Environmental
Engineers & Scientists

May 7, 2001

Mr. Will Hunley
Hampton Roads Sanitation District
1436 Air Rail Avenue
Virginia Beach, VA 23455-3002

Mr. Chris Hornback
Association of Metropolitan Sewerage Authorities
1816 Jefferson Place, NW
Washington, DC 20036

AMSA0010

Re: Ecoregion Nutrient Criteria Documents

Dear Mr. Hunley and Mr. Hornback:

HydroQual has obtained the USEPA *Ambient Water Quality Criteria Recommendations* for the available Ecoregion specific Rivers and Streams, and Lakes and Reservoirs documents. The following documents were available from the USEPA website (USEPA, 2000a-p) at the time of our review:

- Rivers and Streams: Ecoregions II, III, VI, VII, IX, XI, XII and XIV; and
- Lakes and Reservoirs: Ecoregions II, VI, VII, VIII, IX, XI, XII, XIII.

We have reviewed these documents with additional focus on the Rivers and Streams documents, in particular the Ecoregion IX document due to its inclusion of periphyton biomass as a response variable. Our comments will be separated into general and specific comments with a quantitative review of nutrient data presented in the literature by USGS staff (Clark et. al., 2000) with the data obtained from the USGS website. In addition, a brief summary of USEPA Region V Nutrient Workgroup Meetings is provided based on personal communication with Cathy Larson from the Metropolitan Council Environmental Services (St. Paul, MN).

HydroQual was initially planning on analyzing the USEPA National Nutrient Database available on their website. After contacting Debbi Hart from the USEPA National Nutrient Strategy Team, we were informed that the database was initially setup for State and Tribe use in developing their own nutrient criteria and, therefore, currently not available for third party use. She indicated that USEPA was receiving many calls for access to the database and that within approximately one month (end of May),

USEPA will allow third party access to the database. At that time, HydroQual can complete the technical analyses discussed if still desired by AMSA.

General Comments

In general, each of the 16 ecoregion nutrient criteria documents is similar (template based) with the ecoregion specific information modified (data sources, recommended criteria, statistical summaries, etc.). In all of the documents, nutrient criteria were developed based on the population distribution approach using all of the selected (QA/QC) data (independent of watershed quality). For at least two causal (TN and TP) and two response (chlorophyll-a and turbidity/secchi depth) variables, the recommended nutrient criteria were based on the 25th percentile of all QA/QC data between the years of 1990 and 1998. This implies that 75% of all water bodies will not meet the USEPA recommended nutrient criteria on a national scale (in each ecoregion). The alternate approach of sub-selecting "minimally" impacted reference sites for criteria development was not used.

In all of the documents, the other recommended approaches to develop nutrient criteria (USEPA, 2000q) such as predictive relationships or models were not used in any of the ecoregions. In addition, USEPA encouraged the Regional Technical Assistance Groups (RTAG) to assess the potential downstream effects on the proposed nutrient criteria.

As we have commented in the past and feel should be reiterated, the recommended nutrient criteria inherently do not consider the endpoint (response variable) relationship to nutrient levels. Throughout the documents, including the technical guidance manuals, the USEPA has identified numerous factors that complicate the relationship between nutrients and endpoints (e.g., chlorophyll-a, dissolved oxygen, turbidity) such as residence time, water velocity and scour, canopy cover as it relates to reducing available light, natural levels of nutrients and turbidity. They also indicate the difficulty in developing relationships between the two, as highlighted in Figure 7 (reproduced below) from the Rivers and Streams technical guidance manual (USEPA, 2000q). This figure presents 1 to 2 orders of magnitude variation in the response variable (periphyton biomass) for a given nutrient concentration. Given the average ecoregion recommended nutrient criteria, resulting mean periphyton chlorophyll-a levels ranged from approximately 15 to 200 mg/m^2 for TN of 0.73 mg/L and from approximately 4 to 200 mg/m^2 for TP of 32 µg/L. Better relationships may develop on the ecoregion or sub-ecoregion level, but considerable variation is still expected to occur. The r^2 values for the relationships developed from these data ranged from 0.09 to 0.35, which indicate the poor predictive capability of the relationships, and more importantly highlight the complex interactions between nutrients and endpoints.

The original work completed for this analysis was presented in a paper (Dodds et. al., 1997) in which the authors utilized critical nutrient levels from their data analysis as nutrient targets (instead of criteria) and concluded that their targets may not apply to all systems and may not be attainable depending upon local geology, sediment contamination and other factors. In addition, the main focus of their work was a site-specific study of the Clark Fork River in Montana.

In Appendix C of the Ecoregion IX Rivers and Streams document, a regression model analysis was to be completed to examine the relationship between biological and nutrient variables in lakes and reservoirs, and rivers and streams. It was noted that at the time of publication, most of the regressions

were not completed and were to be delivered to USEPA in August 2000. The only regression analysis completed was for aggregate nutrient Ecoregion VII for Lakes and Reservoirs, which was delivered to the USEPA. The results of this regression analysis were not presented in the Ecoregion VII Lakes and Reservoirs document. Based on some of the initial work in the technical guidance manuals, very weak relationships may result, especially for rivers and streams, and should be reviewed when available from USEPA.

The population distribution approach for both nutrients (TN and TP) and endpoints (chlorophyll-a, turbidity and secchi depth) links the 25th percentile TN and TP level with the 25th percentile endpoint level, which disregards whether the nutrient levels would actually attain the corresponding endpoint. Given the inherent variability within ecoregions, even within similar water bodies (river, lakes), the correlation between these causal and response variables 25th percentiles may not exist and, therefore, desired nutrient criteria may not achieve the intended results, such as fishable/swimmable or designated uses.

