can defensible reference conditions be derived from this database via the statistical analyses performed?
4. Are the cited subcoregional reference condition values suitable for nutrient criteria development without the use of additional physical classification factors?

Peer Review Comments by Subject

Reference conditions

- Reference conditions for phosphorus in NW ecoregions appear reasonable. They match up quite well with State action levels. However, Chlorophyll *a* and turbidity reference conditions may not be appropriate.
- 25th percentiles reference approach seems reasonable. In Tennessee the 25th percentile compares favorably with the 75 percentile of a reference population of streams.
- Reference conditions based on 25th percentile may not be representative of conditions within the ecoregion. Actual references are higher than 25th percentile.
- Reference conditions alone cannot be used to derive criteria. Need to use the “weight of evidence approach” which addresses all the key elements of nutrient criterion development.

- Statement that “the values presented in this document generally represent nutrient levels which protect against adverse effects of nutrient overenrichment” is not well supported. Should support this with literature.

EPA response: EPA acknowledges in its waterbody technical guidance manuals and nutrient criteria documents that all the elements of criteria development, including reference condition, should be addressed when developing a nutrient criterion. However, EPA is encouraged by the efforts of some States that have demonstrated that the 25th percentile of a large representative sample compares well with the 75th percentile of a population of reference sites. EPA also acknowledges that the reference conditions developed in the criteria documents may not apply to all waters within the ecoregion, that there may be waters because of their depth or flow or other physical, chemical aspect that are different than the central tendency for the ecoregion. EPA encourages States and Tribes to develop reference conditions after classifying their waters by physical characteristics and to determine which scale is most appropriate for developing reference conditions (e.g., nutrient ecoregion, level three ecoregions, specific classes of waters, individual waterbodies). It is anticipated that variability will reduce as scales are refined and that cause and effect relationships will appear stronger when smaller scales and data from more similar waters are analyzed.

EPA intends that the nutrient criteria, based in part on reference condition, reflect least impaired waters; this presumption is reinforced by comparable chlorophyll *a* and turbidity levels as the initial biological response to added nutrients. However, there are occasions when this initial biological response does not occur such as with fast flowing streams where the planktonic response is rapidly dispersed and is not reflected in either chlorophyll *a* or turbidity. Inorganic turbidity may also mask the expected response in a waterbody. Where this happens, it is expected that these exceptions will be acknowledged and the emphasis placed on the causal variables and periphytic growth and other early biological responses instead.

With regard to how the nutrient criteria recommendations presented in the criteria documents compare to traditionally viewed trophic states, the Lakes and Reservoirs Manual page 1-4 states that "...an in-lake total phosphorus concentration of less than 10ug/L generally is considered to be oligotrophic. Conversely, 100ug/L often is used as the threshold for hypereutrophication (Vollenweider, 1968; Wetzel, 1975; Carlson, pers. com.1999)". Aquatic vegetation takes up approximately 10 to 16 times as much nitrogen as phosphorus (Redfield,1958, 1963) and TN reference values approximately ten times reference TP values are in the range of 100 to 200ug/L TN. This is the origin of the generally conservative threshold eutrophication level of 20ug/L TP and 200ug/L TN (0.02mg/L and 0.20mg/L respectively) used by the Program and many natural resource managers to interpret data. Reference condition values equal to or less than these values are reported by several states, especially Minnesota and Tennessee in reports to the National Nutrient Criteria Program. While oligotrophy is generally accepted as the absence of adverse overenrichment, it is entirely possible for a mesotrophic or eutrophic system to be the natural state of the resource as well. It is for this reason that regionally calibrated reference conditions are part of the nutrient criteria development process.

Data Concerns - Use of medians

- Use of medians, in general, is reasonable.
- Annual medians are probably not appropriate. Seasonal criteria (warm and cold, wet and dry) are recommended. Or focus on summer growing season, index period.
- The data in STORET is not sampled randomly, so it is hard to assume that the 25th derived percentiles are representative of reference conditions. States also sample for different reasons and have different sampling designs. However, the contractor did a credible job of screening out difficult data.
- Need to ensure that data is randomly selected to develop appropriate reference conditions.
- Data is not sorted by depth. Only surface or near surface data should be used.

EPA response: EPA considered developing several different types of central tendency for nutrient parameters within the ecoregion including seasonal medians, seasonal weighted means and annual medians. Because of the large variability across ecoregions with regard to which season is most critical to controlling nutrient loading and responses, EPA decided to take the median of the four seasonal 25th percentiles. States and Tribes are encouraged to develop nutrient criteria for all seasons or for a particular season or seasons, whichever is most appropriate to the critical nutrient loading and response patterns within the ecoregion or subecoregion.

The STORET data set is not a randomly sampled data set. EPA decided to attempt to use as much of the data contained in STORET and other sources as possible. There was concern that a random sample, especially at the subecoregion level, would result in very few numbers of observations, and thus an inability to measure trends within the Nutrient ecoregions as well as the level 3 ecoregions. States and Tribes are encouraged to add additional data to the sets already compiled by EPA or to take subsets of randomly sampled data and compare the 25th percentile derived from these sets to EPA's datasets.

Data were not sorted by depth because the depth of sample collection was not always reported. (There was virtually no physical classification data for lakes or streams in STORET.) Instead, medians of all samples per station per waterbody were taken to reflect entire water column conditions. This was judged to be a better reflection of whole-waterbody nutrient condition, accounting for either stratified or mixed situations.

Classification

- Reservoirs should be analyzed separately.
- Without identifying stream order, there is a possibility of setting criteria for lowest order streams, which may predominate the dataset.
- Need physical classification information to develop suitable criteria, but even at the State level this is difficult to compile. It is also recommended that distributions of maximum lake depths be compiled.
- Chlorophyll *a* criteria are not appropriate for fast moving gravel/rubble streams. Need periphyton criteria.
- Physical classification will not greatly affect the response of algae in gravel-rubble bottom streams if they are light limited (canopy). Reference condition should be confined to low-flow, growth periods (E.g., Spring and Summer).

EPA response: EPA, in its waterbody technical guidance manuals, describes classification of waterbodies by physical classes or flow (for rivers and streams) as an essential first step in developing reference conditions and nutrient criteria. EPA did not have size or flow data readily available from the national databases it was using to develop reference conditions. However, when we attempted to classify some lakes, just as an exercise, it was determined that the variability was reduced. Therefore, we believe physical size and flow rate classification is a valuable step toward refining the reference conditions presented in the EPA nutrient criteria documents and encourage States and Tribes to do so.

EPA agrees that periphyton criteria are more appropriate than chlorophyll *a* criteria for fast moving streams, but little periphyton data was available in the STORET database or other datasets. States are being encouraged to gather and use this information for such stream systems. Similarly, for all water bodies, the States have the option of establishing seasonal criteria as well as further refining their physical classification scheme.

