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Ambient Water Quality Criteria Recommendations

Information Supporting the Development of State and Tribal Nutrient Criteria

Rivers and Streams in Nutrient Ecoregion IX

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AMBIENT WATER QUALITY CRITERIA RECOMMENDATIONS

INFORMATION SUPPORTING THE DEVELOPMENT OF STATE AND TRIBAL NUTRIENT CRITERIA

FOR

RIVERS AND STREAMS IN NUTRIENT ECOREGION IX

Southeastern Temperate Forested Plains and Hills

including all or parts of the States of

Maryland, Pennsylvania, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Tennessee, Kentucky, Indiana, Illinois, Iowa, Missouri, Kansas, Oklahoma, Arkansas, Louisiana, Texas

and the authorized Tribes within the Ecoregion

U.S. ENVIRONMENTAL PROTECTION AGENCY

OFFICE OF WATER
OFFICE OF SCIENCE AND TECHNOLOGY
HEALTH AND ECOLOGICAL CRITERIA DIVISION
WASHINGTON, D.C.

DECEMBER 2000

FOREWORD

This document presents EPA's nutrient criteria for **Rivers and Streams in Nutrient Ecoregion IX.** These criteria provide EPA's recommendations to States and authorized Tribes for use in establishing their water quality standards consistent with section 303(c) of CWA. Under section 303(c) of the CWA, States and authorized Tribes have the primary responsibility for adopting water quality standards as State or Tribal law or regulation. The standards must contain scientifically defensible water quality criteria that are protective of designated uses. EPA's recommended section 304(a) criteria are not laws or regulations – they are guidance that States and Tribes may use as a starting point for the criteria for their water quality standards.

The term "water quality criteria" is used in two sections of the Clean Water Act, Section 304(a)(1) and Section 303(c)(2). The term has a different impact in each section. In Section 304, the term represents a scientific assessment of ecological and human health effects that EPA recommends to States and authorized Tribes for establishing water quality standards that ultimately provide a basis for controlling discharges or releases of pollutants or related parameters. Ambient water quality criteria associated with specific waterbody uses when adopted as State or Tribal water quality standards under Section 303 define the level of a pollutant (or, in the case of nutrients, a condition) necessary to protect designated uses in ambient waters. Quantified water quality criteria contained within State or Tribal water quality standards are essential to a water quality-based approach to pollution control. Whether expressed as numeric criteria or quantified translations of narrative criteria within State or Tribal water quality standards, quantified criteria serve as a critical basis for assessing attainment of designated uses and measuring progress toward meeting the water quality goals of the Clean Water Act.

EPA is developing section 304(a) water quality criteria for nutrients because States and 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, such as full support of aquatic life. EPA expects to develop nutrient criteria that cover four major types of waterbodies – lakes and reservoirs, rivers and streams, estuarine and coastal areas, and wetlands – across fourteen major ecoregions of the United States. EPA's section 304(a) criteria are intended to provide for the protection and propagation of aquatic life and recreation. To support the development of nutrient criteria, EPA is publishing Technical Guidance Manuals that describe a process for assessing nutrient conditions in the four waterbody types.

EPA's section 304(a) water quality criteria for nutrients provide numeric water quality criteria, as well as procedures by which to translate narrative criteria within State or Tribal water quality standards. In the case of nutrients, EPA section 304(a) criteria establish values for causal variables (e.g., total nitrogen and total phosphorus) and response variables (e.g., turbidity and chlorophyll *a*). EPA believes that State and Tribal water quality standards need to include quantified endpoints for causal and response variables to provide sufficient protection of uses and to maintain downstream uses. These quantified endpoints will most often be expressed as numeric water quality criteria or as procedures to translate a State or Tribal narrative criterion into a quantified endpoint.

EPA will work with States and authorized Tribes as they adopt water quality criteria for nutrients into their water quality standards. EPA recognizes that States and authorized Tribes require flexibility in adopting numeric nutrient criteria into State and Tribal water quality standards. States and authorized Tribes have several options available to them. EPA 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.

Geoffrey H. Grubbs, Director
Office of Science and Technology

DISCLAIMER

This document provides technical guidance and recommendations to States, authorized Tribes, and other authorized jurisdictions to develop water quality criteria and water quality standards under the Clean Water Act (CWA) to protect against the adverse effects of nutrient overenrichment. Under the CWA, States and authorized Tribes are to establish water quality criteria to protect designated uses. State and Tribal decision-makers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance when appropriate and scientifically defensible. While this document contains EPA's scientific recommendations regarding ambient concentrations of nutrients that protect aquatic resource quality, it does not substitute for the CWA or EPA regulations; nor is it a regulation itself. Thus it cannot impose legally binding requirements on EPA, States, authorized Tribes, or the regulated community, and it might not apply to a particular situation or circumstance. EPA may change this guidance in the future.

EXECUTIVE SUMMARY

Nutrient Program Goals

EPA developed the National Strategy for the Development of Regional Nutrient Criteria (National Strategy) in June 1998. The strategy presents EPA's intentions to develop technical guidance manuals for four types of waters (lakes and reservoirs, rivers and streams, estuaries and coastal waters, and wetlands) and produce section 304(a) criteria for specific nutrient ecoregions by 2000. In addition, the Agency formed Regional Technical Assistance Groups (RTAGs) which include State and Tribal representatives working to develop more refined and more localized nutrient criteria based on approaches described in the waterbody guidance manuals. This document presents EPA's current recommended criteria for total phosphorus, total nitrogen, chlorophyll *a*, and turbidity for rivers and streams in Nutrient Ecoregion IX (Southeastern Temperate Forested Plains and Hills) which were derived using the procedures described in the Rivers and Streams Nutrient Criteria Technical Guidance Manual (2000b).

EPA's ecoregional nutrient criteria are intended to address cultural eutrophication-- the adverse effects of excess nutrient inputs. The criteria are empirically derived to represent conditions of surface waters that are minimally impacted by human activities and protective of aquatic life and recreational uses. The information contained in this document represent starting points for States and Tribes to develop (with assistance from EPA) more refined nutrient criteria.

In developing these criteria recommendations, EPA followed a process which included, to the extent they were readily available, the following elements critical to criterion derivation:

- **Historical and recent nutrient data in Nutrient Ecoregion IX.**
  Data sets from Legacy STORET, NASQAN, NAWQA, Auburn University, and EPA Regions 3, 5 and 7 were used to assess nutrient conditions from 1990 to 1998.

- **Reference sites/reference conditions in Nutrient Ecoregion IX.**
  Reference conditions presented are based on 25^{th} percentiles of all nutrient data including a comparison of reference condition for the aggregate ecoregion versus the subecoregions. States and Tribes are urged to determine their own reference sites for rivers and streams within the ecoregion at different geographic scales and to compare them to EPA's reference conditions.

- **Models employed for prediction or validation.**
  EPA did not identify any specific models used in the ecoregion to develop nutrient criteria. States and Tribes are encouraged to identify and apply appropriate models to support nutrient criteria development.

- **RTAG expert review and consensus.**
  EPA recommends that when States and Tribes prepare their nutrient criteria, they obtain the expert review and consent of the RTAG.

- **Downstream effects of criteria.**
  EPA encourages the RTAG to assess the potential effects of the proposed criteria on downstream water quality and uses.

In addition, EPA followed specific **QA/QC procedures** during data collection and analysis: All data were reviewed for duplications. All data are from ambient waters that were not located directly outside a permitted discharger. The following States indicated that their data were sampled and analyzed using either Standard methods or EPA approved methods: Florida, Georgia, Illinois, Indiana, Iowa, Maryland, Missouri, North Carolina, South Carolina, and Tennessee.

The following tables contain a summary of Aggregate and level III ecoregion values for TN, TP, water column chl *a*, and turbidity:

BASED ON 25th PERCENTILE ONLY

Nutrient Parameters	Aggregate Nutrient Ecoregion IX Reference Conditions
Total phosphorus (μg/L)	36.56
Total nitrogen (mg/L)	0.69
Chlorophyll *a* (μg/L) (Spectrophotometric method)	0.93
Periphyton Chlorophyll *a* (mg/m^2)	20.35
Turbidity (FTU)	5.7

For subecoregions, 29,33, 35, 37, 40, 45, 64, 65, 71, 72, and 74, the ranges of nutrient parameter reference conditions are:

BASED ON 25th PERCENTILE ONLY

Nutrient Parameters	Range of Level III Subecoregions Reference Conditions
Total phosphorus (μg/L)	22.5 - 100.00
Total nitrogen (mg/L)	0.07 - 1.0
Chlorophyll *a* (μg/L)	0.05 - 5.74
Periphyton Chlorophyll *a* (mg/m^2)	3.13 - 20.35
Turbidity (FTU)	3.15 - 13.5

NOTICE OF DOCUMENT AVAILABILITY

This document is available electronically to the public through the INTERNET at: (http://www.epa.gov/OST/standards/nutrient.html). Requests for hard copies of the document should be made to EPA's National Service Center for Environmental Publications (NSCEP), 11029 Kenwood Road, Cincinnati, OH 45242 or (513) 489-8190, or toll free (800) 490-9198. Please refer to EPA document number **EPA-822-B-00-019**.

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1.0 INTRODUCTION

Background

Nutrients are essential to the health and diversity of our surface waters. However, in excessive amounts, nutrients cause hypereutrophication, which results in overgrowth of plant life and decline of the biological community. Excessive nutrients can also result in potential human health risks, such as the growth of harmful algal blooms - most recently manifested in the *Pfiesteria* outbreaks of the Gulf and East Coasts. Chronic nutrient overenrichment of a waterbody can lead to the following consequences: low dissolved oxygen, fish kills, algal blooms, overabundance of macrophytes, likely increased sediment accumulation rates, and species shifts of both flora and fauna.

Historically, National Water Quality Inventories have repeatedly shown that nutrients are a major cause of ambient water quality use impairments. EPA's 1996 National Water Quality Inventory report identifies excessive nutrients as the leading cause of impairment in lakes and the second leading cause of impairment in rivers (behind siltation). In addition, nutrients were the second leading cause of impairments reported by the States in their 1998 lists of impaired waters. Where use impairment is documented, nutrients contribute roughly 25-50% of the impairment nationally. The Clean Water Act establishes a national goal to achieve, wherever attainable, water quality which provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. In adopting water quality standards, States and Tribes designate uses for their waters in consideration of the Clean Water Act goals, and establish water quality criteria that contain sufficient parameters to protect those uses. To date, EPA has not published information and recommendations under section 304(a) for nutrients to assist States and Tribes in establishing numeric nutrient criteria to protect uses when adopting water quality standards.

In 1995, EPA gathered a set of national experts and asked the experts how to best deal with the national nutrient problem. The experts recommended that the Agency not develop single criteria values for phosphorus or nitrogen applicable to all water bodies and regions of the country. Rather, the experts recommended that EPA put a premium on regionalization, develop guidance (assessment tools and control measures) for specific waterbodies and ecological regions across the country, and use reference conditions (conditions that reflect pristine or minimally impacted waters) as a basis for developing nutrient criteria.

With these suggestions as starting points, EPA developed the National Strategy for the Development of Regional Nutrient Criteria (National Strategy), published in June 1998. This strategy presented EPA's intentions to develop technical guidance manuals for four types of waters (lakes and reservoirs, rivers and streams, estuaries and coastal waters, and wetlands) and, thereafter, to publish section 304(a) criteria recommendations for specific nutrient ecoregions. Technical guidance manuals for lakes/reservoirs and rivers/streams were published in April 2000 and July 2000, respectively. The technical guidance manual for estuaries/coastal waters will be published in spring 2000 and the draft wetlands technical guidance manual will be published by December 2001. Each manual presents EPA's recommended approach for developing nutrient criteria values for a specific waterbody type. In addition, EPA is committed to working with

States and Tribes to develop more refined and more localized nutrient criteria based on approaches described in the waterbody guidance manuals and this document.

Overview of the Nutrient Criteria Development Process

For each Nutrient Ecoregion, EPA developed a set of recommendations for two causal variables (total nitrogen and total phosphorus) and two early indicator response variables (chlorophyll *a* and some measure of turbidity). Other indicators such as dissolved oxygen and macrophyte growth or speciation, and other fauna and flora changes are also deemed useful. However, the first four are considered to be the best suited for protecting designated uses.

The technical guidance manuals describe a process for developing nutrient criteria that involves consideration of five factors. The first of these is the Regional Technical Assistance Group (RTAG), which is a body of qualified regional specialists able to objectively evaluate all of the available evidence and select the value(s) appropriate to nutrient control in the water bodies of concern. These specialists may come from such disciplines as limnology, biology, natural resources management-- especially water resource management, chemistry, and ecology. The RTAG evaluates and recommends appropriate classification techniques for criteria determination, usually physical within an ecoregional construct.

The second factor is the historical information available to establish a perspective of the resource base. This is usually data and anecdotal information available within the past ten-twenty five years. This information gives evidence about the background and enrichment trend of the resource.

The third factor is the present reference condition. A selection of reference sites chosen to represent the least culturally impacted waters of the class existing at the present time. The data from these sites is combined and a value from the distribution of these observations is selected to represent the reference condition, or best attainable, most natural condition of the resource base at this time.

A fourth factor often employed is theoretical or empirical models of the historical and reference condition data to better understand the condition of the resource.

The RTAG comprehensively evaluates the other three elements to propose a candidate criterion (initially one each for TP, TN, chl *a*, and some measure of turbidity).

The last and final element of the criteria development process is the assessment by the RTAG of the likely downstream effects of the criterion. Will there be a negative, positive, or neutral effect on the downstream waterbody? If the RTAG judges that a negative effect is likely, then the proposed State/Tribal water quality criteria should be revised to ameliorate the potential for any adverse downstream effects.

While States and authorized Tribes would not necessarily need to incorporate all five elements into their water quality criteria setting process (e.g., modeling may be significant in only some instances), the best assurance of a representative and effective criterion for nutrient management decision making is the balanced incorporation of all five elements, or at least all elements except modeling.

Because some parts of the country have naturally higher soil and parent material enrichment, and different precipitation regimes, the application of the criterion development process has to be adjusted by region. Therefore, an ecoregional approach was chosen to develop nutrient criteria appropriate to each of the different geographical and climatological areas of the country. Initially, the continental U.S. was divided into 14 separate ecoregions of similar geographical characteristics. Ecoregions are defined as regions of relative homogeneity in ecological systems; they depict areas within which the mosaic of ecosystem components (biotic and abiotic as well as terrestrial and aquatic) is different than adjacent areas in a holistic sense. Geographic phenomena such as soils, vegetation, climate, geology, land cover, and physiology that are associated with spatial differences in the quantity and quality of ecosystem components are relatively similar within each ecoregion.

The Nutrient ecoregions are aggregates of U.S. EPA=s hierarchal level III ecoregions. As such, they are more generalized and less defined than level III ecoregions. EPA determined that setting ecoregional criteria for the large scale aggregates is not without its drawbacks - variability is high due to the lumping of many waterbody classes, seasons, and years worth of multipurpose data over a large geographic area. For these reasons, the Agency recommends that States and Tribes develop nutrient criteria at the level III ecoregional scale and at the waterbody class scale where those data are readily available. Data analyses and recommendations on both the large aggregate ecoregion scale as well as more refined scales (level III ecoregions and waterbody classes), where data were available to make such assessments, are presented for comparison purposes and completeness of analysis.

Relationship of Nutrient Criteria to Biological Criteria

Biological criteria are quantitative expressions of the desired condition of the aquatic community. Such criteria can be based on an aggregation of data from sites that represent the least-impacted and attainable condition for a particular waterbody type in an ecoregion, subecoregion, or watershed. EPA's nutrient criteria recommendations and biological criteria recommendations have many similarities in the basic approach to their development and data requirements. Both are empirically derived from statistical analysis of field collected data and expert evaluation of current reference conditions and historical information. Both utilize direct measurements from the environment to integrate the effects of complex processes that vary according to type and location of waterbody. The resulting criteria recommendations, in both cases, are efficient and holistic indicators of water quality necessary to protect uses.

States and authorized Tribes can develop and apply nutrient criteria and biological criteria in tandem, with each providing important and useful information to interpret both the nutrient enrichment levels and the biological condition of sampled waterbodies. For example, using the same reference sites for both types of criteria can lead to efficiencies in both sample design and data analysis. In one effort, environmental managers can obtain information to support assessment of biological and nutrient condition, either through evaluating existing data sets or through designing and conducting a common sampling program. The traditional biological criteria variables of benthic invertebrate and fish sampling can be readily incorporated to supplement a nutrient assessment. To demonstrate the effectiveness of this tandem approach, EPA has initiated pilot projects in both freshwater and marine environments to investigate the relationship between nutrient overenrichment and apparent declines in diversity indices of benthic invertebrates and fish.

2.0 BEST USE OF THIS INFORMATION

EPA recommendations published under section 304(a) of the CWA serve several purposes, including providing guidance to States and Tribes in adopting water quality standards for nutrients that ultimately provide a basis for controlling discharges or releases of pollutants. The recommendations also provide guidance to EPA when promulgating Federal water quality standards under section 303(c) when such action is necessary. Other uses include identification of overenrichment problems, management planning, project evaluation, and determination of status and trends of water resources.

State water quality inventories and listings of impaired waters consistently rank nutrient overenrichment as a top contributor to use impairments. EPA's water quality standards regulations at 40 CFR §131.11(a) require States and Tribes to adopt criteria that contain sufficient parameters and constituents to protect the designated uses of their waters. In addition, States and Tribes need quantifiable targets for nutrients in their standards to assess attainment of uses, develop water quality-based permit limits and source control plans, and establish targets for total maximum daily loads (TMDLs).

EPA expects States and Tribes to address nutrient overenrichment in their water quality standards, and to build on existing State and Tribal initiated efforts where possible. States and Tribes can address nutrient overenrichment through establishment of numerical criteria or through use of new or existing narrative criteria statements (e.g., free from excess nutrients that cause or contribute to undesirable or nuisance aquatic life or produce adverse physiological response in humans, animals, or plants). In the case of narrative criteria, EPA expects that States and Tribes establish procedures to quantitatively translate these statements for both assessment and source control purposes.