Although the data presented in the ecoregion documents has undergone formal QA/QC procedures, there is still some doubt as to the quality and accuracy of the data. As indicated in Appendix C of the Ecoregion IX Rivers and Streams document, minimal QA/QC was completed on the Legacy STORET, NAWQA and NASQAN databases due to the assumption that either the source agency or prior USEPA contractors completed a rigorous QA/QC of their data. Laboratory methods were not always available, as were water body specific information. This point is clearly noted in a recent letter to the USEPA Nutrient Program Coordinator from the North Carolina Department of Environment and Natural Resources dated 3/30/01 (see attached). The letter states that the NC data used in the ecoregion documents is in error due to incorrectly labeled water bodies and on-going analytical corrections to their chlorophyll-a database.

Specific Comments

The Ecoregion IX Rivers and Streams document was the only ecoregion where periphyton biomass (chlorophyll-a) was used to developed an endpoint (response) variable criterion. The resulting value was reported as 20.35 mg/m^2 with a sub-ecoregion range of 3.13 to 20.35 mg/m^2. Either the number of data points used to develop the Ecoregion IX periphyton biomass criteria was not large enough to develop a 25th percentile value or the units are incorrect. These two issues will be addressed separately below.

If the number of periphyton biomass data points is limited, which is most likely the case due to the intensive sampling efforts required to obtain the data, the sample population used to determine the 25th percentile value will most likely not reflect a random sample distribution and the statistics may not be valid (see page 6 of Appendix C, Ecoregion IX Rivers and Streams document). In addition, if the sample population is small, the periphyton database may not reflect a large range of ambient periphyton levels. That is, periphyton levels ranging from low biomass, unimpacted streams to high biomass, nuisance level streams. If this is case, the population is not representative of a wide range of stream conditions and the 25th percentile approach would not be appropriate.

The maximum number of streams used to develop the Ecoregion IX periphyton criterion was 6 (Table 2 from Ecoregion IX Rivers and Streams document) of which 2 were located in level III Ecoregion

35 with data from less than 3 seasons, and 6 were located in level III Ecoregion 64. All other level III Ecoregions (29, 33, 37, 40, 45, 65, 71, 72 and 74) did not have periphyton biomass data available for analysis. This extremely limited database is not sufficient to determine periphyton levels that maintain existing uses using the population distribution method.

Most guidelines for nuisance periphyton levels, as chlorophyll-a, range from 100 to 200 mg/m^2 (Dodds et. al., 1998, Welch et. al., 1988). These maximum biomass levels represent conditions intended to avoid problems for recreational and aesthetic uses in streams. If the proposed nutrient criterion for periphyton biomass is designed to protect designated uses, then the developed criterion should be similar to the above guidelines. The proposed criterion is 20.35 mg/m^2 with a sub-ecoregion range of 3.13 to 20.35 mg/m^2, which is an order of magnitude less than the above guidelines. If the units in the document were incorrectly reported as mg/m^2 when they were actually $\mu g/cm^2$, the resulting criterion would be 204 mg/m^2, which is more representative of the 100 to 200 mg/m^2 guideline presented in the literature. Also, in Table 4 (page 101) of the Rivers and Streams Technical Guidance Manual (USEPA, 2000q), the USEPA presented periphyton criteria for streams that have been set or suggested by various agencies and investigators that ranged from 100 to 200 mg/m^2.

Similarly, guidelines for planktonic algal levels in rivers and streams from Table 4 of the Rivers and Streams Technical Guidance Manual suggests chlorophyll-a levels of between 8 and 15 μg/L for the prevention of nuisance conditions and water quality degradation. The average river and stream level from the ecoregion nutrient criteria documents is 1.72 μg/L with a range of 0.4 to 3.75 μg/L. The recommended criteria values are considerably less than the guidelines recommended by the USEPA in their Rivers and Streams Technical Guidance Manual. In addition, recommended planktonic algal levels are usually greater in rivers and streams than in lakes and reservoirs. The average lake and reservoir level from the ecoregion nutrient criteria documents is 4.78 μg/L with a range of 1.9 to 12.35 μg/L.

In reviewing the Rivers and Streams document for Ecoregion XII, there are discrepancies between the criteria listed in the Executive Summary on page *v* under "Reference site/reference conditions in Nutrient Ecoregion XII" and the table on page *vi*. The value and units for TP are different as is the value for turbidity. It is assumed the 40 μg/L TP criterion is correct but should be verified with USEPA along with the correct turbidity criterion.

A summary table of the ecoregion nutrient criteria for both Streams and Rivers, and Lakes and Reservoirs was obtained from the USEPA website and compared to the nutrient criteria documents. Numerous discrepancies were found between the documents and summary tables in the values and units. Tables 1 and 2 present the discrepancies and should be clarified with the USEPA. These discrepancies may just be related to units or method differences but the summary table values are not consistently less than or greater than those reported in the documents. The TN criterion for Ecoregion VI (Lakes and Reservoirs) is not a units or method problem and, therefore, a potential cause is unknown and needs to be clarified with USEPA. The differences observed potentially due to units or methods highlights the need for consistency in the databases to be used for deriving the nutrient criteria. Specifically, when comparing across the various ecoregions in the nation.