The intent of developing ecoregional nutrient criteria is to represent conditions of surface waters that are minimally impacted by human activities and thus protect against the adverse effects of nutrient overenrichment from cultural eutrophication. EPA's recommended process for developing such criteria includes physical classification of waterbodies, determination of current reference conditions, evaluation of historical data and other information (such as published literature), use of models to simulate physical and ecological processes or determine empirical relationships among causal and response variables (if necessary), expert judgement, and evaluation of downstream effects. To the extent allowed by the information available, EPA has used elements of this process to produce the information contained in this document. The values for both causal (total nitrogen, total phosphorus) and biological and physical response (chlorophyll *a*, turbidity) variables represent a set of starting points for States and Tribes to use in establishing their own criteria in standards to protect uses.

In its water quality standards regulations, EPA recommends that States and Tribes establish numerical criteria based on section 304(a) guidance, section 304(a) guidance modified to reflect site-specific conditions, or other scientifically defensible methods. For many pollutants, such as toxic chemicals, EPA expects that section 304(a) guidance will provide an appropriate level of protection without further modification in most cases. EPA has also published methods for modifying 304(a) criteria on a site-specific basis, such as the water effect ratio, where site-specific conditions warrant modification to achieve the intended level of protection. For nutrients, however, EPA expects that, in most cases, it will be necessary for States and authorized Tribes to identify with greater precision the nutrient levels that protect aquatic life and recreational uses. This can be achieved through development of criteria modified to reflect conditions at a smaller geographic scale than an ecoregion such as a subecoregion, the State or Tribe level, or specific class of waterbodies. Criteria refinement can occur by grouping data or performing data analyses at these smaller geographic scales. Refinement can also occur through further consideration of other elements of criteria development, such as published literature or models.

The values presented in this document generally represent nutrient levels that protect against the adverse effects of nutrient overenrichment and are based on information available to the Agency at the time of this publication. However, States and Tribes should critically evaluate this information in light of the specific designated uses that need to be protected. For example, more sensitive uses may require more stringent values as criteria to ensure adequate protection. On the other hand, overly stringent levels of protection against the adverse effects of cultural eutrophication may actually fall below levels that represent the natural load of nutrients for certain waterbodies. In cases such as these, the level of nutrients specified may not be sufficient to support a productive fishery. In the criteria derivation process, it is important to distinguish between the natural load associated with a specific waterbody and current reference conditions, using historical data and expert judgement. These elements of the nutrient criteria derivation process are best addressed by States and Tribes with access to information and local expertise. Therefore, EPA strongly encourages States and Tribes to use the information contained in this document and to develop more refined criteria according to the methods described in EPA's technical guidance manuals for specific waterbody types.

To assist in the process of further refinement of nutrient criteria, EPA has established ten Regional Technical Advisory Groups (experts from EPA Regional Offices and States/Tribes). In the process of refining criteria, States and authorized Tribes need to provide documentation of data and analyses, along with a defensible rationale, for any new or revised nutrient criteria they submit to EPA for review and approval. As part of EPA's review of State and Tribal standards, EPA intends to seek assurance from the RTAG that proposed criteria are sufficient to protect uses.

In the process of using the information and recommendations contained in this document, as well as additional information, to develop numerical criteria or procedures to translate narrative criteria, EPA encourages States and Tribes to:

- Address both chemical causal variables and early indicator response variables. Causal variables are necessary to provide sufficient protection of uses before impairment occurs and to maintain downstream uses. Early response variables are necessary to provide warning signs of possible impairment and to integrate the effects of variable and potentially unmeasured nutrient loads.
- Include variables that can be measured to determine if standards are met, and variables that can be related to the ultimate sources of excess nutrients.
- Identify appropriate periods of duration (i.e., how long) and frequency (i.e., how often) of occurrence in addition to magnitude (i.e., how much). EPA does not recommend identifying nutrient concentrations that must be met at all times, rather a seasonal or annual averaging period (e.g., based on weekly measurements) is considered appropriate. However, these seasonal or annual central tendency measures should apply each season or each year, except under the most extraordinary of conditions (e.g., a 100 year flood).

3.0 AREA COVERED BY THIS DOCUMENT

The following sections provide a general description of the aggregate ecoregion and its geographical boundaries. Descriptions of the level III ecoregions contained within the aggregate ecoregion are also provided.

3.1 Description of Aggregate Ecoregion IX - Southeastern Temperate Forested Plains and Hills

Region IX is composed of irregular plains and hills. Originally, the Southeastern Temperate Forested Plains and Hills (IX) was mostly forested in contrast to the South Central Cultivated Great Plains (V); areas of savannah and grassland also occurred. Today, Region IX is a mosaic of forest, cropland, and pasture. The Southeastern Temperate Forested Plains and Hills (IX) is not as arable as the South Central Cultivated Great Plains (V) or the Corn Belt and Northern Great Plains (VI). However, there is much more cropland than in the more rugged Central and Eastern Forested Uplands (XI). Lateritic soils are common and are a contrast to the soils of the surrounding regions. Areas of depleted soils are found in Region IX. Major poultry and aquaculture operations occur locally in the Southeastern Temperate Forested Plains and Hills (IX). Stream quality in the Southeastern Temperate Forested Plains and Hills (IX) has been significantly affected by urban, suburban, and industrial development as well as by poultry, livestock, silviculture, and aquaculture operations. Downstream of sewage treatment plants, poultry farms, and hog operations, nutrient levels and fecal coliform bacteria concentrations can be very high. There are a large number of intensive chicken, turkey, and hog operations in Region IX; effluent from intensive livestock production poses a substantial eutrophication threat to surface waters. In contrast, streams draining relatively undisturbed and forested watersheds have low median concentrations of fecal coliform bacteria, sulfate, dissolved solids, and phosphorus. Silviculture, agriculture, and urban development have impacted suspended sediment levels in streams especially where soils are highly erodible. Coal mining has degraded water quality and affected aquatic biota in several areas including southern Iowa, northern Missouri, and eastern Pennsylvania. Excessive PCB and DDT concentrations have been detected in the Schuylkill River of Pennsylvania and have led to advisories against local fish consumption.

3.2 Geographical Boundaries of Aggregate Ecoregion IX

Ecoregion IX is an expansive region encompassing parts of twenty States (Figure 1). The region's northeastern border is the southeastern corner of Pennsylvania. The region runs southward through the States of Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida. Only the northwestern corner of Florida is included in the region. West of Georgia, the region includes parts of Alabama, Mississippi, Louisiana and Texas. The region runs north up through the middle of the country to include parts of Oklahoma, Arkansas, Kansas, Missouri, Tennessee, Kentucky, Iowa, Illinois and Indiana. The northwestern boundary of the region is approximately described by the southeastern corner of Iowa, the southern half of Illinois and the southwestern third of Indiana.

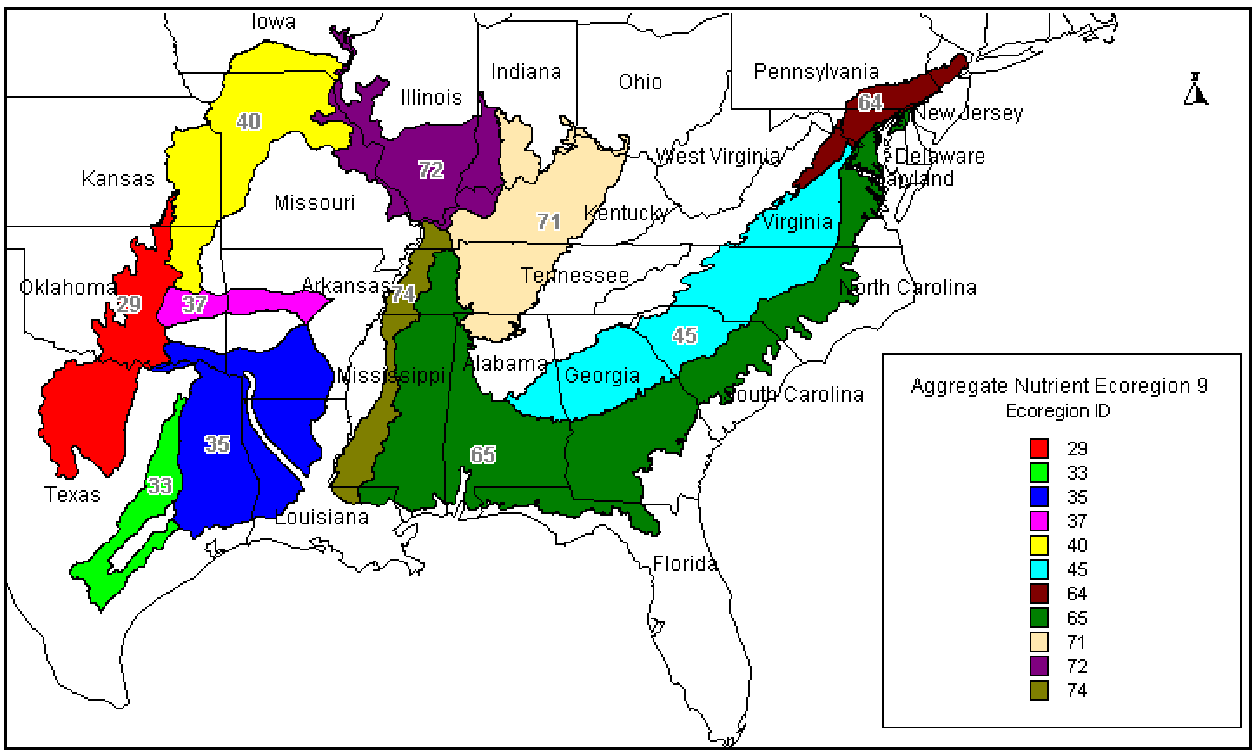

Figure 1. Aggregate Ecoregion IX

3.3 Level III Ecoregions Within Aggregate Ecoregion IX

There are eleven Level III ecoregions contained within Aggregate Ecoregion IX (Figure 2). The following provides brief descriptions of the climate, vegetation cover, topography, and other ecological information pertaining to these subecoregions**.**

29. Central Oklahoma/Texas Plains

The Central Oklahoma/Texas Plains ecoregion is a transition area between the once prairie, now winter wheat growing regions to the west, and the forested low mountains of eastern Oklahoma. The region does not possess the arability and suitability for crops such as corn and soybeans that are common in the Central Irregular Plains to the northeast. Transitional "cross-timbers" (little bluestem grassland with scattered blackjack oak and post oak trees) is the native vegetation, and presently rangeland and pastureland comprise the predominant land cover. Oil extraction has been a major activity in this region for over eighty years.

33. East Central Texas Plains

Also called the Claypan Area, this region of irregular plains was originally covered by a post oak savanna vegetation, in contrast to the more open prairie-type regions to the north, south and west and the piney woods to the east. The bulk of this region is now used for pasture and range.

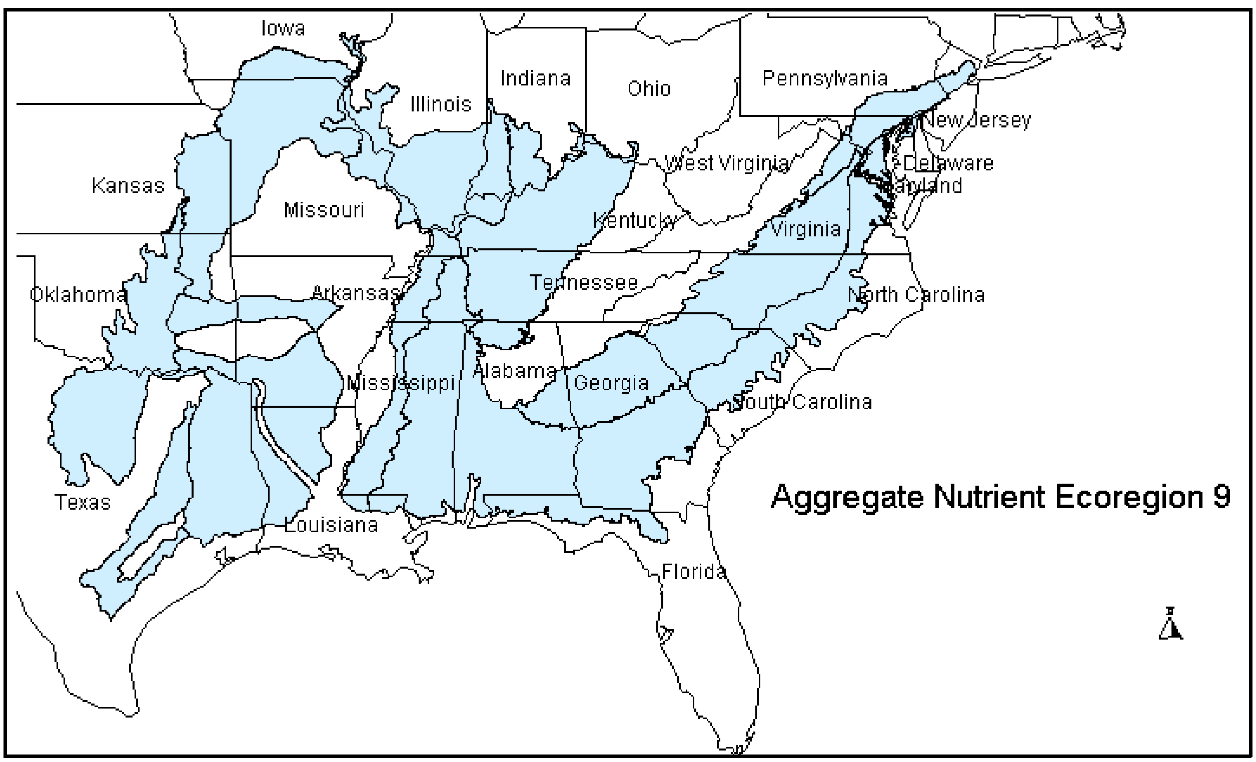

Figure 2. Aggregate Ecoregion IX with level III ecoregions shown.

35. South Central Plains
Locally termed the "piney woods", this region of mostly irregular plains was once blanketed by oak-hickory-pine forests, but is now predominantly in loblolly and shortleaf pine. Only about one sixth of the region is in cropland, whereas about two thirds is in forests and woodland. Lumber and pulpwood production are major economic activities

37. Arkansas Valley
A region of mostly forested valleys and ridges, the physiography of the Arkansas Valley is much less irregular than that of the Boston Mountains to the north and the Ouachita Mountains to the south, but is more irregular than the ecological regions to the west and east. About one fourth of the region is grazed and roughly one tenth is cropland. In the Arkansas Valley, even streams that have been relatively unimpacted by human activities have considerably lower dissolved oxygen levels, and hence support different biological communities, than those of most of the adjacent regions.

40. Central Irregular Plains
The Central Irregular Plains has a mix of land use types and tends to be topographically more irregular than the Western Corn Belt Plains to the north, where most of the land is in crops; however, the region is less irregular and less forest covered than the ecoregions to the south and east. The potential natural vegetation of this ecological region is a grassland/forest mosaic with wider forested strips along the streams compared to the region to the north. The mix of land use activities in the Central Irregular Plains also includes mining operations of high-sulfur bituminous coal. The disturbance of these coal strata in southern Iowa and northern Missouri has degraded water quality and affected aquatic biota.

45. Piedmont
Considered the nonmountainous portion of the old Appalachians Highland by physiographers, the northeast-southwest trending Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the flat coastal plain to the southeast. Once largely cultivated, much of this region has reverted to pine and hardwood woodlands.

64. Northern Piedmont
The Northern Piedmont is transitional region of low rounded hills, irregular plains, and open valleys in contrast to the low mountains of ecoregions to the north and west and the flat coastal plains of the ecoregion to the east. Potential natural vegetation here was predominantly Appalachian oak forest as compared to the mostly oak-hickory-pine forests of the Piedmont ecoregion to the southwest.

65. Southeastern Plains
These irregular plains have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is mostly oak-hickory-pine and Southern mixed forest. The Cretaceous or Tertiary-age sands, silts, and clays of the region contrast geologically to the older igneous and metamorphic rocks of the Piedmont, and the older limestone, chert, and shale found in the Interior Plateau. Streams in this area are relatively low-gradient and sandy-bottomed.

71. Interior Plateau

The Interior Plateau is a diverse ecoregion extending from southern Indiana and Ohio to northern Alabama. Rock types are distinctly different from the coastal plain sands and alluvial deposits to the west, and elevations are lower than the Appalachian ecoregions to the east. Mississippian to Ordovician-age limestone, chert, sandstone, siltstone and shale compose the landforms of open hills, irregular plains, and tablelands. The natural vegetation is primarily oak-hickory forest, with some areas of bluestem prairie and cedar glades. The region has a diverse fish fauna.

72. Interior River Lowland

The Interior River Lowland is made up of many wide, flat-bottomed terraced valleys, forested valley walls, and dissected glacial till plains. In contrast to the generally rolling to slightly irregular plains in adjacent ecological regions to the north, east and west, where most of the land is cultivated for corn and soybeans, a little less than half of this area is in cropland, about 30 percent is in pasture, and the remainder is in pasture.

74. Mississippi Valley Loess Plains

This ecoregion stretches from near the Ohio River in western Kentucky to Louisiana. It consists primarily of irregular plains, with oak-hickory and oak-hickory-pine natural vegetation. Thick loess tends to be the distinguishing characteristic. With flatter topography than the Southeastern Plains ecoregion to the east, streams tend to have less gradient and more silty substrates. Agriculture is the dominant land use in the Kentucky and Tennessee portion of the region, while in Mississippi there is a mosaic of forest and cropland.

Suggested ecoregional subdivisions or adjustments.

EPA recommends that the RTAG evaluate the adequacy of EPA nutrient ecoregional and subecoregional boundaries and refine them as needed to reflect local conditions.

4.0 DATA REVIEW FOR RIVERS AND STREAMS IN AGGREGATE ECOREGION IX

The following section describes the nutrient data EPA has collected and analyzed for this Ecoregion, including an assessment of data quantity and quality. The data tables present the data for each causal parameter-- total phosphorus and total nitrogen (both reported and calculated from TKN and nitrite/nitrate), and the primary response variables-- some measure of turbidity and chlorophyll *a*. These are the parameters which EPA considers essential to nutrient assessment because the first two are the main causative agents of enrichment and the two response variables are the early indicators of system enrichment for most of the surface waters (see Chapter 3 of the Rivers and Streams Nutrient Criteria Technical Guidance Manual [U.S. EPA, 2000b] for a complete discussion on choosing causal and response variables.)