Table 1. Rivers and Streams Criteria Discrepancies

Parameter	Ecoregion	Document	Summary Table
Chla (μg/L)	II	1.08 (fl)	0.66 (*sp)
Chla (μg/L)	III	1.78 (fl)	1.43 (*sp)
Chla (μg/L)	VI	2.70 (fl)	7.33 (*sp)
Chla (μg/L)	VII	1.54 (fl)	3.50 (*sp)
Turbidity	III	2.34 FTU	1.84 NTU
Turbidity	VI	6.36 FTU	9.89 NTU
Turbidity	VII	2.32 FTU	1.70 NTU
Turbidity	IX	5.70 FTU	7.02 NTU
Turbidity	XI	1.70 FTU	2.30 NTU
Turbidity	XIV	3.04 FTU	1.94 NTU

Notes: fl – fluorometric method, *sp – spectrophotometric method assumed

Table 2. Lakes and Reservoirs Criteria Discrepancies

Parameter	Ecoregion	Document	Summary Table
TN (mg/L)	VI	0.781	1.68
Chla (μg/L)	VII	2.63 (fl)	5.23 (*)
Chla (μg/L)	VIII	2.43 (fl)	2.39 (*)
Chla (μg/L)	IX	4.93 (fl)	5.18 (*)
Chla (μg/L)	XIII	12.35 (tr)	3.35 (*)

Notes: fl – fluorometric method, tr – trichromatic method, * – method unknown

USGS Watershed Data

One of the alternate approaches to developing nutrient criteria recommended by the USEPA is a modification of the population distribution method. This modification is to analyze minimally impacted reaches instead of analyzing the entire database as the USEPA followed in the ecoregion nutrient criteria documents. A recent paper by USGS staff titled "Nutrient Concentrations and Yields in Undeveloped Stream Basins of the United States" (Clark et. al., 2000) compiled and analyzed data from 85 sites across the US in streams draining relatively undeveloped basins. The data used in the paper were obtained from the following sources: Hydrologic Benchmark Network (HBN), National

Water-Quality Assessment (NAWQA), and the Research Program. The raw data used in the paper (mean annual flow-weighted concentrations) in addition to a NAWQA database (1992 to 1996) was obtained from the USGS website and analyzed using the population distribution approach. The parameters available in the database did not include any measure of the response variables (chlorophyll-a, turbidity) and included various nutrient species. Additional parameters were also available with flow, temperature, dissolved oxygen and pH the most significant. In total there were 8459 data points in the NAWQA data set that included a range of land uses (urban, agricultural, rangeland, forest, water, wetlands and other). The drainage basin areas represented in the database ranged from approximately 7 to 85,530 mi^2 and included about 20 major watersheds in the nation.

The USGS undeveloped basin data for 85 sites (mean annual flow-weighted concentrations) are presented in Figure 1 as probability distributions for dissolved inorganic nitrogen (DIN), orthophosphate (PO_4), total nitrogen (TN) and total phosphorus (TP). When using the population distribution approach on undeveloped basins, the 75th percentile is recommended for setting nutrient criteria. The 75th percentiles from this database were calculated as follows: 0.19 mg/L for DIN, 10 μg/L for PO_4, 0.50 mg/L for TN and 37 μg/L for TP. These values are similar to the average ecoregion values of 0.73 mg/L for TN and 32 μg/L for TP, which used the population distribution approach from all basins and the 25th percentile. This relative comparison of the two methods still does not give validation to the population distribution approach because it inherently does not link the causal nutrient level with an acceptable response variable level. Also, this method defines 25% of undeveloped basins (natural conditions) as impaired.

The NAWQA database was also analyzed using the population distribution approach for both the entire database (25th percentile) and the undeveloped basin data (75th percentile). The distributions are presented in Figure 2 for a variety of land uses. The entire data set was used to develop the 25th percentile value (filled circles) and the undeveloped data set (filled squares) was used to develop the 75th percentile value. These values are compared in Table 3.

Table 3. NAWQA Database Percentile Values

Parameter	25th Percentile	75th Percentile
DIN (mg/L)	0.19	0.25
PO4 (μg/L)	10	10
TN (mg/L)	0.55	0.65
TP (μg/L)	30	30

Again, the comparison between the two approaches results in similar values. Two additional data sets are presented in this figure for various levels of land use. First, urban land use # 20% is presented as the solid line, which is basically indistinguishable from the entire data set. This seems to indicate that urban effects on ambient nutrient levels in this national database are minimal. Second, some measure of "minimally" impacted basins was selected as urban and agricultural land use # 20% and presented as the open circles in the figure. A significant change in the nutrient distributions resulted when this range of land uses was sub-selected from the entire data set but yet still greater than the

undeveloped basin data from the NAWQA database, particularly for nitrogen. This suggests that nonpoint sources represent a greater fraction of the total loading to this database and also that some reasonable level of development may be desired when assessing "unimpacted" nutrient levels. The resulting 75th percentiles from the "minimally" impacted database are presented in Table 4.

Table 4. NAWQA Minimally Impacted Nutrient Levels

Parameter	75th Percentile
DIN (mg/L)	0.50
PO4 (µg/L)	40
TN (mg/L)	0.92
TP (µg/L)	90

Finally, two surrogate response variables (dissolved oxygen and pH) from the NAWQA database were analyzed to see if any relationships existed for the "minimally" impacted basins (Figures 3 and 4). In general, it is anticipated that dissolved oxygen would increase with increasing nutrients due to the added oxygen production associated with increased eutrophication. Similarly, pH is also anticipated to increase with increasing nutrients due to the added CO_2 consumption associated with increased photosynthesis. Although these processes can be complicated by various factors, no strong relationships were obvious, which again suggests that the link between cause and response variables can be complicated by many variables not currently included in the USEPAs approach to developing nutrient criteria.