4.1 Data Sources

Data sets from Legacy STORET, NASQAN, NAWQA, Auburn University, and EPA Regions 3, 5, and were used to assess nutrient conditions from1990 to1999. EPA recommends that the RTAGs identify additional data sources that can be used to supplement the data sets listed above. In addition, the RTAGs may utilize published literature values to support quantitative and qualitative analyses.

4.2 Historical Data from Aggregate Ecoregion IX (TP, TN, Chl *a* and Turbidity)

EPA recommends that States/Tribes assess long-term trends observed over the past 50 years. This information may be obtained from scientific literature or documentation of historical trends. To gain additional perspective on more recent trends, it is recommended that States and Tribes assess nutrient trends over the last 10 years (e.g., what do seasonal trends indicate?)

4.3 QA/QC of Data Sources

An initial quality screen of data was conducted using the rules presented in Appendix C. Data remaining after screening for duplications and other QA measures (.e.g., poor or unreported analytical records, sampling errors or omissions, stations associated with outfalls, storm water sewers, hazardous waste sites) is the data used in statistical analyses.

The following States indicated that their data were sampled and analyzed using either Standard methods or EPA approved methods: Florida, Georgia, Illinois, Iowa, Indiana, Maryland, Missouri, North Carolina, South Carolina, Tennessee. Other States in Ecoregion IX did not provide information at this time.

4.4 Data for All Rivers and Streams Within Aggregate Ecoregion IX

Figure 3 shows the location of the sampling stations within each subecoregion. Table 1 presents all data records for all parameters for Aggregate Ecoregion IX and subecoregions within the Aggregate Ecoregion.

4.5 Statistical Analysis of Data

EPA's Technical Guidance Manual for Developing Nutrient Criteria for Rivers and Streams describes two ways of establishing a reference condition. One method is to choose the upper 25th percentile (75th percentile) of a reference population of streams. This is the preferred method to establish a reference condition. The 75th percentile was chosen by EPA since it is likely associated with minimally impacted conditions, will be protective of designated uses, and provides management flexibility. When reference streams are not identified, the second method is to determine the lower 25th percentile of the population of all streams within a region. The 25th percentile of the entire population was chosen by EPA to represent a surrogate for an actual reference population. Data analyses to date indicate that the lower 25th percentile from an entire population roughly approximates the 75th percentile for a reference population (see case studies for Minnesota lakes in the Lakes and Reservoirs Nutrient Criteria Technical Guidance Document [U.S. EPA, 2000a], the case study for Tennessee streams in the Rivers and Streams Nutrient Criteria Technical Guidance Document [U.S. EPA, 2000b], and the letter from Tennessee Department of Environment and Conservation to Geoffrey Grubbs [TNDEC, 2000]). New York State has also presented evidence that the 25^{th} percentile and the 75^{th} percentile compare well based on user perceptions of water resources (NYSDEC, 2000).

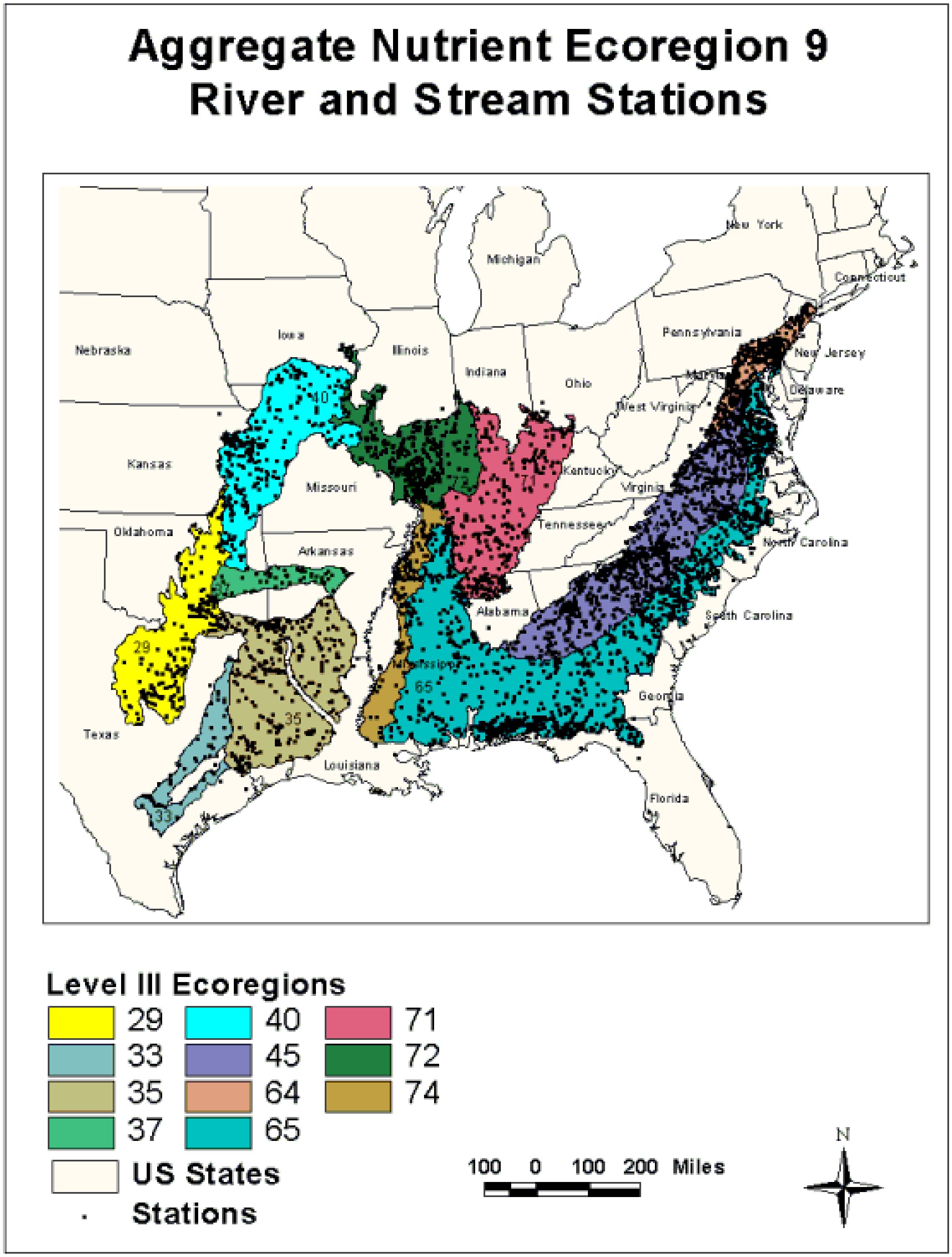

Figure 3 Map of sampling locations within each level III ecoregion.

Table 1. Rivers and Streams records for Aggregate Ecoregion IX - Southeastern Temperate Forested Plains and Hills

	Aggregate Ecoregion IX	Sub ecoR 29	Sub ecoR 33	Sub ecoR 35	Sub ecoR 37	Sub ecoR 40	Sub ecoR 45
# of Stream names	3,278	160	44	286	56	220	639
# of Stream Stations		256	73	465	93	445	1,298
Key Nutrient Parameters (listed below)							
- # of records for Turbidity (all methods)	115,125	1,631	203	8,137	2,226	3,569	36,404
- # of records for Chlorophyll *a* (all methods) + Periphyton	16,756	698	521	889	2	229	858
- # of records for Total Kjeldahl Nitrogen (TKN)	116,104	2,173	856	6,808	1,215	2,522	31,205
- # of records for Nitrate + Nitrite (NO_2 + NO_3)	117,925	1,334	469	9,184	2,469	3,015	29,898
- # of records for Total Nitrogen (TN)	13,749	351	80	317	123	390	1,014
- # of records for Total Phosphorus (TP)	164,145	2,412	981	10,173	2,421	5,305	42,948
Total # of records for key nutrient parameters	543,804	8,599	3,110	35,508	8,456	15,030	142,327

Table 1(continued). Rivers and Streams records for Aggregate Ecoregion IX - Southeastern Temperate Forested Plains and Hills

	Sub ecoR 64	Sub ecoR 65	Sub ecoR 71	Sub ecoR 72	Sub ecoR 74
# of Stream names	284	1,001	213	309	103
# of Stream Stations	880	1,870	429	550	162
Key Nutrient Parameters (listed below)					
- # of records for Turbidity (all methods)	8,325	40,234	3,574	9,772	1,050
- # of records for Chlorophyll *a* (all methods) + Periphyton	3,397	9,336	606	194	24
- # of records for Total Kjeldahl Nitrogen (TKN)	14,572	41,353	3,709	7,801	3,890
- # of records for Nitrate + Nitrite (NO_2 + NO_3)	6,407	37,963	6,640	13,823	6,723
- # of records for Total Nitrogen (TN)	2,396	6,382	206	2,424	66
- # of records for Total Phosphorus (TP)	17,541	52,744	6,454	16,108	7,058
Total # of records for key nutrient parameters	52,638	180,012	21,189	50,122	18,811

Definitions used in filling Table 1

1. # of records refers to the total count of observations for that parameter over the entire decade (1990-1999) for that particular aggregate or subecoregion. These are counts for all seasons over that decade.

2. # of stream stations refers to the total number of river and stream stations within the aggregate or subecoregion from which nutrient data was collected. Since streams and rivers can cross ecoregional boundaries, it is important to note that only those portions of a river or stream (and data associated with those stations) that exist within the ecoregion are included within this table.

Tables 2 and 3a-k present potential reference conditions for both the aggregate ecoregion and the subecoregions using both methods. However, the reference stream column is left blank because EPA does not have reference data and anticipates that States/Tribes will provide information on reference streams. Appendix A provides a complete presentation of all descriptive statistics for both the aggregate ecoregion and the level III subecoregion.

4.6. Classification of River/Stream Type

It is anticipated that assessing the data by stream type will further reduce the variability in the data analysis. There were no readily available classification data in the National datasets used to develop these criteria. States and Tribes are strongly encouraged to classify their streams before developing a final criterion.

4.7. Summary of Data Reduction Methods

All descriptive statistics were calculated using the medians for each stream within ecoregion IX, for which data existed. For example, if one stream had 300 observations for phosphorus over the decade or one year's time, one median resulted. Each median from each stream was then used in calculating the percentiles for phosphorus for the aggregate nutrient ecoregion/subecoregion (level III ecoregion) by season and year (Figure 4a & b).

Table 2. Reference conditions for aggregate ecoregion IX streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	1,609	0	4.825	0.3	
$NO_2 + NO_3$ (mg/L)	1,671	0	9.78	0.125	
TN (mg/L) - calculated	NA	0	15.60	0.425	
TN (mg/L) - reported	274	0.24	12.4	0.692	
TP (*u*g/L)	2,104	0	2,400	36.56	
Turbidity (NTU)	476	0.175	162.5	7.02	
Turbidity (FTU)	1,143	0.475	148	5.7	
Turbidity (JCU)	97	0.713	164.5	3.53	
Chlorophyll *a* (*u*g/L) -F	71	0.225	36.73	2.25	
Chlorophyll *a* (*u*g/L) -S	235	0	78.9	0.93	
Chlorophyll *a* (*u*g/L) -T	70	0	93.92	0.53	
Periphyton Chl *a* (mg/m^2)	6	11	62	20.35	

P25: 25th percentile of all data
P75: 75th percentile of all data
** as determined by the Regional Technical Assistance Groups (RTAGs)
\+ Median for all seasons' 25th percentiles. E.g. this value was calculated from four seasons' 25th percentiles. If the seasonal 25th percentile (P25) TP values are - spring 10*u*g/L, summer 15*u*g/L, fall 12*u*g/L, and winter 5*u*g/L, the median value of all seasons P25 will be 11*u*g/L.
++ N = largest value reported for a decade / Season.
TN calculated is based on the sum of TKN + NO_2+NO_3.
TN reported is actual TN value reported in the database for one sample.

F Chlorophyll *a* measured by Fluorometric method with acid correction.
S Chlorophyll *a* measured by Spectrophotometric method with acid correction.
T Chlorophyll *a b c* measured by Trichromatic method.
NA Not Applicable
zz calculated medians from less than 3 seasons' data.

Table(s) 3a.-k. present the potential reference conditions for rivers and streams in the Level III subecoregions within the Aggregate Ecoregion. The footnotes for Table 2 apply to tables 3a-k.

Table 3a. Reference conditions for level III ecoregion 29 streams.

Parameter	**No. of Streams N ++**	**Reported values**		**25th Percentiles based on all seasons data for the Decade**	**Reference Streams ****
		Min	**Max**	**P25-all seasons+**	**P75 - all seasons**
TKN (mg/L)	**93 W**	**0.05**	**2.058**	**0.4**	
$NO_2 + NO_3$ (mg/L)	**78 W**	**0.01**	**4.7**	**0.078**	
TN (mg/L) - calculated	**NA**	**0.06**	**6.758**	**0.478**	
TN (mg/L) - reported	**20**	**0.39**	**3.228**	**0.68**	
TP (*ug*/L)	**100 W**	**2.5**	**1,332.5**	**37.5**	
Turbidity (NTU)	**6**	**2.738**	**27.4**	**3.713**	
Turbidity (FTU)	**53 F**	**0.9**	**95.5**	**8.825**	
Turbidity (JCU)	**17**	**2**	**164.5**	**9.125**	
Chlorophyll *a* (*ug*/L) -F	**1 z**	**13**	**13**	**13 zz**	
Chlorophyll *a* (*ug*/L) -S	**32**	**0.25**	**33.8**	**1.238**	
Chlorophyll *a* (*ug*/L) -T	**--**	**–**	**–**	**–**	
Periphyton Chl *a* (mg/m^2)	**--**	**–**	**–**	**–**	

Table 3b. Reference conditions for level III ecoregion 33 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	30	0.285	2.48	**0.543**	
$NO_2 + NO_3$ (mg/L)	21	0.04	7.582	**0.138**	
TN (mg/L) - calculated	NA	0.325	10.062	**0.681**	
TN (mg/L) - reported	3	0.935	5.688	**0.935**	
TP (*ug*/L)	28	45	1,880	**100**	
Turbidity (NTU)	1 z	0.5	0.5	**0.5 zz**	
Turbidity (FTU)	7	4.3	90.25	**10.9**	
Turbidity (JCU)	0	–	–	**–**	
Chlorophyll *a* (*ug*/L) -F	0	–	–	**–**	
Chlorophyll *a* (*ug*/L) -S	24	0.25	21.15	**0.733**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3c. Reference conditions for level III ecoregion 35 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	124	0.05	3.213	**0.44**	
$NO_2 + NO_3$ (mg/L)	140	0.005	6.245	**0.067**	
TN (mg/L) - calculated	NA	0.055	9.458	**0.507**	
TN (mg/L) - reported	19	0.33	3.738	**0.385**	
TP (*u*g/L)	164	2.5	1900	**50**	
Turbidity (NTU)	82	2.863	106.5	**9.513**	
Turbidity (FTU)	57 S/W	2	69.375	**6.938**	
Turbidity (JCU)	8 z	3.5	127	**13**	
Chlorophyll *a* (*u*g/L) -F	0	–	–	**–**	
Chlorophyll *a* (*u*g/L) -S	44	0.25	34.213	**0.566**	
Chlorophyll *a* (*u*g/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	2 z	3.13	5.85	**3.13 zz**	

Table 3d. Reference conditions for level III ecoregion 37 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	26	0.23	2.315	**0.53**	
$NO_2 + NO_3$ (mg/L)	37	0.015	6.479	**0.075**	
TN (mg/L) - calculated	NA	0.245	8.794	**0.605**	
TN (mg/L) - reported	8	0.55	1.75	**0.683**	
TP (*u*g/L)	39	5	1410	**42.5**	
Turbidity (NTU)	23	3.15	71.5	**6.95**	
Turbidity (FTU)	17 S/W	5.15	53.5	**13.5**	
Turbidity (JCU)	7	2	61.5	**15.25**	
Chlorophyll *a* (*u*g/L) -F	0	–	–	**--**	
Chlorophyll *a* (*u*g/L) -S	1 z	4.5	4.5	**4.5 zz**	
Chlorophyll *a* (*u*g/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3e. Reference conditions for level III ecoregion 40 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	81	0.184	4.175	**0.625**	
$NO_2 + NO_3$ (mg/L)	137	0.003	9.203	**0.23**	
TN (mg/L) - calculated	NA	0.187	13.378	**0.855**	
TN (mg/L) - reported	31	0.28	6.225	**0.712**	
TP (*ug*/L)	146	10	2090	**92.5**	
Turbidity (NTU)	53	7.825	96.575	**15.5**	
Turbidity (FTU)	78	2.2	73.625	**12.25**	
Turbidity (JCU)	19	4.9	115.25	**10.5**	
Chlorophyll *a* (*ug*/L) -F	12	0.65	24.8	**2.75 zz**	
Chlorophyll *a* (*ug*/L) -S	16	2.025	22.55	**5.488**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3f. Reference conditions for level III ecoregion 45 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	338	0.025	3.1	**0.234**	
$NO_2 + NO_3$ (mg/L)	327	0.003	8.813	**0.177**	
TN (mg/L) - calculated	NA	0.028	11.913	**0.411**	
TN (mg/L) - reported	18	0.238	2.57	**0.615**	
TP (*ug*/L)	436	0	1425	**30**	
Turbidity (NTU)	35	2.25	35.45	**5.713**	
Turbidity (FTU)	356	1.125	108	**7.488**	
Turbidity (JCU)	10	1.9	26.05	**5.95**	
Chlorophyll *a* (*ug*/L) -F	33	1	36.725	**3.3**	
Chlorophyll *a* (*ug*/L) -S	11	1.8	25	**3.493**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3g. Reference conditions for level III ecoregion 64 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	125	0.05	2.843	**0.3**	
$NO_2 + NO_3$ (mg/L)	77	0.225	8.362	**0.995**	
TN (mg/L) - calculated	NA	0.275	11.205	**1.295**	
TN (mg/L) - reported	76	0.56	12.4	**2.225**	
TP (*ug*/L)	181	1.25	1545	**40**	
Turbidity (NTU)	33	1.05	23	**2.825**	
Turbidity (FTU)	46 F	0.625	13.088	**3.15**	
Turbidity (JCU)	2	4.4	5.425	**4.4**	
Chlorophyll *a* (*ug*/L) -F	0	–	–	**–**	
Chlorophyll *a* (*ug*/L) -S	18	0.443	8.41	**1.205**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	6 F	17	62	**20.35**	

Table 3h. Reference conditions for level III ecoregion 65 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	554	0	4.138	**0.3**	
$NO_2 + NO_3$ (mg/L)	518	0	5.077	**0.095**	
TN (mg/L) - calculated	NA	0	9.215	**0.395**	
TN (mg/L) - reported	65	0.33	2.938	**0.618**	
TP (*ug*/L)	650	0	1735	**22.5**	
Turbidity (NTU)	173	0.25	100	**6.2**	
Turbidity (FTU)	426	0.475	88.75	**4.338**	
Turbidity (JCU)	21 S	1.875	88	**6.55**	
Chlorophyll *a* (*ug*/L) -F	14	0.25	8.8	**1.438**	
Chlorophyll *a* (*ug*/L) -S	74	0	65.552	**0.049**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3i. Reference conditions for level III ecoregion 71 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	65	0.05	2.045	**0.284**	
$NO_2 + NO_3$ (mg/L)	109	0.008	5.373	**0.345**	
TN (mg/L) - calculated	NA	0.058	7.418	**0.629**	
TN (mg/L) - reported	10	0.625	4.35	**0.8**	
TP (*ug*/L)	117	2.5	1280	**30**	
Turbidity (NTU)	47	0.875	104.138	**6.975**	
Turbidity (FTU)	22	1.8	44.075	**7.3**	
Turbidity (JCU)	21 S	0.813	15.75	**1.325**	
Chlorophyll *a* (*ug*/L) -F	9	2.6	15.4	**3.85**	
Chlorophyll *a* (*ug*/L) -S	14	0.25	7.75	**1.5**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3j. Reference conditions for level III ecoregion 72 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	154	0.025	4.318	**0.539**	
$NO_2 + NO_3$ (mg/L)	173	0.003	8.625	**0.215**	
TN (mg/L) - calculated	NA	0.028	12.943	**0.754**	
TN (mg/L) - reported	21	0.47	7.088	**1.669**	
TP (*ug*/L)	183	1.25	1,600	**83.125**	
Turbidity (NTU)	5	13.5	39	**15**	
Turbidity (FTU)	118	1.15	126.75	**6.263**	
Turbidity (JCU)	3	29.75	37	**29.75**	
Chlorophyll *a* (*ug*/L) -F	2 **z**	1.5	6.55	**1.5 zz**	
Chlorophyll *a* (*ug*/L) -S	1	5.74	5.74	**5.74**	
Chlorophyll *a* (*ug*/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Table 3k. Reference conditions for level III ecoregion 74 streams.