USEPA Region V Nutrient Workgroup Meetings

Based on feedback from recent USEPA Region V Nutrient Workgroup Meetings (personal communication Cathy Larson, 2000 – 2001), the States in this region (IL, IN, MI, MN, OH and WI) as well as potentially affected entities have had widely varying responses to the proposed nutrient criteria and their own State's efforts. The following items list some of the highlights:

- There are potential problems with the national and regional nutrient databases (non-representative historical data, minimal screening, bulk of QA/QC left to States, TN and chlorophyll-a data are sparse and biological response data are "thin");
- Many State's historical databases and current data collection efforts are not sufficient for developing nutrient criteria. Some States are just now adding chlorophyll-a measurements to their collection efforts or have replaced traditional chemical sampling (TN, TP, chlorophyll-a) with more biological monitoring due to budget restraints;
- For instance, all of INs stream data were excluded from the national database because the sites were impacted by point sources and their lake data was excluded because it was not in a digital format;
- Few states monitor for periphyton biomass (too labor intensive) and different chlorophyll-a methods yield different results;

- Some believe ecoregional criteria will not work because of the variability within ecoregions and want the flexibility to develop goals/criteria on a watershed basis;
- One suggestion indicated that exceedance of a single criterion alone should not cause 303d listing but possibly exceedance of one causal and one response variable should be required for listing. However exceedance of one variable may trigger additional study;
- The sampling period (seasonal, summer, growing season, yearly) for assessing compliance was also raised as an important issue;
- If using the distribution approach, it may be better to use a range of acceptable values rather than a single value (i.e., three tiers: reference, acceptable and noncompliant);
- The ecoregion recommended nutrient criteria documents received limited input from the RTAGs;
- The deadline for setting State standards is too tight with States estimating a need for 3 to 9 additional years. This time is required for additional data collection, methodology development and rule making;
- Many States are struggling with how to connect nutrient standards to designated uses;
- It was noted that different uses may be supported by different levels of productivity (e.g., bass fishing may be best at higher productivity, while swimming may be best at lower productivity);
- Potentially affected entities are concerned about the difficulty to remove TN to levels less than 1 mg/L at WWTPs because current technologies do not exist;
- Are nutrient criteria reasonable in effluent dominated streams where nutrient removal to the limit of technology will still result in high nutrient and algal levels?;
- States anticipate finding it difficult to promote TN standards to the general public and regulated community when the water body is phosphorus limited and nitrogen controls will not have immediate downstream effects;
- Effluent limits are better justified when based on specific goals because better agency and public support is obtained. Even though they use more resources, they result in fewer contested case hearings;
- Representatives from USEPA have indicated that the proposed nutrient criteria will be "very rough numbers" and should be viewed more as recommendations than criteria. "It's obvious that one number will not fit an entire ecoregion.";
- USEPA also indicated the flexibility afforded to the States in developing the criteria and that they can be less than or greater than the recommended criteria. However if less stringent, the States must provide a strong rationale;
- All of the States in Region V share similar concerns about the nutrient criteria that included the following main points:

    - Apparent lack of linkage between the nutrient criteria and their effects,
    - Weak approach (25^{th} percentile) and the need for stronger ties to designated uses,
    - Shifting the burden of providing scientific support from the USEPA to the States,
    - How the Gulf of Mexico hypoxia issue relates to nutrient criteria, and
    - Inadequate time for data collection and rule making.

- The most simple and direct response to the proposed criteria was: "There's no way we're going to put 75% of our lakes on the 303d list."

HydroQual appreciates the opportunity to review these documents for AMSA and hope that our review and comments can aid AMSA in their negotiations with the USEPA in developing rational, science based, technically defensible nutrient criteria or targets. Please call to discuss our comments if there are any questions or additional information is required.

Very truly yours,

HYDROQUAL, INC.

Andrew J. Thuman, P.E.
Senior Project Manager

AJT/mag
Attachments
cc: Thomas Gallagher
Dominic DiToro

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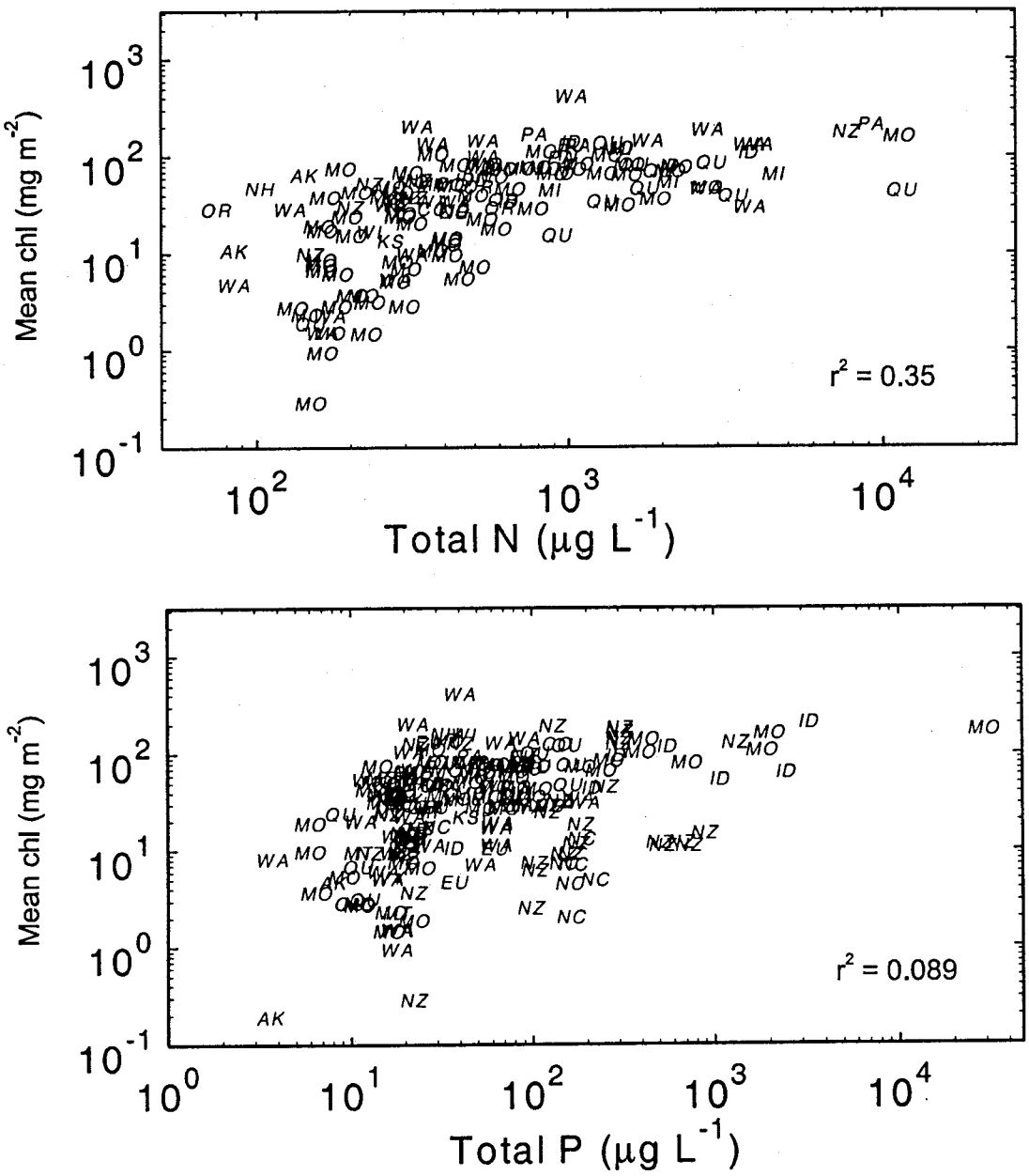