Parameter	No. of Streams N ++	Reported values		25th Percentiles based on all seasons data for the Decade	Reference Streams **
		Min	Max	P25-all seasons+	P75 - all seasons
TKN (mg/L)	31	0.137	2.875	**0.364**	
$NO_2 + NO_3$ (mg/L)	65	0.022	2.515	**0.14**	
TN (mg/L) - calculated	NA	0.159	5.39	**0.504**	
TN (mg/L) - reported	3	0.6	1.25	**0.6**	
TP (*u*g/L)	70	2.5	1,162.5	**75**	
Turbidity (NTU)	18	6.3	91.75	**16.25**	
Turbidity (FTU)	11	3.25	78.375	**13.5**	
Turbidity (JCU)	5	1.775	18.25	**7.55**	
Chlorophyll *a* (*u*g/L) -F	2 F z	2	2.1	**2 zz**	
Chlorophyll *a* (*u*g/L) -S	0	–	–	**–**	
Chlorophyll *a* (*u*g/L) -T	--	–	–	**–**	
Periphyton Chl *a* (mg/m^2)	--	–	–	**–**	

Definitions used in filling Tables 2 and 3 - Reference Condition tables

Definitions used in filling Tables 2 and 3 - Reference Condition tables

1. **Number of Streams in Table 2** refers to the largest number of streams and rivers for which data existed for a given season within an aggregate nutrient ecoregion.

2. **Number of Streams in Table 3** refers to the number of streams and rivers for which data existed for the summer months since summer is generally when the greatest amount of nutrient sampling is conducted. If another season greatly predominates, notification is made (s=spring, f=fall, w=winter).

3. **Medians. All values** (min, max, and 25th percentiles) included in the table are based on waterbody medians. All data for a particular parameter within a stream for the decade were reduced to one median for that stream. This prevents over-representation of individual waterbodies with a great deal of data versus those with fewer data points within the statistical analysis.

4. **25th percentile for all seasons** is calculated by taking the median of the 4 seasonal 25th percentiles. If a season is missing, the median was calculated with 3 seasons of data. If less than 3 seasons were used to derive the median, the entry is flagged **(z).**

5. **A 25th percentile for a season** is best derived with data from a minimum of 4 streams/season. However, this table provides 25th percentiles that were derived with less than 4 streams/season in order to retain all information for all seasons. In calculating the 25th percentile for a season with less than 4 stream medians, the statistical program automatically used the minimum value within the less-than-4 population. If less than 4 streams were used in developing a seasonal quartile and or all-seasons median, the entry is flagged (**zz).**

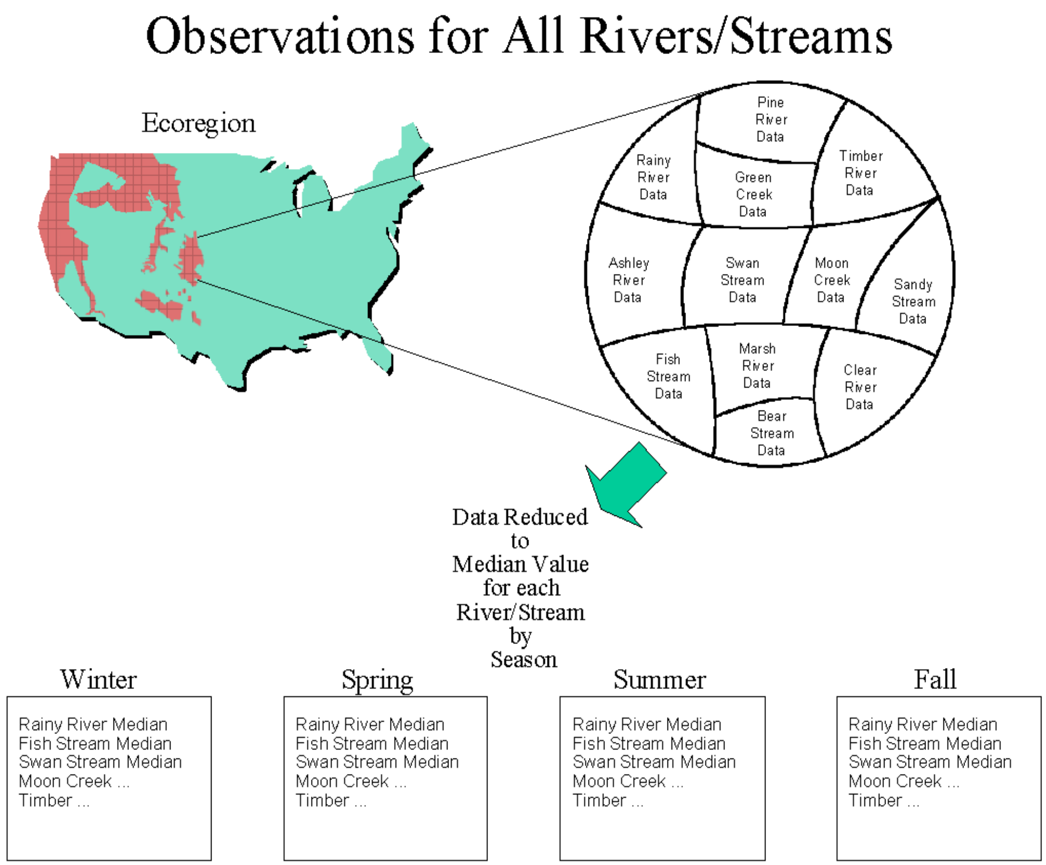

Figure 4a. Illustration of data reduction process for stream data.

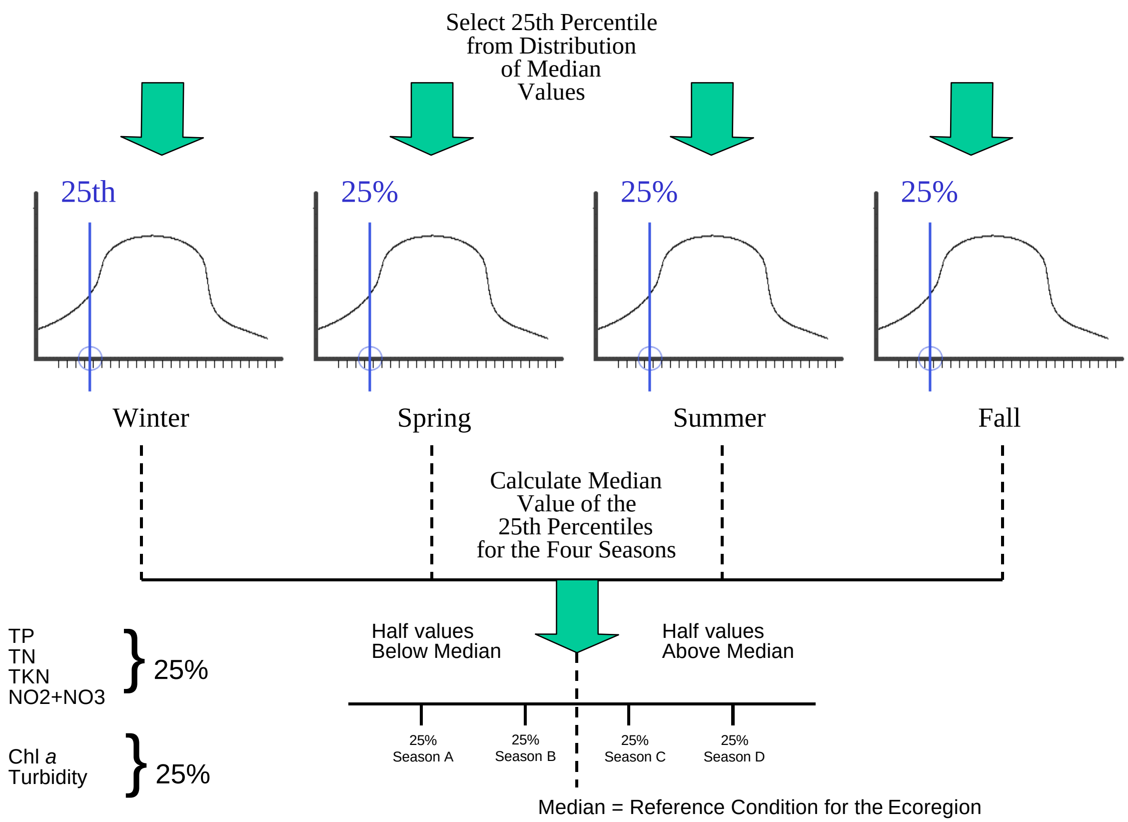

Figure 4b. Illustration of reference condition calculation.

Preferred Data Choices and Recommendations When Data Are Missing

1. Where data are missing or are very low in total records for a given parameter, use 25th percentiles for parameters within an adjacent, similar subecoregion within the same aggregate nutrient ecoregion **or** when a similar subecoregion can not be determined, use the the 25th percentile for the Aggregate ecoregion or consider the **lowest** 25th percentile from a subecoregion (level III) within the aggregate nutrient ecoregion. The rationale being that without data, one may assume that the subecoregion in question may be as sensitive as the most sensitive subecoregion within the aggregate.

2. TN calculated: When reported Total Nitrogen (TN) median values are lacking or very low in comparison to TKN and Nitrate/Nitrite-N values, the medians for TKN and nitrite/nitrate-N were added, resulting in a calculated TN value. The number of samples (N) for calculated TN is not filled in since it is represented by two subsamples of data: TKN and nitrite/nitrate-N. Therefore, N/A is placed in this box.

3. TN reported: This is the median based on reported values for TN from the database.

4. Chlorophyll *a*: Medians based on all methods are reported, however, the acid corrected medians are preferred to the uncorrected medians. In developing a reference condition from a particular method, it is recommended that the method with the most observations be used. Fluorometric and Spectrophotometric are preferred over all other methods. However, when no data exist for Fluorometric and Spectrophotometric methods, Trichromatic values may be used. Data from the variance techniques are not interchangeable.

5. Periphyton: Where periphyton data exist, record them separately For periphyton-dominated streams, a measure of periphyton chlorophyll is a more appropriate response variable than planktonic chlorophyll *a*. See Table 4, p. 101 of the Rivers and Streams Nutrient Technical Guidance Manual (U. S. EPA, 2000b) for values of periphyton and planktonic chlorophyll *a* related to eutrophy in streams.

6. Secchi depth: The 75th percentile is reported for Secchi depth since this is the only variable for which the value of the parameter **increases** with greater clarity. (For lakes and reservoirs only.)

7. Turbidity units: All turbidity units from all methods are reported. FTUs and NTUs are preferred over JCUs. If FTUs and NTUs do not exist, use JCUs. These units are not interchangeable. Turbidity is chosen as a response variable in streams since it can be an indicator of increasing algal biomass due to nutrient enrichment. See pages 32 -33 of the Rivers and Streams Nutrient Technical Guidance Manual for a discussion of turbidity and correlations with algal growth.

8. Lack of data: A dash (-) represents missing, inadequate, or inconclusive data. A zero (0) is reported if the reported median for a parameter is 0 or if the component value is below detection.

5.0 REFERENCE SITES AND CONDITIONS IN AGGREGATE ECOREGION IX

Reference conditions represent the natural, least impacted conditions or what is considered to be the most attainable conditions. This section compares the different reference conditions determined from the two methods and establishes which reference condition is most appropriate.

A priori determination of reference sites. The preferred method for establishing reference condition is to choose the upper percentile of an *a priori* population of reference streams. States and Tribes are encouraged to identify reference conditions based on this method.

Statistical determination of reference conditions (25th percentile of entire database.) See Tables 2 and 3a-k in section 4.0.

RTAG discussion and rationale for selection of reference sites and conditions in Ecoregion IX. The RTAG should compare the results derived from the two methods described above and present a rationale for the final selection of reference sites.

6.0 MODELS USED TO PREDICT OR VERIFY RESPONSE PARAMETERS

The RTAG is encouraged to identify and apply relevant models to support nutrient criteria development. The following are three scenarios under which models may be used to derive criteria or support criteria development.

- Models for predicting correlations between causal and response variables
- Models used to verify reference conditions based on percentiles
- Regression models used to predict reference conditions in impacted areas

7.0 FRAMEWORK FOR REFINING RECOMMENDED NUTRIENT CRITERIA FOR RIVERS AND STREAMS IN AGGREGATE ECOREGION IX

Information on each of the following six weight of evidence factors is important to refine the criteria presented in this document. All elements should be addressed in developing criteria, as is expressed in our nutrient criteria technical guidance manuals. It is our expectation that EPA Regions, States, and Tribes (as RTAGs) will consider these elements as States/Tribes develop their criteria. This section should be viewed as a work sheet (sections are left blank for this purpose) to assist in the refinement of nutrient criteria. If many of these elements are ultimately unaddressed, EPA may rely on the proposed reference conditions presented in Tables 3a-k and other literature and information readily available to the HQ nutrient team to develop nutrient water quality recommendations for this ecoregion.

7.1 Example Worksheet for Developing Aggregate Ecoregion and Subecoregion Nutrient Criteria

- *Literature sources*

- *Historical data and trends*

- *Reference condition*

- *Models*

- *RTAG expert review and consensus*

- *Downstream effects*

7.2 Tables of Refined Nutrient Water Quality Criteria for Aggregate Ecoregion IX and Level III Subecoregions for TP, TN, Chl *a*, Turbidity (where sufficient data exist)

Aggregate Ecoregion IX- Southeastern Temperate Forested Hills and Plains	**Proposed Criterion**
Total Phosphorus (µg/L)	
Total Nitrogen (mg/L)	
Chlorophyll *a* (µg/L or mg/m^2)	
Turbidity (NTU or other units)	
Other (Index; other parameter such as DO)	

- *Literature sources*

- *Historical data and trends*

- *Reference condition*

- *Models*

- *RTAG expert review and consensus*

- *Downstream effects*

Ecoregion #29 Central Oklahoma/Texas Plains	**Proposed Criterion**
Total Phosphorus (µg/L)	
Total Nitrogen (mg/L)	
Chlorophyll *a* (µg/L or mg/m^2))	
Turbidity (NTU or other units)	
Other (Index; other parameter such as DO)	

7.3 Setting Seasonal Criteria

The recommendations presented in this document are based in part on medians of all the 25^{th} percentile seasonal data (decadal), and as such are reflective of all seasons and not one particular season or year. It is recommended that States and Tribes monitor in all seasons to best assess compliance with the resulting criterion. States/Tribes may choose to develop criteria which reflect **each** particular season or a **given year** when there is significant variability between seasons/years or designated uses that are specifically tied to one or more seasons of the year (e.g., recreation, fishing). Using the tables in Appendix A and B, one can set reference conditions based on a particular season or year and then develop a criterion based on each individual season. Obviously, this option is season-specific and would also require increased monitoring within each season to assess compliance.

7.4 When Data/Reference Conditions are Lacking

When data are unavailable to develop a reference condition for a particular parameter(s) within a subecoregion, EPA recommends one of three options: 1. Use data from a similar neighboring subecoregion. E.g., If data are few or nonexistent for the northern cascades, consider using the data and reference condition developed for the cascades; or 2. Use the 25th perecentiles for the Aggregate ecoregion or 3. Consider using the lowest of the yearly medians for that parameter calculated for all the subecoregions within the Aggregate Ecoregion.

7.5 Site-specific Criteria Development

Criteria may be refined in a number of ways. The best way to refine criteria is to follow the critical elements of criteria development as well as to refer to the Rivers and Streams Nutrient Criteria Technical Guidance Manual (U.S. EPA, 2000b).

The Technical Guidance Manual presents sections on each of the following factors to consider in setting criteria

- refinements to ecoregions (Section 2.3)
- classification of waterbodies (Chapter 2)
- setting seasonal criteria to reflect major seasonal climate differences and accounting for significant or cyclical precipitation events (high flow/low flow conditions) (Chapter 4).

8.0 LITERATURE CITED

NYSDEC (New York State Department of Environment and Conservation). 2000. Memorandum from Scott Kishbaugh to Jay Bloomfield, September 26, 2000, regarding reference lakes for nutrient criteria.

TNDEC (Tennessee Department of Environment and Conservation). 2000. Letter to Geoff Grubbs, October 5, 2000, containing comments on draft nutrient criteria recommendations.

U.S. EPA. 2000a. Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs, U.S. Environmental Protection Agency, Washington, DC. EPA-822-B00-001.

U.S. EPA. 2000b. Nutrient Criteria Technical Guidance Manual: Rivers and Streams, U.S. Environmental Protection Agency, Washington, DC. EPA-822-B00-002.

9.0 APPENDICES

A. Descriptive Statistics Data Tables for Aggregate Ecoregion

B. Descriptive Statistics Data Tables for Level III Subecoregions within Aggregate Ecoregion

C. Quality Control/Quality Assurance Rules

APPENDIX A

Descriptive Statistics Data Tables for Aggregate Ecoregion

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Fluo_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	54	8.03	.250	36.35	9.19	1.25	114	0.40	1.80	4.10	8.80	29.8
SPRING	37	8.27	.000	37.10	8.19	1.35	99	0.25	2.70	4.50	11.7	24.5
SUMMER	71	10.7	.625	95.10	12.9	1.53	120	1.00	3.65	7.00	12.8	26.8
WINTER	18	4.40	.200	13.90	3.92	0.92	89	0.20	1.10	3.40	7.90	13.9

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_C_F_ug_L_Med

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1	3.40	3.40	3.40	.	.	.	3.40	3.40	3.40	3.40	3.40
SPRING	2	6.68	1.90	11.45	6.75	4.78	101	1.90	1.90	6.68	11.5	11.5
SUMMER	1	9.60	9.60	9.60	.	.	.	9.60	9.60	9.60	9.60	9.60
WINTER	1	0.78	.775	0.78	.	.	.	0.78	0.78	0.78	0.78	0.78

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_Spec_A_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	187	6.03	.000	78.60	9.79	0.72	162	0.25	0.90	2.85	7.50	19.8
SPRING	206	6.54	.000	98.52	11.1	0.77	170	0.00	0.97	3.38	7.95	25.0
SUMMER	235	7.44	.000	79.20	11.5	0.75	154	0.00	1.03	3.48	9.00	25.4
WINTER	178	3.13	.000	34.80	4.80	0.36	153	0.00	0.25	1.65	3.48	12.0

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_Spec_U_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1	0.03	.025	0.03	.	.	.	0.03	0.03	0.03	0.03	0.03
SPRING	1	4.37	4.37	4.37	.	.	.	4.37	4.37	4.37	4.37	4.37
SUMMER	1	0.02	.021	0.02	.	.	.	0.02	0.02	0.02	0.02	0.02
WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Tric_U_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	48	9.75	.000	97.78	18.2	2.63	187	0.00	1.06	1.91	10.5	43.4
SPRING	44	9.22	.000	95.06	17.2	2.59	186	0.00	1.60	3.47	7.11	40.8

SUMMER	70	12.0	.000	92.78	19.9	2.38	166	0.00	0.00	3.94	13.0	63.9
WINTER	50	2.09	.000	16.90	3.76	0.53	180	0.00	0.00	1.08	2.34	12.5

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chlb_Phyto_C_F_ug_L_Med

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1	0.40	.400	0.40	.	.	.	0.40	0.40	0.40	0.40	0.40
SPRING	2	0.31	.200	0.43	0.16	0.11	51	0.20	0.20	0.31	0.43	0.43
SUMMER	1	0.70	.700	0.70	.	.	.	0.70	0.70	0.70	0.70	0.70
WINTER	1	0.05	.050	0.05	.	.	.	0.05	0.05	0.05	0.05	0.05

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chlb_Phyto_Spec_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	0	.	.	.	.	.	.	.	.	.	.	.
SPRING	1	0.24	.236	0.24	.	.	.	0.24	0.24	0.24	0.24	0.24
SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DIP_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	217	175	.000	9600.00	742	50.4	423	5.00	16.3	50.0	115	568
SPRING	180	64.1	.000	812.00	115	8.58	180	5.00	10.0	30.0	70.0	224
SUMMER	230	65.9	.000	930.00	102	6.70	154	5.00	12.5	37.3	81.5	183
WINTER	170	63.3	.000	1000.00	108	8.29	171	5.00	13.8	35.0	75.0	200

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DO_mg_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1437	7.73	.000	17.88	1.87	0.05	24	4.30	6.75	8.00	8.75	10.4
SPRING	1417	8.57	1.80	13.80	1.61	0.04	19	5.83	7.60	8.60	9.50	11.2
SUMMER	1579	6.83	.000	13.50	1.67	0.04	24	3.50	6.00	7.10	7.83	9.10
WINTER	1240	10.5	2.90	14.70	1.60	0.05	15	7.73	9.64	10.5	11.6	13.0

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter NO2_NO3_mg_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1527	0.74	.000	10.00	1.30	0.03	175	0.01	0.09	0.27	0.74	3.20
SPRING	1529	0.71	.000	9.80	1.15	0.03	161	0.03	0.14	0.32	0.73	2.95
SUMMER	1671	0.73	.000	9.03	1.20	0.03	165	0.01	0.12	0.29	0.74	3.11
WINTER	1378	0.83	.000	9.76	1.28	0.03	155	0.03	0.14	0.36	0.90	3.41

Aggregate Nutrient Ecoregion: IX 11
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Org_P_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	15	70.4	22.5	188.30	50.2	13.0	71	22.5	37.6	51.1	84.1	188
SPRING	0	.	.	.	.	.	.	.	.	.	.	.
SUMMER	15	52.4	6.77	115.44	28.5	7.37	54	6.77	27.4	48.7	66.3	115
WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX 12
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Orthophosphate_T_as_P_ug_L_Med

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	100	117	5.00	1600.00	261	26.1	223	5.00	17.5	40.0	98.8	490
SPRING	103	82.9	5.00	1095.00	162	15.9	195	5.00	17.5	37.5	80.0	238
SUMMER	103	104	5.00	1307.50	202	19.9	194	5.00	16.3	41.3	103	310
WINTER	101	77.6	5.00	815.00	113	11.3	146	5.00	20.0	40.0	100	225

Aggregate Nutrient Ecoregion: IX 13
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TKN_mg_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1404	0.62	.000	5.40	0.55	0.01	89	0.13	0.30	0.50	0.78	1.50
SPRING	1452	0.60	.000	5.00	0.53	0.01	88	0.12	0.30	0.48	0.73	1.47
SUMMER	1609	0.64	.000	4.30	0.48	0.01	74	0.15	0.35	0.53	0.81	1.45
WINTER	1397	0.53	.000	4.65	0.43	0.01	80	0.12	0.30	0.44	0.65	1.20

Aggregate Nutrient Ecoregion: IX 14
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TN_mg_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	213	1.87	.180	12.50	2.06	0.14	110	0.35	0.67	1.17	2.20	6.03
SPRING	204	2.02	.300	11.00	1.98	0.14	98	0.51	0.71	1.26	2.27	6.55

SUMMER	274	2.31	.200	12.30	2.47	0.15	107	0.38	0.72	1.37	3.03	8.62
WINTER	211	1.95	.275	13.00	2.05	0.14	105	0.40	0.67	1.20	2.30	6.16

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TP_ug_L_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1811	157	.000	2420.00	255	5.99	163	5.00	35.0	75.0	160	645
SPRING	1864	131	.000	2360.00	234	5.42	178	5.00	38.1	70.0	130	465
SUMMER	2104	148	.000	2400.00	226	4.92	152	7.50	40.0	80.0	160	530
WINTER	1685	122	.000	2400.00	199	4.86	163	5.00	30.0	65.0	125	430

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_FTU_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1059	11.0	.000	180.00	13.4	0.41	122	2.00	4.55	7.70	12.8	29.5
SPRING	1113	14.1	.650	123.00	13.5	0.40	95	2.50	6.40	11.0	16.8	38.9
SUMMER	1143	14.6	.800	160.00	15.6	0.46	106	2.50	5.85	10.0	17.0	45.2
WINTER	991	14.5	.300	136.00	15.4	0.49	106	2.25	5.55	9.70	18.0	43.0

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_JCU_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	89	21.9	.600	171.00	31.9	3.38	145	1.10	3.25	11.0	24.0	90.0
SPRING	88	20.1	.700	158.00	28.9	3.08	144	1.50	3.46	10.7	23.5	88.8
SUMMER	97	25.8	.725	173.00	36.6	3.72	142	1.05	3.60	11.3	30.0	127
WINTER	92	18.9	1.10	96.00	18.8	1.96	100	1.50	6.70	13.5	21.5	60.8

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_NTU_Median

SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	366	15.1	.250	113.00	16.4	0.86	109	2.00	5.50	9.55	19.0	55.0
SPRING	379	20.5	.100	175.00	20.4	1.05	99	2.25	8.70	15.0	25.0	57.0
SUMMER	476	20.2	.000	212.00	25.2	1.16	125	2.00	6.20	12.3	24.0	72.5
WINTER	323	19.6	.250	150.00	20.2	1.12	103	2.00	7.85	14.0	24.5	55.0

APPENDIX B

Descriptive Statistics Data Tables for Level III Subecoregions within Aggregate Ecoregion

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	1	15.6	15.6	15.60	.	.	.	15.6	15.6	15.6	15.6	15.6
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	1	10.4	10.4	10.40	.	.	.	10.4	10.4	10.4	10.4	10.4
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	11	4.44	.400	26.40	7.48	2.25	169	0.40	0.90	1.60	4.20	26.4
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	12	11.1	.900	23.20	7.19	2.07	65	0.90	4.60	12.4	16.9	23.2
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	26	11.4	1.00	36.35	10.9	2.14	96	1.10	3.00	8.20	16.5	32.0
45	SPRING	23	10.9	1.00	37.10	9.22	1.92	84	1.13	2.70	10.5	15.8	24.5
45	SUMMER	33	10.6	.625	41.00	9.61	1.67	91	1.00	3.60	9.00	11.5	30.9
45	WINTER	6	7.99	1.50	13.90	3.96	1.62	50	1.50	7.50	8.03	9.00	13.9
64	FALL	0	.	.	.	.	.	.	.	.	.	.	.
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	9	3.18	.250	8.00	3.10	1.03	98	0.25	0.63	2.20	6.30	8.00
65	SPRING	12	3.70	.250	8.80	2.33	0.67	63	0.25	2.25	4.06	4.70	8.80
65	SUMMER	14	13.0	1.00	95.10	24.0	6.42	184	1.00	4.00	6.59	8.00	95.1

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	12	2.61	.200	8.80	2.46	0.71	94	0.20	0.63	2.30	3.75	8.80
71	FALL	2	11.9	8.30	15.40	5.02	3.55	42	8.30	8.30	11.9	15.4	15.4
71	SPRING	2	4.95	.000	9.90	7.00	4.95	141	0.00	0.00	4.95	9.90	9.90
71	SUMMER	9	8.52	2.60	20.20	6.29	2.10	74	2.60	3.85	6.35	11.5	20.2
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	3	5.77	1.80	8.80	3.59	2.07	62	1.80	1.80	6.70	8.80	8.80

72	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
72	SUMMER	2	2.75	1.20	4.30	2.19	1.55	80	1.20	1.20	2.75	4.30	4.30
72	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
74	FALL	2	2.05	2.00	2.10	0.07	0.05	3	2.00	2.00	2.05	2.10	2.10
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX 3
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_C_F_ug_L_Med

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	0	.	.	.	.	.	.	.	.	.	.	.
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	0	.	.	.	.	.	.	.	.	.	.	.
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	0	.	.	.	.	.	.	.	.	.	.	.
45	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
45	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	0	.	.	.	.	.	.	.	.	.	.	.
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	0	.	.	.	.	.	.	.	.	.	.	.
65	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
65	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_C_F_ug_L_Med

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	1	1.90	1.90	1.90	.	.	.	1.90	1.90	1.90	1.90	1.90
71	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	1	3.40	3.40	3.40	.	.	.	3.40	3.40	3.40	3.40	3.40
72	SPRING	1	11.5	11.5	11.45	.	.	.	11.5	11.5	11.5	11.5	11.5
72	SUMMER	1	9.60	9.60	9.60	.	.	.	9.60	9.60	9.60	9.60	9.60
72	WINTER	1	0.78	.775	0.78	.	.	.	0.78	0.78	0.78	0.78	0.78
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_Spec_A_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	25	4.84	.250	19.20	5.37	1.07	111	0.25	1.00	3.18	5.15	16.6
29	SPRING	29	8.68	.250	32.80	9.76	1.81	112	0.25	1.33	5.28	11.3	30.6
29	SUMMER	32	9.99	.250	54.50	11.5	2.03	115	0.25	3.73	7.36	12.4	44.3
29	WINTER	30	6.35	.250	34.80	8.71	1.59	137	0.25	1.15	3.33	7.80	27.8
33	FALL	22	6.62	.250	47.00	11.1	2.37	168	0.25	0.68	1.92	5.98	23.0
33	SPRING	24	4.37	.250	15.00	4.32	0.88	99	0.25	1.01	2.53	8.49	11.0
33	SUMMER	24	6.04	.250	27.30	7.49	1.53	124	0.25	0.44	3.19	10.8	20.1
33	WINTER	21	2.85	.250	9.38	2.68	0.58	94	0.25	0.79	1.78	5.28	7.11
35	FALL	41	5.59	.250	78.60	12.3	1.93	221	0.25	0.25	2.28	6.86	12.8
35	SPRING	41	4.42	.250	18.90	4.38	0.68	99	0.25	1.16	4.15	5.89	11.4
35	SUMMER	44	5.47	.250	49.53	8.24	1.24	151	0.25	0.88	2.73	7.10	17.4
35	WINTER	38	2.79	.250	13.60	3.40	0.55	122	0.25	0.25	1.92	3.19	12.8
37	FALL	1	6.00	6.00	6.00	.	.	.	6.00	6.00	6.00	6.00	6.00
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	1	3.00	3.00	3.00	.	.	.	3.00	3.00	3.00	3.00	3.00
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	11	10.1	2.45	18.90	5.58	1.68	55	2.45	5.45	9.95	15.4	18.9
40	SPRING	11	11.3	3.80	26.20	7.74	2.33	68	3.80	5.53	7.98	15.9	26.2
40	SUMMER	16	11.9	1.60	26.40	7.41	1.85	62	1.60	6.80	11.8	15.8	26.4
40	WINTER	6	3.50	1.40	10.10	3.29	1.34	94	1.40	1.50	2.55	2.90	10.1
45	FALL	4	7.90	2.60	19.80	7.99	4.00	101	2.60	3.49	4.60	12.3	19.8
45	SPRING	6	12.0	1.80	25.00	7.69	3.14	64	1.80	9.43	10.4	15.1	25.0
45	SUMMER	11	20.7	.800	67.93	22.4	6.75	108	0.80	3.00	15.7	22.0	67.9
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

64	FALL	21	2.56	.635	9.43	2.43	0.53	95	0.67	0.94	1.50	3.00	7.63
64	SPRING	21	5.80	1.50	47.53	10.2	2.23	176	1.87	2.29	2.54	4.00	19.0
64	SUMMER	18	2.36	.250	7.39	1.68	0.40	71	0.25	1.41	1.79	3.00	7.39
64	WINTER	18	1.56	.250	4.13	0.92	0.22	59	0.25	1.00	1.20	1.89	4.13
65	FALL	49	7.67	.000	51.90	12.1	1.72	157	0.00	0.48	3.00	8.05	38.3
65	SPRING	64	7.30	.000	98.52	16.6	2.08	227	0.00	0.10	2.20	5.74	35.9
65	SUMMER	74	6.75	.000	79.20	13.3	1.55	198	0.00	0.00	2.01	7.00	31.0

Rivers and Streams

Descriptive Statistics by Decade and Season

Parameter Chla_Phyto_Spec_A_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	59	2.45	.000	14.55	3.77	0.49	154	0.00	0.00	0.59	3.18	12.0
71	FALL	12	3.74	.250	10.00	3.16	0.91	84	0.25	1.50	2.50	5.31	10.0
71	SPRING	9	2.53	.250	5.50	1.55	0.52	61	0.25	1.50	3.00	3.00	5.50
71	SUMMER	14	5.35	.625	21.00	5.20	1.39	97	0.63	2.00	4.25	6.00	21.0
71	WINTER	6	1.13	.250	2.00	0.59	0.24	52	0.25	1.00	1.00	1.50	2.00
72	FALL	1	8.00	8.00	8.00	.	.	.	8.00	8.00	8.00	8.00	8.00
72	SPRING	1	0.50	.500	0.50	.	.	.	0.50	0.50	0.50	0.50	0.50
72	SUMMER	1	5.74	5.74	5.74	.	.	.	5.74	5.74	5.74	5.74	5.74
72	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Rivers and Streams

Descriptive Statistics by Decade and Season

Parameter Chla_Phyto_Spec_U_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	0	.	.	.	.	.	.	.	.	.	.	.
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
40	FALL	0	.	.	.	.	.	.	.	.	.	.	.
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	0	.	.	.	.	.	.	.	.	.	.	.
45	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
45	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	1	0.03	.025	0.03	.	.	.	0.03	0.03	0.03	0.03	0.03
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	1	0.02	.021	0.02	.	.	.	0.02	0.02	0.02	0.02	0.02
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	0	.	.	.	.	.	.	.	.	.	.	.
65	SPRING	1	4.37	4.37	4.37	.	.	.	4.37	4.37	4.37	4.37	4.37
65	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Phyto_Spec_U_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
71	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	0	.	.	.	.	.	.	.	.	.	.	.
72	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
72	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
72	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chla_Tric_U_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	0	.	.	.	.	.	.	.	.	.	.	.
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	3	4.17	1.25	10.00	5.05	2.92	121	1.25	1.25	1.25	10.0	10.0
40	SPRING	2	3.79	1.25	6.33	3.59	2.54	95	1.25	1.25	3.79	6.33	6.33
40	SUMMER	5	15.9	8.50	28.00	8.48	3.79	53	8.50	8.50	13.5	21.0	28.0
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	4	18.2	3.69	40.90	16.6	8.32	92	3.69	5.91	14.0	30.4	40.9
45	SPRING	5	19.9	2.50	37.50	14.2	6.36	71	2.50	13.7	14.7	31.4	37.5
45	SUMMER	10	31.8	3.09	92.78	31.3	9.89	98	3.09	5.90	26.8	34.1	92.8
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	14	1.83	1.00	4.19	0.82	0.22	45	1.00	1.35	1.60	2.03	4.19
64	SPRING	14	3.24	1.86	5.20	0.98	0.26	30	1.86	2.65	3.02	3.94	5.20
64	SUMMER	14	3.46	1.28	10.99	2.57	0.69	74	1.28	2.08	2.71	3.34	11.0
64	WINTER	14	1.53	.960	3.02	0.55	0.15	36	0.96	1.19	1.31	1.93	3.02
65	FALL	23	14.4	.000	97.78	23.8	4.96	166	0.00	0.00	4.07	14.8	58.4
65	SPRING	22	11.1	.000	95.06	22.5	4.80	203	0.00	0.00	3.47	7.65	45.4
65	SUMMER	37	9.21	.000	76.55	18.7	3.08	203	0.00	0.00	0.00	9.33	63.9