Figure 7. Relationships of log-transformed mean chlorophyll *a* as a function of TN and TP.

Data points are represented by abbreviations identifying the State or country of origin: AK- Alaska, ID- Idaho, MI- Michigan, MO-Montana, NH-New Hampshire, NC-North Carolina, OR-Oregon, PA- Pennsylvania, WA-Washington, QU-Quebec, EU-Europe, NZ-New Zealand.

State of North Carolina
Department of Environment
and Natural Resources
Division of Water Quality

Michael F. Easley, Governor
William G. Ross Jr. Secretary
Kerr T. Stevens, Director

March 30, 2001

Mr. Robert E. Cantilli
EPA Nutrient Program Coordinator
Health and Ecological Criteria Division
Mail Code 4304
USEPA Headquarters Ariel Rios Building
1200 Pennsylvania Ave., NW
Washington, DC 20460

Re: Comments on Ecoregion Nutrient Criteria Documents Ambient Water Quality Criteria Recommendations

Dear Mr. Cantilli,

It is our understanding from the January 9th Federal Register notice that EPA is currently accepting significant scientific nutrient information submitted to the Agency with "adequate documentation and with enough supporting information to indicate that acceptable and scientifically defensible procedures were used and that the results are reliable". It is our desire that the EPA apply these same standards to the construction of the numerically-based ecoregion criteria that are the subject of these comments.

The North Carolina data used to construct the ecoregion nutrient criteria documents are in error. Many data points designated within the National Nutrient Database (NNB) have been incorrectly labeled as lakes when in fact they are from run-of-the-river reservoirs. According to the Lakes and Reservoirs document, lakes and reservoirs should be evaluated differently. Noting this error, we question if EPA has performed a sufficient review of the NNB. Without a rigorous review of the data used for development of these criteria, there can be little confidence in the reported criteria ranges – even as they are limited to a nutrient concentration definition of minimally impacted waters.

In addition to problems with categorizing data, please be advised that we recently determined that there are significant errors in North Carolina's chlorophyll data (response variable). Analytical quality control review completed in February, 2001 indicates that North Carolina chlorophyll data collected since 1996 will require additional and detailed corrections in order to accommodate problems with analytical results. We are in the process of amending these data reports and request that our chlorophyll data be removed from the dataset until the results are corrected.

We appreciate EPA's tenacity in responding to the challenge of developing nutrient criteria. We support the need for nutrient management and we also recognize that the challenge put to EPA is formidable. North Carolina has developed many different management strategies that have successfully begun the process of reducing nutrient loading to our impaired waters. In addition, we clearly recognize that we must do even more to proactively protect those waters that currently meet all of their designated uses. We have carefully reviewed the series of documents for the Nutrient Ecoregions that are represented within our state's borders. We find the documents disappointing, scientifically misleading, complete with constructions of numerical criteria based on erroneous summarization of water quality databases that are

also riddled with errors. Worst of all, these documents will establish reference concentrations that will be used and misused for many years to come.

We believe that the fundamental approach of using ecoregion-based reference conditions is not supported in these documents particularly for the evaluation of artificially constructed reservoirs. The documents fail to demonstrate an association, cause and effect relationship, or correlation between the ecoregion approach and use support. This demonstration is vital to the defensibility of ecoregion based nutrient criteria. The basis for regulatory control of nutrient over-enrichment must rely on biological responses to nutrient delivery as well as environmental effects on the ability to support designated uses. The focus of the current documents is a comparative approach to reference conditions that does not take into consideration the impact of the variability associated with environmental conditions such as retention time, depth, shading, turbidity, etc.

There is a general mixed-message provided throughout the document. One message is that these are valid, scientifically derived ecoregion-based numerical criteria. However, there is also the profound disclaimer that "the values presented in this document generally represent nutrient levels that protect against the adverse effects of nutrient enrichment and are based on information available to the Agency at the time of publications. However, States and Tribes should critically evaluate this information in light of the specific designated uses that need to be protected." Thus, it can be concluded that EPA believes that use support is a critical component to criteria development, but the EPA did not have the time nor the scientific information to develop defensible criteria and expeditiously meet the demands of the established timetable. It is our conclusion that the documents as they currently exist are clearly the wrong answer.