Aggregate Nutrient Ecoregion: IX

Rivers and Streams

Descriptive Statistics by Decade and Season

Parameter Chla_Tric_U_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	34	1.87	.000	16.68	3.75	0.64	200	0.00	0.00	0.00	2.53	12.5
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
71	SUMMER	2	8.27	7.62	8.92	0.92	0.65	11	7.62	7.62	8.27	8.92	8.92
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	1	27.1	27.1	27.10	.	.	.	27.1	27.1	27.1	27.1	27.1
72	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
72	SUMMER	1	25.1	25.1	25.10	.	.	.	25.1	25.1	25.1	25.1	25.1
72	WINTER	1	16.9	16.9	16.90	.	.	.	16.9	16.9	16.9	16.9	16.9
74	FALL	3	0.09	.065	0.12	0.03	0.01	27	0.07	0.07	0.10	0.12	0.12
74	SPRING	1	8.97	8.97	8.97	.	.	.	8.97	8.97	8.97	8.97	8.97
74	SUMMER	1	10.2	10.2	10.20	.	.	.	10.2	10.2	10.2	10.2	10.2
74	WINTER	1	2.41	2.41	2.41	.	.	.	2.41	2.41	2.41	2.41	2.41

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	0	.	.	.	.	.	.	.	.	.	.	.
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	0	.	.	.	.	.	.	.	.	.	.	.
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	0	.	.	.	.	.	.	.	.	.	.	.
45	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
45	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	0	.	.	.	.	.	.	.	.	.	.	.
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	0	.	.	.	.	.	.	.	.	.	.	.
65	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
65	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	1	0.20	.200	0.20	.	.	.	0.20	0.20	0.20	0.20	0.20
71	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	1	0.40	.400	0.40	.	.	.	0.40	0.40	0.40	0.40	0.40

72	SPRING	1	0.43	.425	0.43	.	.	.	0.43	0.43	0.43	0.43	0.43
72	SUMMER	1	0.70	.700	0.70	.	.	.	0.70	0.70	0.70	0.70	0.70
72	WINTER	1	0.05	.050	0.05	.	.	.	0.05	0.05	0.05	0.05	0.05
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chlb_Phyto_Spec_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	0	.	.	.	.	.	.	.	.	.	.	.
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	0	.	.	.	.	.	.	.	.	.	.	.
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	0	.	.	.	.	.	.	.	.	.	.	.
45	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
45	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	0	.	.	.	.	.	.	.	.	.	.	.
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	0	.	.	.	.	.	.	.	.	.	.	.
65	SPRING	1	0.24	.236	0.24	.	.	.	0.24	0.24	0.24	0.24	0.24
65	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Chlb_Phyto_Spec_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
71	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
72	FALL	0	.	.	.	.	.	.	.	.	.	.	.
72	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
72	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
72	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DIP_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	11	45.3	.000	135.00	44.3	13.4	98	0.00	10.0	35.0	65.0	135
29	SPRING	9	30.1	5.00	80.00	24.5	8.16	81	5.00	10.0	25.0	35.0	80.0
29	SUMMER	10	27.8	5.00	92.50	28.1	8.89	101	5.00	6.25	18.8	40.0	92.5
29	WINTER	9	30.1	5.00	70.00	24.8	8.25	82	5.00	7.50	25.0	55.0	70.0
33	FALL	4	676	60.0	1412.50	683	342	101	60.0	95.0	615	1256	1413
33	SPRING	4	323	92.5	750.00	310	155	96	92.5	93.8	225	553	750
33	SUMMER	4	365	82.5	837.50	342	171	94	82.5	116	270	614	838
33	WINTER	4	483	52.5	1000.00	479	239	99	52.5	76.3	440	890	1000
35	FALL	11	146	5.00	790.00	281	84.6	192	5.00	5.00	20.0	65.0	790
35	SPRING	12	48.4	5.00	295.00	83.0	24.0	171	5.00	10.6	13.8	53.8	295
35	SUMMER	12	109	5.00	930.00	264	76.2	242	5.00	10.0	12.5	51.3	930
35	WINTER	12	60.4	6.25	360.00	102	29.6	170	6.25	13.8	20.0	47.5	360
37	FALL	3	45.0	20.0	70.00	25.0	14.4	56	20.0	20.0	45.0	70.0	70.0
37	SPRING	3	47.5	12.5	100.00	46.3	26.7	97	12.5	12.5	30.0	100	100
37	SUMMER	3	84.2	42.5	165.00	70.0	40.4	83	42.5	42.5	45.0	165	165
37	WINTER	3	98.3	25.0	202.50	92.7	53.5	94	25.0	25.0	67.5	203	203
40	FALL	22	58.0	18.7	293.02	56.3	12.0	97	18.9	26.1	47.6	65.0	87.5
40	SPRING	11	60.5	12.5	120.00	30.6	9.24	51	12.5	35.0	65.0	82.5	120
40	SUMMER	23	59.1	4.30	176.33	48.4	10.1	82	7.41	18.1	47.5	100	145
40	WINTER	11	81.5	23.8	215.00	62.0	18.7	76	23.8	25.0	70.0	125	215
45	FALL	16	44.0	5.00	275.00	68.0	17.0	155	5.00	8.75	15.0	62.5	275
45	SPRING	16	25.2	5.00	102.50	28.5	7.12	113	5.00	5.00	12.5	32.5	103
45	SUMMER	16	50.9	5.00	362.50	87.8	21.9	173	5.00	8.13	25.0	43.8	363

45	WINTER	16	25.7	5.00	125.00	29.6	7.39	115	5.00	7.50	18.1	34.8	125
64	FALL	48	516	5.00	9600.00	1512	218	293	15.0	70.0	143	285	1551
64	SPRING	25	171	5.00	812.00	221	44.2	129	5.00	37.0	75.0	204	752
64	SUMMER	62	68.3	4.25	412.50	68.2	8.66	100	7.00	21.0	50.0	96.0	183
64	WINTER	18	103	16.8	310.25	82.1	19.4	80	16.8	40.0	86.3	133	310
65	FALL	45	33.0	5.00	250.00	50.9	7.59	154	5.00	5.00	12.5	25.0	115
65	SPRING	45	24.8	5.00	205.00	35.8	5.33	144	5.00	7.50	10.0	25.0	80.0
65	SUMMER	45	34.6	5.00	360.00	60.1	8.96	174	5.00	7.50	12.5	30.0	120

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DIP_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	45	22.8	5.00	150.00	30.3	4.52	133	5.00	5.00	12.5	22.5	65.0
71	FALL	13	94.1	7.50	295.00	87.9	24.4	93	7.50	35.0	56.3	135	295
71	SPRING	13	48.2	7.50	162.50	46.9	13.0	97	7.50	15.0	30.0	55.0	163
71	SUMMER	13	80.6	10.0	322.50	85.7	23.8	106	10.0	20.0	60.0	80.0	323
71	WINTER	12	65.4	17.5	200.00	59.2	17.1	91	17.5	30.0	40.0	85.0	200
72	FALL	41	86.0	.000	240.00	66.6	10.4	78	5.00	35.2	70.0	128	220
72	SPRING	39	52.9	.000	160.00	35.6	5.69	67	0.00	30.0	50.0	70.0	125
72	SUMMER	39	70.0	.000	185.50	45.6	7.30	65	4.00	35.0	62.5	95.0	170
72	WINTER	37	66.9	.000	140.00	38.4	6.32	57	1.00	40.0	60.0	93.5	135
74	FALL	3	38.3	5.00	75.00	35.1	20.3	92	5.00	5.00	35.0	75.0	75.0
74	SPRING	3	33.3	15.0	47.50	16.6	9.61	50	15.0	15.0	37.5	47.5	47.5
74	SUMMER	3	38.8	11.3	60.00	25.0	14.4	64	11.3	11.3	45.0	60.0	60.0
74	WINTER	3	30.0	5.00	50.00	22.9	13.2	76	5.00	5.00	35.0	50.0	50.0

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DO_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	83	7.88	4.50	10.70	1.36	0.15	17	5.55	7.00	7.95	8.85	9.75
29	SPRING	82	8.19	4.00	11.45	1.31	0.14	16	6.10	7.60	8.20	8.80	10.4
29	SUMMER	87	6.91	3.60	9.45	1.21	0.13	17	4.85	6.00	7.00	7.80	8.40
29	WINTER	98	11.3	2.90	14.70	1.76	0.18	16	8.10	10.4	11.5	12.5	14.1
33	FALL	26	7.24	2.90	9.45	1.44	0.28	20	4.88	6.20	7.45	8.15	9.30
33	SPRING	31	7.54	5.00	9.90	1.15	0.21	15	5.20	6.88	7.65	8.35	9.40
33	SUMMER	26	6.55	3.40	10.60	1.69	0.33	26	3.80	5.70	6.60	7.40	9.75
33	WINTER	30	9.76	8.10	12.20	1.02	0.19	10	8.25	9.00	9.60	10.3	11.7
35	FALL	151	6.62	1.20	11.10	1.75	0.14	27	3.40	5.68	6.70	7.70	9.30
35	SPRING	144	7.56	2.80	11.80	1.61	0.13	21	5.40	6.69	7.40	8.48	10.6
35	SUMMER	146	5.58	1.20	9.60	1.66	0.14	30	2.40	4.55	5.75	6.80	7.95
35	WINTER	139	9.52	4.55	13.30	1.53	0.13	16	6.90	8.60	9.50	10.3	12.5
37	FALL	33	6.72	2.50	9.60	1.71	0.30	26	3.43	6.00	6.60	7.83	9.60
37	SPRING	27	8.15	6.15	10.53	1.22	0.24	15	6.63	7.35	7.90	9.25	10.3
37	SUMMER	32	5.94	2.20	8.45	1.53	0.27	26	2.60	5.18	6.08	6.85	8.40

37	WINTER	28	10.6	6.20	13.80	1.58	0.30	15	7.48	9.80	10.9	11.7	12.3
40	FALL	104	7.37	1.25	17.88	2.20	0.22	30	4.10	5.96	7.41	8.58	10.8
40	SPRING	90	9.34	4.25	13.80	1.38	0.15	15	7.20	8.75	9.43	10.1	11.5
40	SUMMER	115	6.74	.200	13.10	1.83	0.17	27	3.30	5.88	6.70	7.85	9.37
40	WINTER	75	11.8	6.30	13.80	1.33	0.15	11	9.21	11.4	12.0	12.7	13.5
45	FALL	344	8.24	1.70	10.95	1.02	0.06	12	6.40	7.90	8.30	8.80	9.70
45	SPRING	367	8.93	5.60	12.00	1.01	0.05	11	7.20	8.30	8.93	9.50	10.7
45	SUMMER	371	7.28	1.50	12.00	1.03	0.05	14	5.40	6.90	7.43	7.85	8.50
45	WINTER	264	10.7	8.80	14.10	0.83	0.05	8	9.50	10.2	10.6	11.2	12.1
64	FALL	115	10.2	6.50	13.85	1.26	0.12	12	8.00	9.40	10.3	10.9	12.2
64	SPRING	91	10.5	3.30	12.90	1.58	0.17	15	7.30	10.0	10.8	11.6	12.4
64	SUMMER	167	8.63	6.05	13.20	1.13	0.09	13	6.80	7.98	8.60	9.10	10.9
64	WINTER	69	12.4	9.13	14.10	1.07	0.13	9	10.3	11.9	12.8	13.1	13.7
65	FALL	352	7.08	.400	11.60	1.79	0.10	25	3.25	6.24	7.55	8.30	9.30
65	SPRING	371	7.73	1.80	11.90	1.64	0.09	21	4.70	6.83	7.90	8.80	10.1
65	SUMMER	402	6.20	.450	10.63	1.66	0.08	27	2.80	5.65	6.55	7.25	8.10

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter DO_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	330	9.57	4.10	13.20	1.51	0.08	16	6.90	8.60	9.80	10.6	11.8
71	FALL	93	8.04	.000	12.50	2.09	0.22	26	4.00	7.45	8.20	9.20	11.0
71	SPRING	79	9.49	4.70	12.40	1.22	0.14	13	7.70	8.75	9.50	10.1	11.6
71	SUMMER	95	7.36	2.50	10.10	1.46	0.15	20	4.70	6.40	7.60	8.50	9.45
71	WINTER	78	11.0	7.68	14.60	1.28	0.15	12	8.80	10.2	10.9	11.8	13.0
72	FALL	84	7.55	2.33	11.80	2.04	0.22	27	4.00	6.30	7.63	8.95	11.0
72	SPRING	83	9.43	7.30	12.40	1.04	0.11	11	8.05	8.80	9.20	10.1	11.3
72	SUMMER	84	6.26	.000	8.85	1.52	0.17	24	3.60	5.38	6.40	7.30	8.40
72	WINTER	80	11.5	7.00	13.80	0.99	0.11	9	10.3	11.1	11.6	12.1	13.0
74	FALL	52	7.71	1.60	11.90	1.78	0.25	23	3.90	6.80	8.25	8.70	9.88
74	SPRING	52	8.55	5.85	12.15	1.31	0.18	15	6.60	7.55	8.55	9.39	10.5
74	SUMMER	54	6.93	2.35	13.50	1.74	0.24	25	3.35	6.15	7.20	7.70	9.30
74	WINTER	49	10.2	5.75	12.40	1.38	0.20	14	7.20	9.50	10.4	11.1	12.3

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter NO2_NO3_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	74	0.57	.010	5.40	1.08	0.13	189	0.01	0.05	0.13	0.48	3.36
29	SPRING	65	0.37	.010	3.75	0.60	0.07	164	0.03	0.09	0.15	0.39	1.41
29	SUMMER	67	0.33	.000	6.20	0.79	0.10	235	0.01	0.07	0.13	0.35	0.92
29	WINTER	78	0.46	.025	4.00	0.66	0.07	143	0.05	0.12	0.21	0.49	1.70
33	FALL	24	2.31	.010	8.32	2.99	0.61	130	0.02	0.09	0.91	4.38	8.27
33	SPRING	22	1.33	.093	5.43	1.67	0.36	125	0.11	0.21	0.68	1.67	5.35
33	SUMMER	21	1.60	.010	6.84	2.30	0.50	144	0.02	0.11	0.35	2.04	6.60

33	WINTER	25	2.13	.070	8.45	2.51	0.50	118	0.10	0.16	0.77	3.42	6.51
35	FALL	142	0.56	.005	9.08	1.43	0.12	254	0.01	0.04	0.11	0.26	3.70
35	SPRING	134	0.37	.005	4.45	0.72	0.06	195	0.03	0.09	0.15	0.32	1.51
35	SUMMER	140	0.43	.005	6.15	0.92	0.08	212	0.01	0.06	0.14	0.29	2.65
35	WINTER	143	0.33	.005	6.34	0.72	0.06	220	0.02	0.07	0.14	0.25	1.19
37	FALL	35	0.57	.003	7.16	1.38	0.23	243	0.01	0.03	0.07	0.34	4.25
37	SPRING	30	0.41	.025	4.92	0.89	0.16	215	0.05	0.10	0.17	0.32	1.25
37	SUMMER	37	0.48	.005	6.84	1.27	0.21	265	0.01	0.05	0.13	0.23	4.05
37	WINTER	32	0.52	.093	6.12	1.05	0.19	205	0.10	0.15	0.27	0.45	1.28
40	FALL	125	0.82	.000	7.84	1.42	0.13	172	0.00	0.11	0.34	0.76	4.20
40	SPRING	111	1.03	.005	9.80	1.59	0.15	153	0.05	0.26	0.51	1.01	4.92
40	SUMMER	137	1.03	.000	9.03	1.72	0.15	167	0.00	0.20	0.50	0.83	5.63
40	WINTER	78	1.25	.025	9.38	1.71	0.19	137	0.13	0.40	0.67	1.24	6.32
45	FALL	315	0.73	.003	8.85	1.26	0.07	173	0.03	0.12	0.33	0.71	3.26
45	SPRING	332	0.64	.000	9.30	1.03	0.06	162	0.04	0.19	0.37	0.64	2.23
45	SUMMER	327	0.73	.003	7.00	1.14	0.06	157	0.01	0.17	0.37	0.75	3.11
45	WINTER	241	0.70	.020	8.78	1.03	0.07	148	0.06	0.21	0.38	0.73	2.40
64	FALL	62	2.24	.330	9.02	1.77	0.22	79	0.52	0.98	1.73	3.00	5.80
64	SPRING	61	2.20	.110	7.70	1.76	0.23	80	0.55	0.96	1.63	2.70	6.24
64	SUMMER	77	2.05	.120	6.27	1.47	0.17	72	0.23	1.01	1.69	2.80	5.57
64	WINTER	53	2.74	.660	9.76	1.97	0.27	72	0.80	1.57	2.16	3.10	8.28
65	FALL	439	0.45	.000	5.95	0.76	0.04	168	0.01	0.07	0.20	0.44	1.88
65	SPRING	496	0.39	.000	5.46	0.57	0.03	147	0.01	0.10	0.20	0.43	1.50
65	SUMMER	518	0.41	.000	4.70	0.62	0.03	152	0.01	0.09	0.21	0.45	1.66

Rivers and Streams

Descriptive Statistics by Decade and Season

Parameter NO2_NO3_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	433	0.44	.000	4.10	0.60	0.03	138	0.01	0.10	0.23	0.51	1.57
71	FALL	107	0.99	.003	10.00	1.50	0.14	151	0.03	0.20	0.44	1.35	2.72
71	SPRING	94	1.05	.025	5.41	1.06	0.11	101	0.13	0.40	0.60	1.17	3.38
71	SUMMER	109	0.98	.012	4.72	1.01	0.10	103	0.06	0.29	0.62	1.20	2.95
71	WINTER	91	1.36	.003	5.34	1.19	0.13	88	0.11	0.49	1.04	1.72	4.20
72	FALL	151	0.97	.000	5.70	1.24	0.10	127	0.01	0.14	0.44	1.40	3.75
72	SPRING	124	1.53	.023	8.45	1.81	0.16	118	0.07	0.29	0.86	1.90	5.50
72	SUMMER	173	1.13	.003	8.80	1.61	0.12	142	0.02	0.14	0.46	1.45	4.45
72	WINTER	151	1.58	.003	9.00	1.84	0.15	116	0.05	0.39	0.83	2.13	5.98
74	FALL	53	0.28	.005	1.05	0.23	0.03	81	0.04	0.14	0.21	0.33	0.69
74	SPRING	60	0.52	.020	3.30	0.67	0.09	129	0.03	0.14	0.27	0.63	2.11
74	SUMMER	65	0.48	.024	6.00	1.00	0.12	210	0.03	0.09	0.18	0.49	1.20
74	WINTER	53	0.43	.033	1.73	0.41	0.06	95	0.08	0.15	0.27	0.55	1.55

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	1	37.6	37.6	37.64	.	.	.	37.6	37.6	37.6	37.6	37.6
29	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
29	SUMMER	1	36.5	36.5	36.48	.	.	.	36.5	36.5	36.5	36.5	36.5
29	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	0	.	.	.	.	.	.	.	.	.	.	.
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
35	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
37	FALL	0	.	.	.	.	.	.	.	.	.	.	.
37	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
37	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
37	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
40	FALL	11	73.3	22.5	188.30	52.1	15.7	71	22.5	37.6	58.6	84.1	188
40	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
40	SUMMER	12	53.7	23.1	115.44	25.3	7.30	47	23.1	36.4	49.8	64.3	115
40	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
45	FALL	0	.	.	.	.	.	.	.	.	.	.	.
45	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
45	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
45	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
64	FALL	0	.	.	.	.	.	.	.	.	.	.	.
64	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
64	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
64	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
65	FALL	0	.	.	.	.	.	.	.	.	.	.	.
65	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
65	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
71	FALL	0	.	.	.	.	.	.	.	.	.	.	.
71	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
71	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
71	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

72	FALL	3	70.6	34.6	138.53	58.9	34.0	83	34.6	34.6	38.7	139	139
72	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
72	SUMMER	2	52.0	6.77	97.22	64.0	45.2	123	6.77	6.77	52.0	97.2	97.2
72	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
74	FALL	0	.	.	.	.	.	.	.	.	.	.	.
74	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
74	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
74	WINTER	0	.	.	.	.	.	.	.	.	.	.	.