Our challenge in protecting the state's waters from over-enrichment is confounded by the lack of broad-based public support for mandatory nutrient management initiatives. These ecoregion based criteria documents will greatly impede our ability to demonstrate to the public why reasonable management strategies must be developed for waterbodies that experience nuisance conditions. Simply put, the ecoregion-based criteria will dilute our efforts to focus attention on the very waterbodies that are in most need of rehabilitation for eutrophic concerns. While some of the public will perceive the ecoregion approach as realistic and fully support it based on their lack of understanding of eutrophication, the more educated public will see this as a strategy designed to restore most waters to an unrealistic condition.

Please take the time to revisit the National Nutrient Strategy and revamp it in such a way that allows the states and EPA to direct their attention to the waters that are a priority for restoration or protection. We will continue to work in a positive manner with the Region IV RTAG and hope to assist EPA with transforming the National Nutrient Strategy into a program that truly benefits in maintaining and restoring the designated uses of our state's waters.

Sincerely,

Coleen H. Sullins, Chief
Water Quality Section

Cc Jim Harrison EPA Region IV
Ed Decker EPA Region IV
Water Environment Federation ASIWPCA
NC League of Municipalities AMSA

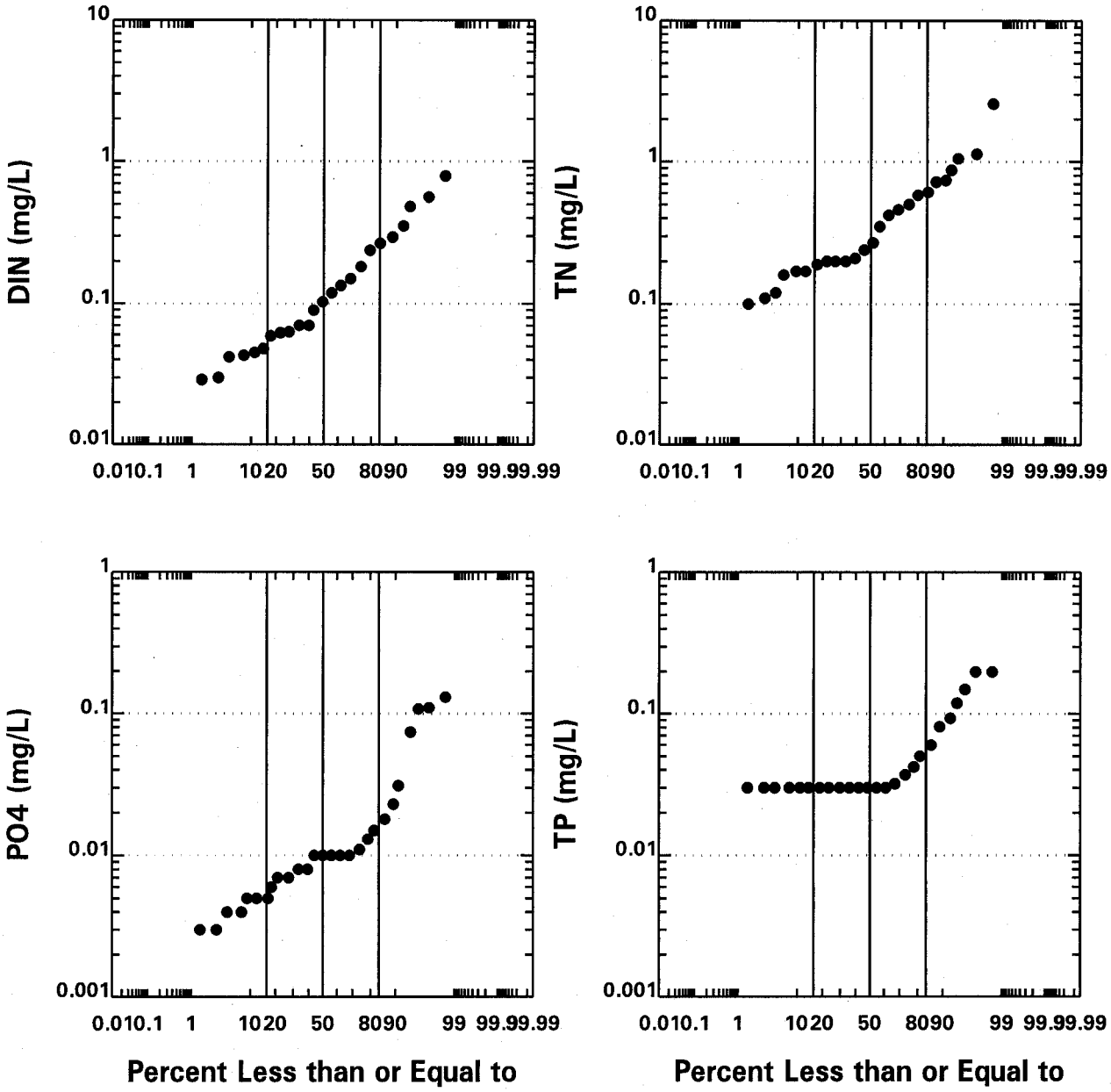

Figure 1. USGS Undeveloped Stream Basin Data (Mean Annual Flow Weighted)