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Orthophosphate_T_as_P_ug_L_Med

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	5	45.0	20.0	60.00	15.8	7.07	35	20.0	40.0	50.0	55.0	60.0
29	SPRING	5	46.5	22.5	70.00	22.3	9.99	48	22.5	30.0	40.0	70.0	70.0
29	SUMMER	5	54.3	25.0	97.50	26.9	12.0	50	25.0	43.8	47.5	57.5	97.5
29	WINTER	4	90.9	31.3	225.00	91.0	45.5	100	31.3	34.4	53.8	148	225
33	FALL	3	920	60.0	1600.00	786	454	85	60.0	60.0	1100	1600	1600
33	SPRING	3	733	70.0	1095.00	575	332	78	70.0	70.0	1033	1095	1095
33	SUMMER	3	822	103	1307.50	635	367	77	103	103	1055	1308	1308
33	WINTER	3	522	70.0	815.00	397	229	76	70.0	70.0	680	815	815
35	FALL	10	265	5.00	1600.00	525	166	198	5.00	12.5	40.0	95.0	1600
35	SPRING	13	92.8	12.5	550.00	149	41.4	161	12.5	26.3	35.0	60.0	550
35	SUMMER	13	153	10.0	897.50	295	81.9	193	10.0	20.0	32.5	70.0	898
35	WINTER	13	50.4	12.5	130.00	36.4	10.1	72	12.5	30.0	37.5	70.0	130
37	FALL	3	90.0	30.0	200.00	95.4	55.1	106	30.0	30.0	40.0	200	200
37	SPRING	3	64.2	27.5	125.00	53.1	30.6	83	27.5	27.5	40.0	125	125
37	SUMMER	3	95.8	47.5	185.00	77.3	44.6	81	47.5	47.5	55.0	185	185
37	WINTER	3	102	30.0	225.00	107	61.9	106	30.0	30.0	50.0	225	225
40	FALL	11	87.7	30.0	130.00	33.6	10.1	38	30.0	50.0	95.0	118	130
40	SPRING	11	85.9	12.5	210.00	58.6	17.7	68	12.5	37.5	65.0	130	210
40	SUMMER	11	88.5	20.0	150.00	39.8	12.0	45	20.0	55.0	90.0	120	150
40	WINTER	11	104	30.0	240.00	68.9	20.8	66	30.0	40.0	95.0	170	240
45	FALL	8	63.8	5.00	255.00	82.8	29.3	130	5.00	10.0	40.0	75.0	255
45	SPRING	8	36.3	5.00	112.50	36.4	12.9	100	5.00	12.5	23.1	50.6	113
45	SUMMER	7	74.3	7.50	240.00	82.8	31.3	111	7.50	15.0	31.3	110	240
45	WINTER	8	38.0	5.00	115.00	38.4	13.6	101	5.00	9.38	22.5	60.0	115
64	FALL	6	257	20.0	595.00	219	89.3	85	20.0	40.0	250	385	595
64	SPRING	6	160	25.0	452.50	165	67.2	103	25.0	25.0	110	238	453
64	SUMMER	6	128	5.00	285.00	113	46.0	88	5.00	21.5	118	220	285
64	WINTER	6	96.3	20.0	180.00	65.8	26.9	68	20.0	27.5	95.0	160	180
65	FALL	34	32.6	5.00	150.00	41.1	7.05	126	5.00	5.00	20.0	30.0	150
65	SPRING	34	27.8	5.00	120.00	28.9	4.95	104	5.00	7.50	18.1	40.0	105
65	SUMMER	34	36.0	5.00	310.00	57.4	9.85	160	5.00	10.0	16.9	29.5	120

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Orthophosphate_T_as_P_ug_L_Med

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	34	29.5	5.00	155.00	31.4	5.39	107	5.00	7.50	15.6	35.0	90.0
71	FALL	10	90.0	5.00	270.00	84.1	26.6	93	5.00	20.0	80.0	120	270
71	SPRING	10	74.9	5.00	282.50	86.8	27.4	116	5.00	20.0	36.3	133	283
71	SUMMER	10	114	5.00	575.00	169	53.6	149	5.00	17.5	77.5	95.0	575
71	WINTER	9	111	21.3	260.00	83.4	27.8	75	21.3	50.0	90.0	130	260
72	FALL	7	92.9	15.0	175.00	58.7	22.2	63	15.0	30.0	120	130	175
72	SPRING	7	72.5	10.0	182.50	54.7	20.7	75	10.0	37.5	60.0	87.5	183
72	SUMMER	8	117	20.0	255.00	69.4	24.5	60	20.0	77.5	110	141	255
72	WINTER	7	103	20.0	157.50	50.1	18.9	49	20.0	50.0	120	140	158
74	FALL	3	48.3	5.00	75.00	37.9	21.9	78	5.00	5.00	65.0	75.0	75.0
74	SPRING	3	105	80.0	125.00	22.9	13.2	22	80.0	80.0	110	125	125
74	SUMMER	3	53.3	10.0	100.00	45.1	26.0	85	10.0	10.0	50.0	100	100
74	WINTER	3	66.7	17.5	102.50	44.0	25.4	66	17.5	17.5	80.0	103	103

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TKN_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	83	0.60	.050	1.75	0.33	0.04	54	0.17	0.40	0.55	0.79	1.20
29	SPRING	83	0.65	.125	1.84	0.34	0.04	52	0.25	0.40	0.60	0.73	1.35
29	SUMMER	83	0.64	.050	2.75	0.41	0.05	64	0.21	0.40	0.56	0.78	1.45
29	WINTER	93	0.58	.050	2.28	0.33	0.03	58	0.19	0.38	0.56	0.65	1.16
33	FALL	29	0.91	.240	5.40	0.91	0.17	100	0.35	0.57	0.71	0.97	1.60
33	SPRING	33	0.83	.390	1.63	0.25	0.04	30	0.46	0.70	0.80	0.93	1.33
33	SUMMER	30	0.83	.330	1.88	0.37	0.07	45	0.36	0.50	0.81	0.99	1.58
33	WINTER	32	0.77	.200	3.08	0.50	0.09	65	0.29	0.52	0.62	1.00	1.30
35	FALL	125	0.67	.010	2.61	0.40	0.04	59	0.23	0.43	0.60	0.80	1.45
35	SPRING	110	0.71	.050	2.63	0.45	0.04	63	0.05	0.45	0.63	0.84	1.59
35	SUMMER	124	0.78	.050	3.80	0.54	0.05	69	0.20	0.51	0.70	0.88	1.80
35	WINTER	137	0.68	.050	4.65	0.60	0.05	89	0.20	0.40	0.55	0.74	1.38
37	FALL	20	0.80	.200	1.80	0.47	0.10	58	0.22	0.50	0.67	1.19	1.68
37	SPRING	19	0.98	.345	2.83	0.68	0.15	69	0.35	0.60	0.70	1.20	2.83
37	SUMMER	24	0.82	.240	1.66	0.35	0.07	42	0.49	0.56	0.72	1.08	1.50
37	WINTER	26	0.82	.220	3.60	0.84	0.16	102	0.22	0.43	0.55	0.78	3.37
40	FALL	79	1.17	.175	5.00	0.95	0.11	81	0.45	0.60	0.90	1.27	4.55
40	SPRING	76	1.08	.315	4.02	0.68	0.08	63	0.33	0.65	0.96	1.28	1.98
40	SUMMER	81	1.11	.193	3.10	0.56	0.06	51	0.50	0.70	1.00	1.35	2.25
40	WINTER	49	0.87	.125	4.33	0.73	0.10	84	0.30	0.50	0.60	0.89	2.30
45	FALL	301	0.47	.025	3.20	0.42	0.02	90	0.10	0.24	0.31	0.56	1.23
45	SPRING	328	0.45	.025	3.95	0.48	0.03	108	0.10	0.23	0.33	0.50	1.10
45	SUMMER	338	0.49	.025	3.00	0.40	0.02	81	0.09	0.29	0.40	0.59	1.22
45	WINTER	279	0.40	.025	1.84	0.28	0.02	69	0.10	0.23	0.35	0.50	1.04

64	FALL	98	0.59	.050	3.01	0.51	0.05	87	0.10	0.30	0.43	0.80	1.85
64	SPRING	98	0.60	.050	2.68	0.52	0.05	87	0.05	0.31	0.46	0.65	1.60
64	SUMMER	125	0.59	.050	3.88	0.57	0.05	96	0.05	0.30	0.50	0.65	1.20
64	WINTER	78	0.55	.100	1.90	0.38	0.04	69	0.15	0.30	0.42	0.70	1.50
65	FALL	453	0.50	.000	4.10	0.38	0.02	75	0.10	0.30	0.42	0.60	1.10
65	SPRING	515	0.49	.000	3.93	0.34	0.02	70	0.13	0.30	0.42	0.60	1.00
65	SUMMER	554	0.58	.000	4.30	0.41	0.02	71	0.17	0.34	0.49	0.74	1.28

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TKN_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	492	0.45	.000	4.18	0.34	0.02	76	0.12	0.28	0.40	0.55	0.94
71	FALL	72	0.71	.050	3.60	0.68	0.08	97	0.10	0.29	0.46	0.90	1.82
71	SPRING	56	0.45	.035	1.58	0.31	0.04	68	0.05	0.27	0.40	0.54	1.00
71	SUMMER	65	0.56	.110	2.47	0.41	0.05	73	0.15	0.30	0.46	0.75	1.20
71	WINTER	48	0.47	.050	1.62	0.30	0.04	63	0.09	0.28	0.44	0.61	0.90
72	FALL	120	0.93	.025	4.80	0.75	0.07	81	0.28	0.53	0.79	0.99	2.70
72	SPRING	104	0.97	.025	4.80	0.75	0.07	77	0.30	0.60	0.80	1.07	2.30
72	SUMMER	154	0.85	.025	3.84	0.45	0.04	53	0.30	0.55	0.84	1.04	1.44
72	WINTER	134	0.68	.025	2.40	0.41	0.04	60	0.03	0.39	0.65	0.90	1.40
74	FALL	24	0.72	.195	1.65	0.41	0.08	57	0.25	0.38	0.70	0.96	1.40
74	SPRING	30	1.07	.110	5.00	1.30	0.24	122	0.16	0.35	0.58	1.25	4.85
74	SUMMER	31	0.88	.093	4.10	0.76	0.14	87	0.26	0.40	0.67	1.05	2.30
74	WINTER	29	0.67	.163	1.60	0.40	0.07	59	0.17	0.32	0.55	0.88	1.34

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TN_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	13	1.29	.450	2.80	0.81	0.22	63	0.45	0.80	1.00	1.17	2.80
29	SPRING	14	1.26	.330	4.30	1.04	0.28	83	0.33	0.56	1.13	1.45	4.30
29	SUMMER	20	0.80	.250	1.45	0.36	0.08	45	0.30	0.51	0.77	1.04	1.42
29	WINTER	21	1.24	.520	3.66	0.70	0.15	56	0.59	0.88	0.95	1.50	2.00
33	FALL	3	4.73	.600	7.70	3.69	2.13	78	0.60	0.60	5.90	7.70	7.70
33	SPRING	3	2.60	1.10	4.30	1.61	0.93	62	1.10	1.10	2.40	4.30	4.30
33	SUMMER	3	3.53	1.04	5.30	2.22	1.28	63	1.04	1.04	4.25	5.30	5.30
33	WINTER	3	3.94	.830	6.08	2.75	1.59	70	0.83	0.83	4.90	6.08	6.08
35	FALL	10	1.34	.300	4.90	1.71	0.54	128	0.30	0.35	0.68	0.81	4.90
35	SPRING	12	0.75	.400	1.60	0.38	0.11	51	0.40	0.51	0.55	1.03	1.60
35	SUMMER	19	1.49	.270	11.00	2.59	0.59	174	0.27	0.37	0.62	0.87	11.0
35	WINTER	18	0.69	.360	2.58	0.52	0.12	76	0.36	0.41	0.52	0.67	2.58
37	FALL	3	1.10	.600	1.90	0.70	0.40	64	0.60	0.60	0.80	1.90	1.90
37	SPRING	3	1.06	.760	1.60	0.47	0.27	44	0.76	0.76	0.82	1.60	1.60
37	SUMMER	8	0.94	.500	1.40	0.27	0.09	29	0.50	0.85	0.87	1.08	1.40
37	WINTER	8	1.02	.450	2.15	0.57	0.20	56	0.45	0.61	0.84	1.33	2.15

40	FALL	30	1.29	.180	5.10	1.04	0.19	81	0.25	0.72	0.98	1.45	3.83
40	SPRING	19	1.93	.340	7.90	1.83	0.42	95	0.34	0.67	1.48	2.43	7.90
40	SUMMER	31	1.38	.220	7.25	1.34	0.24	97	0.33	0.70	0.94	1.70	3.66
40	WINTER	19	1.54	.490	5.20	1.23	0.28	80	0.49	0.75	1.06	1.95	5.20
45	FALL	18	1.00	.200	2.98	0.68	0.16	69	0.20	0.56	0.70	1.30	2.98
45	SPRING	17	0.95	.300	1.80	0.38	0.09	41	0.30	0.70	0.89	1.23	1.80
45	SUMMER	18	0.93	.200	2.45	0.60	0.14	64	0.20	0.48	0.86	1.41	2.45
45	WINTER	16	1.03	.275	2.69	0.61	0.15	60	0.28	0.67	0.84	1.29	2.69
64	FALL	37	4.08	.567	12.50	3.30	0.54	81	0.63	1.65	3.12	4.02	11.0
64	SPRING	38	4.07	.547	11.00	2.50	0.41	61	0.65	2.10	3.63	5.25	10.0
64	SUMMER	76	4.84	.552	12.30	2.92	0.34	60	1.44	2.49	4.16	7.08	10.7
64	WINTER	30	4.48	1.85	13.00	3.04	0.55	68	1.88	2.35	3.60	4.57	12.0
65	FALL	64	1.00	.290	3.10	0.59	0.07	59	0.40	0.57	0.75	1.34	2.20
65	SPRING	65	1.06	.360	2.94	0.56	0.07	53	0.51	0.66	0.90	1.30	2.08
65	SUMMER	65	1.03	.385	2.75	0.54	0.07	52	0.46	0.65	0.83	1.36	2.06

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TN_mg_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	65	1.10	.300	2.94	0.67	0.08	61	0.40	0.59	0.85	1.63	2.30
71	FALL	10	1.35	.370	3.60	1.14	0.36	84	0.37	0.51	0.97	1.65	3.60
71	SPRING	10	1.61	.550	4.65	1.43	0.45	89	0.55	0.72	0.94	1.70	4.65
71	SUMMER	10	1.73	.740	4.05	1.12	0.36	65	0.74	0.88	1.35	2.00	4.05
71	WINTER	9	2.28	.700	5.40	1.53	0.51	67	0.70	1.35	2.00	2.30	5.40
72	FALL	22	2.86	.230	6.30	1.73	0.37	61	0.46	1.32	2.86	4.26	5.03
72	SPRING	20	3.86	.943	7.88	2.29	0.51	59	1.09	1.81	3.72	5.62	7.76
72	SUMMER	21	2.74	.280	6.18	1.58	0.34	58	0.61	1.52	2.35	3.73	4.98
72	WINTER	19	4.10	.660	8.20	2.32	0.53	57	0.66	2.40	4.06	6.16	8.20
74	FALL	3	0.96	.570	1.20	0.34	0.20	35	0.57	0.57	1.10	1.20	1.20
74	SPRING	3	1.22	.935	1.45	0.26	0.15	21	0.94	0.94	1.28	1.45	1.45
74	SUMMER	3	0.81	.630	0.95	0.16	0.09	20	0.63	0.63	0.84	0.95	0.95
74	WINTER	3	0.99	.555	1.30	0.39	0.22	39	0.56	0.56	1.10	1.30	1.30