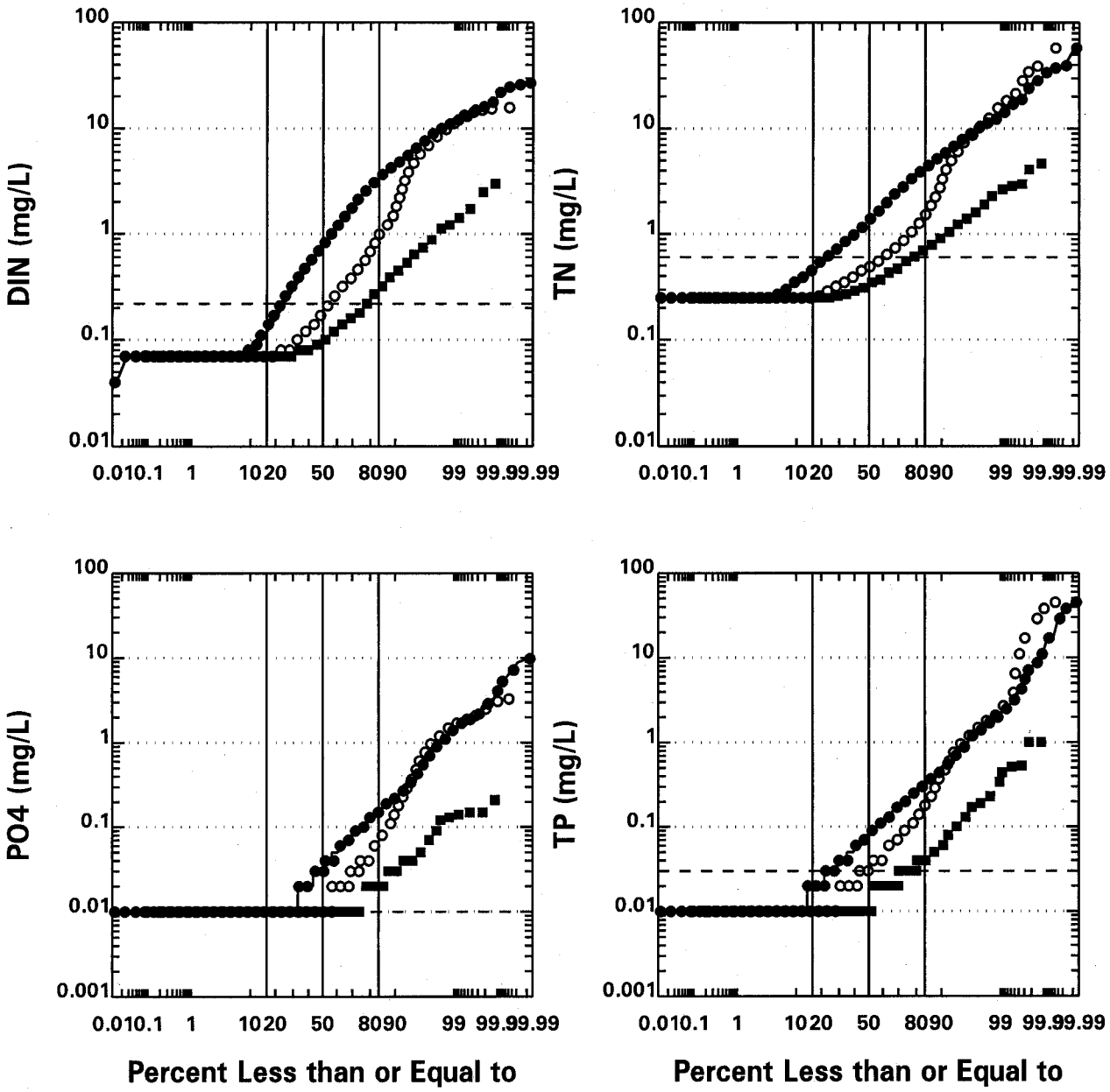

Figure 2. USGS NAWQA Stream Data (1992 to 1996)
(Filled Circles - All, Filled Squares - Undeveloped Land Use)
(Open Circles - Urban & Agriculture Land Uses < 20%)
(Solid Line - Urban Land Uses < 20%)

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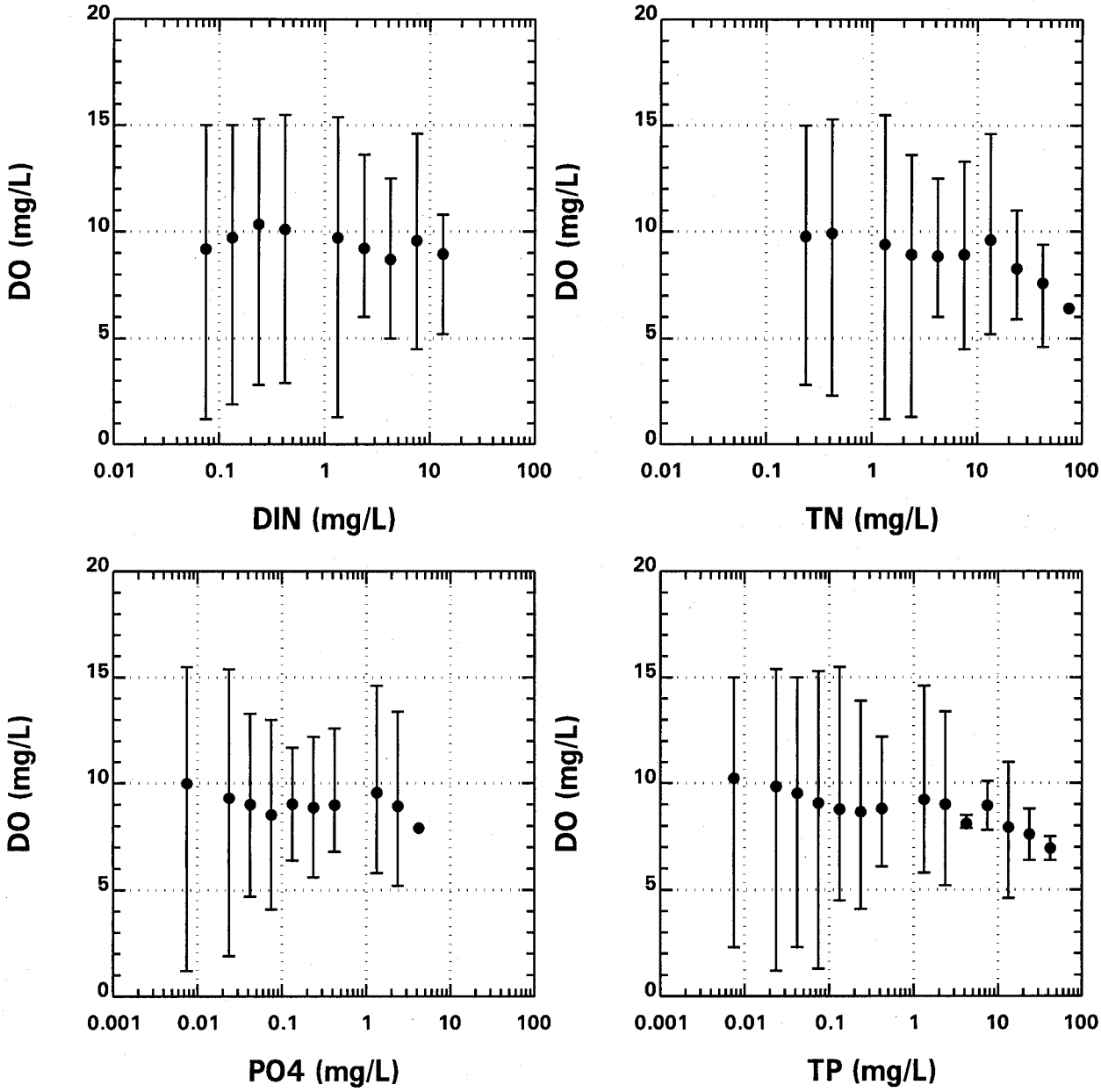

Figure 3. USGS NAWQA "Minimally" Impacted Data Set DO Relationships

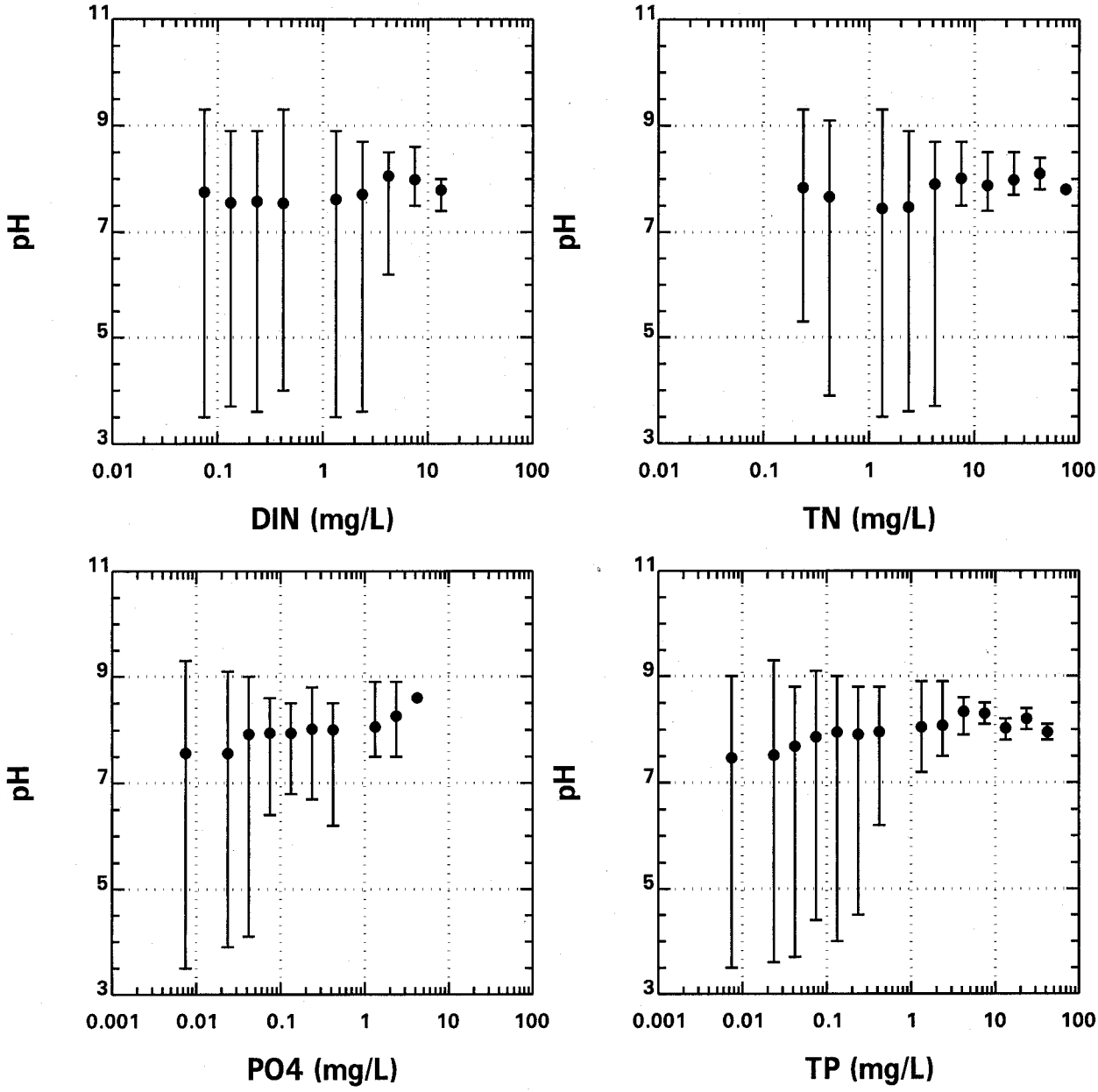

Figure 4. USGS NAWQA "Minimally" Impacted Data Set pH Relationships

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