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter TP_ug_L_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	85	163	2.50	1500.00	265	28.7	163	20.0	40.0	75.0	155	445
29	SPRING	84	131	2.50	1235.00	188	20.5	143	16.3	35.0	70.0	135	475
29	SUMMER	90	106	2.50	690.00	125	13.2	118	10.0	30.0	50.0	140	385
29	WINTER	100	141	2.50	1430.00	201	20.1	142	8.13	43.8	87.5	170	380
33	FALL	29	486	40.0	2120.00	572	106	118	50.0	90.0	265	495	1800
33	SPRING	35	420	50.0	2360.00	493	83.3	117	50.0	140	218	480	1630
33	SUMMER	28	381	50.0	1640.00	420	79.4	110	50.0	110	213	450	1230
33	WINTER	31	352	20.0	1210.00	351	63.1	100	40.0	90.0	200	660	1100

35	FALL	158	173	2.50	2420.00	316	25.1	183	10.0	50.0	75.0	140	778
35	SPRING	153	151	2.50	2090.00	258	20.9	171	10.0	50.0	72.5	150	510
35	SUMMER	164	159	2.50	1510.00	247	19.3	155	10.0	50.0	80.0	147	700
35	WINTER	160	143	2.50	1710.00	251	19.8	175	18.8	45.0	70.0	130	450
37	FALL	34	176	5.00	1345.00	278	47.8	158	11.3	45.0	70.0	150	925
37	SPRING	31	188	5.00	1440.00	345	62.1	184	5.00	37.5	70.0	120	1215
37	SUMMER	39	229	17.5	1592.50	389	62.3	170	20.0	50.0	90.0	170	1515
37	WINTER	33	167	5.00	1380.00	316	55.0	189	5.00	40.0	60.0	100	1045
40	FALL	139	242	10.0	1880.00	299	25.3	124	41.2	95.0	150	240	930
40	SPRING	126	261	10.0	2140.00	377	33.6	144	40.0	90.0	135	255	1040
40	SUMMER	146	242	20.0	2040.00	284	23.5	117	49.3	100	156	260	940
40	WINTER	96	195	2.50	2140.00	320	32.7	164	10.0	43.8	87.5	198	975
45	FALL	395	130	.000	1650.00	221	11.1	170	10.0	30.0	56.3	115	565
45	SPRING	425	104	.000	1187.50	159	7.72	153	10.0	35.0	50.0	95.0	415
45	SUMMER	436	145	.000	2400.00	266	12.7	184	9.00	30.0	60.0	124	625
45	WINTER	322	93.0	.000	1200.00	137	7.64	147	6.25	30.0	51.3	100	310
64	FALL	110	182	2.50	1335.00	243	23.1	134	10.0	40.0	85.0	220	793
64	SPRING	108	144	.000	1755.00	233	22.4	162	20.0	42.5	70.0	130	590
64	SUMMER	181	150	2.50	1760.00	237	17.6	157	10.0	40.0	70.0	150	510
64	WINTER	86	114	.000	550.00	124	13.4	108	10.0	40.0	70.0	130	450
65	FALL	532	82.0	.000	1770.00	139	6.01	169	0.00	20.0	50.0	95.0	255
65	SPRING	603	72.8	.000	990.00	96.6	3.94	133	0.00	25.0	50.0	90.0	185
65	SUMMER	650	95.8	.000	1700.00	132	5.18	138	0.00	30.0	60.0	120	270

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	543	79.7	.000	2400.00	163	6.98	204	0.00	20.0	45.0	80.0	215
71	FALL	115	145	2.50	1900.00	250	23.3	173	4.50	30.0	75.0	140	435
71	SPRING	98	80.9	2.50	625.00	112	11.3	138	2.50	20.0	40.0	90.0	325
71	SUMMER	117	142	2.50	1150.00	203	18.8	143	2.50	30.0	60.0	163	615
71	WINTER	94	124	2.50	1410.00	216	22.2	174	5.00	30.0	60.0	97.5	475
72	FALL	156	275	2.50	1800.00	306	24.5	111	20.0	110	190	279	948
72	SPRING	136	231	10.0	2300.00	373	32.0	162	30.0	86.3	138	241	740
72	SUMMER	183	203	.000	1400.00	199	14.7	98	25.0	80.0	163	240	530
72	WINTER	160	174	.000	920.00	164	12.9	94	20.0	70.0	140	214	500
74	FALL	58	243	2.50	1125.00	279	36.7	115	25.0	50.0	110	370	970
74	SPRING	65	219	10.0	2170.00	338	42.0	154	25.0	70.0	123	205	760
74	SUMMER	70	212	.000	1200.00	228	27.3	107	20.0	80.0	140	250	660
74	WINTER	60	195	2.50	840.00	170	22.0	87	13.1	81.3	134	291	530

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	53	23.0	2.10	95.00	25.1	3.45	109	2.90	5.95	11.8	29.0	89.5
29	SPRING	46	22.9	.900	96.00	22.2	3.27	97	3.10	7.10	13.0	32.5	66.0
29	SUMMER	46	26.1	.900	81.00	22.7	3.34	87	4.68	10.6	15.5	42.5	73.8
29	WINTER	52	30.1	.800	117.00	26.9	3.73	89	3.50	11.5	20.4	44.5	99.0
33	FALL	6	27.8	1.10	87.00	31.8	13.0	114	1.10	7.10	19.3	33.0	87.0
33	SPRING	8	42.2	1.00	64.00	23.6	8.36	56	1.00	21.9	55.0	59.3	64.0
33	SUMMER	7	44.4	8.50	110.00	39.1	14.8	88	8.50	11.8	29.7	81.8	110
33	WINTER	7	43.9	7.50	93.50	36.0	13.6	82	7.50	10.0	24.0	79.0	93.5
35	FALL	47	14.5	2.20	55.00	11.8	1.72	81	2.60	6.00	10.1	19.9	40.0
35	SPRING	57	18.3	1.80	75.00	12.9	1.71	71	3.50	9.00	15.3	25.0	47.0
35	SUMMER	42	14.8	1.30	77.00	15.2	2.34	103	2.95	6.00	8.69	21.5	47.0
35	WINTER	57	18.7	2.55	63.75	13.2	1.75	71	2.70	7.88	19.0	25.0	45.5
37	FALL	6	24.7	3.60	57.50	19.8	8.08	80	3.60	8.00	23.0	33.0	57.5
37	SPRING	17	24.8	5.50	57.00	15.6	3.79	63	5.50	15.0	20.0	32.0	57.0
37	SUMMER	7	28.8	12.0	50.00	15.1	5.70	52	12.0	17.5	22.5	49.4	50.0
37	WINTER	17	22.2	4.80	48.00	15.9	3.86	72	4.80	12.0	15.0	32.0	48.0
40	FALL	71	19.2	3.90	67.00	12.4	1.48	65	7.00	11.0	16.8	22.5	40.8
40	SPRING	73	30.3	3.00	123.00	25.9	3.03	86	7.30	13.5	20.7	38.7	92.0
40	SUMMER	78	31.5	1.40	74.50	17.2	1.94	55	8.00	19.0	27.3	41.5	67.0
40	WINTER	70	13.6	1.00	72.75	13.6	1.63	100	2.00	5.10	8.30	17.3	38.0
45	FALL	342	9.87	1.00	110.00	8.05	0.44	81	2.95	5.93	8.50	12.0	19.5
45	SPRING	357	13.1	1.00	106.00	8.98	0.48	68	2.95	7.65	12.0	16.0	25.5
45	SUMMER	356	13.1	1.25	102.50	9.64	0.51	74	2.65	7.33	11.8	16.0	27.0
45	WINTER	271	15.9	1.40	136.00	12.0	0.73	76	3.63	8.68	14.0	20.0	32.5
64	FALL	46	2.78	.450	8.75	1.90	0.28	68	0.70	1.20	2.25	3.80	6.40
64	SPRING	28	5.22	1.00	11.10	2.69	0.51	52	1.13	3.30	5.10	7.05	10.1
64	SUMMER	30	7.01	.800	16.75	4.16	0.76	59	1.00	4.05	6.08	9.40	16.5
64	WINTER	29	5.81	.400	15.08	3.65	0.68	63	1.00	3.00	5.25	7.30	15.0
65	FALL	358	6.86	.000	41.03	5.46	0.29	80	1.80	3.40	5.30	8.50	17.0
65	SPRING	418	9.61	.650	54.00	7.57	0.37	79	2.00	4.60	7.50	11.9	24.0
65	SUMMER	426	11.5	1.10	156.00	14.9	0.72	130	2.20	4.85	7.88	12.0	28.8

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	350	10.4	.300	123.50	12.6	0.67	122	1.85	4.08	6.75	11.0	31.4
71	FALL	20	9.18	1.45	18.40	5.17	1.16	56	1.55	5.09	8.45	13.3	18.2
71	SPRING	21	13.4	1.80	41.00	10.5	2.30	78	2.40	6.40	10.1	17.0	31.0
71	SUMMER	22	15.3	1.95	47.15	10.8	2.31	71	2.25	8.20	13.7	19.4	34.5
71	WINTER	13	19.7	1.80	70.00	18.1	5.03	92	1.80	8.50	14.9	25.2	70.0
72	FALL	96	17.2	1.00	180.00	24.3	2.48	141	2.70	7.36	12.0	20.3	32.0

72	SPRING	77	15.8	2.80	61.50	11.5	1.31	73	4.60	9.00	13.0	17.8	48.0
72	SUMMER	118	13.5	1.00	160.00	16.6	1.53	123	2.70	5.10	9.45	16.9	35.0
72	WINTER	112	10.8	1.30	93.50	10.8	1.02	100	2.60	5.16	7.68	12.8	30.0
74	FALL	14	19.9	1.00	120.00	31.5	8.42	158	1.00	3.00	6.50	26.5	120
74	SPRING	11	29.9	4.00	64.00	18.2	5.49	61	4.00	22.3	28.3	34.0	64.0
74	SUMMER	11	24.6	2.50	62.50	23.0	6.92	93	2.50	7.00	9.50	49.0	62.5
74	WINTER	13	44.3	14.8	92.75	26.5	7.35	60	14.8	20.0	42.5	62.5	92.8

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_JCU_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	11	50.2	2.00	171.00	51.0	15.4	102	2.00	3.80	35.0	79.5	171
29	SPRING	11	39.0	2.00	158.00	45.8	13.8	117	2.00	11.0	25.0	46.0	158
29	SUMMER	17	47.1	2.35	173.00	59.1	14.3	125	2.35	7.25	21.0	46.5	173
29	WINTER	15	32.3	2.00	79.10	23.4	6.04	72	2.00	13.0	31.3	44.0	79.1
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	0	.	.	.	.	.	.	.	.	.	.	.
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	5	56.2	3.50	140.50	57.4	25.7	102	3.50	22.0	25.0	90.0	141
35	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
35	SUMMER	8	46.4	2.00	127.00	48.7	17.2	105	2.00	5.00	25.9	90.0	127
35	WINTER	7	31.8	4.00	72.00	24.0	9.06	75	4.00	13.0	21.5	48.0	72.0
37	FALL	5	20.2	2.00	62.00	23.9	10.7	118	2.00	10.0	12.8	14.0	62.0
37	SPRING	3	62.3	19.0	115.00	48.7	28.1	78	19.0	19.0	53.0	115	115
37	SUMMER	7	31.9	1.00	61.00	20.3	7.66	64	1.00	16.5	27.0	47.0	61.0
37	WINTER	5	16.0	2.00	26.00	9.35	4.18	58	2.00	14.0	15.0	23.0	26.0
40	FALL	14	35.5	4.90	134.50	32.8	8.77	93	4.90	16.5	26.5	35.5	135
40	SPRING	13	37.6	.700	130.50	37.9	10.5	101	0.70	10.0	31.0	42.0	131
40	SUMMER	19	26.3	4.90	100.00	22.9	5.25	87	4.90	10.0	20.0	36.5	100
40	WINTER	11	20.4	7.00	57.00	13.4	4.04	66	7.00	11.0	17.5	23.0	57.0
45	FALL	11	8.04	1.70	30.00	8.03	2.42	100	1.70	3.05	5.70	11.0	30.0
45	SPRING	11	12.8	2.10	29.00	7.01	2.11	55	2.10	9.60	12.1	17.0	29.0
45	SUMMER	10	11.8	1.10	23.10	8.52	2.69	72	1.10	2.10	12.3	20.5	23.1
45	WINTER	12	11.6	3.60	19.50	4.87	1.40	42	3.60	8.85	10.5	15.4	19.5
64	FALL	1	3.73	3.73	3.73	.	.	.	3.73	3.73	3.73	3.73	3.73
64	SPRING	1	6.50	6.50	6.50	.	.	.	6.50	6.50	6.50	6.50	6.50
64	SUMMER	2	4.30	4.10	4.50	0.28	0.20	7	4.10	4.10	4.30	4.50	4.50
64	WINTER	2	5.53	4.70	6.35	1.17	0.83	21	4.70	4.70	5.53	6.35	6.35
65	FALL	17	16.5	2.30	80.00	18.8	4.55	114	2.30	7.50	11.1	18.0	80.0
65	SPRING	21	10.5	1.75	29.30	6.63	1.45	63	2.15	5.60	11.0	13.0	20.0
65	SUMMER	11	20.6	1.60	135.00	38.4	11.6	186	1.60	2.88	9.30	15.0	135

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_JCU_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	18	22.9	2.00	96.00	24.0	5.65	105	2.00	10.7	15.0	21.7	96.0
71	FALL	18	2.42	.600	4.60	1.30	0.31	54	0.60	1.15	2.38	3.60	4.60
71	SPRING	21	7.68	.900	88.80	18.8	4.11	245	1.15	1.55	2.95	4.18	14.9
71	SUMMER	15	3.00	.725	16.00	3.81	0.98	127	0.73	1.05	1.70	3.35	16.0
71	WINTER	17	4.74	1.10	15.50	4.10	0.99	86	1.10	1.50	3.10	6.40	15.5
72	FALL	2	25.3	22.5	28.00	3.89	2.75	15	22.5	22.5	25.3	28.0	28.0
72	SPRING	2	41.5	37.0	46.00	6.36	4.50	15	37.0	37.0	41.5	46.0	46.0
72	SUMMER	3	59.5	43.5	84.00	21.5	12.4	36	43.5	43.5	51.0	84.0	84.0
72	WINTER	2	15.0	13.0	17.00	2.83	2.00	19	13.0	13.0	15.0	17.0	17.0
74	FALL	5	11.1	1.00	17.50	6.13	2.74	55	1.00	11.0	13.0	13.0	17.5
74	SPRING	5	9.89	2.15	26.50	9.96	4.46	101	2.15	3.23	6.10	11.5	26.5
74	SUMMER	5	5.90	1.40	12.50	4.19	1.87	71	1.40	4.10	4.50	7.00	12.5
74	WINTER	3	17.3	15.0	19.00	2.08	1.20	12	15.0	15.0	18.0	19.0	19.0

Aggregate Nutrient Ecoregion: IX
Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_NTU_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
29	FALL	5	13.0	2.43	48.50	19.9	8.89	153	2.43	3.95	4.55	5.53	48.5
29	SPRING	4	3.23	1.70	4.00	1.04	0.52	32	1.70	2.60	3.60	3.85	4.00
29	SUMMER	6	18.5	3.43	70.00	26.2	10.7	141	3.43	4.48	5.65	22.0	70.0
29	WINTER	4	4.50	3.05	6.30	1.39	0.69	31	3.05	3.48	4.33	5.53	6.30
33	FALL	0	.	.	.	.	.	.	.	.	.	.	.
33	SPRING	0	.	.	.	.	.	.	.	.	.	.	.
33	SUMMER	1	0.50	.500	0.50	.	.	.	0.50	0.50	0.50	0.50	0.50
33	WINTER	0	.	.	.	.	.	.	.	.	.	.	.
35	FALL	81	15.6	2.15	63.00	12.4	1.38	80	4.58	7.80	12.0	18.0	40.0
35	SPRING	83	27.6	2.25	175.00	28.2	3.09	102	8.20	12.5	18.5	26.5	75.0
35	SUMMER	82	16.5	3.55	58.50	10.1	1.12	61	4.65	8.80	15.3	22.3	36.1
35	WINTER	72	22.4	3.48	150.00	25.5	3.00	114	6.25	10.2	14.3	24.1	53.5
37	FALL	27	19.3	2.20	91.00	23.0	4.42	119	3.80	5.60	10.8	17.5	76.0
37	SPRING	22	19.5	4.80	52.00	12.3	2.63	63	6.10	10.4	15.6	28.0	44.7
37	SUMMER	23	25.3	2.15	150.00	35.5	7.41	140	4.10	5.75	11.5	26.5	86.7
37	WINTER	21	15.9	4.10	50.25	10.4	2.28	66	6.50	8.15	13.5	19.5	29.5
40	FALL	32	36.2	3.00	113.00	26.3	4.64	72	7.00	17.0	25.5	57.5	73.4
40	SPRING	18	37.2	16.5	80.15	18.5	4.35	50	16.5	21.0	33.5	43.0	80.2
40	SUMMER	53	41.5	4.65	212.00	37.3	5.13	90	5.80	14.0	32.0	52.7	104
40	WINTER	6	31.0	11.0	55.00	19.6	8.01	63	11.0	14.0	25.5	55.0	55.0
45	FALL	25	9.29	2.80	23.75	5.52	1.10	59	3.05	5.95	8.60	10.7	21.0
45	SPRING	26	10.5	.900	28.50	7.07	1.39	67	1.20	5.48	9.25	14.2	23.0
45	SUMMER	35	11.9	1.70	80.50	13.3	2.24	112	2.30	5.30	9.35	14.0	28.3
45	WINTER	22	12.0	4.35	42.40	8.39	1.79	70	4.73	7.70	10.4	13.9	28.2

64	FALL	20	4.75	.250	19.00	5.06	1.13	106	0.25	1.63	2.43	6.85	17.0
64	SPRING	21	6.98	1.10	27.00	6.78	1.48	97	1.30	2.75	4.30	7.60	20.0
64	SUMMER	33	6.42	1.40	16.90	4.07	0.71	63	1.80	3.05	5.10	10.0	13.2
64	WINTER	15	7.25	1.00	32.75	7.77	2.01	107	1.00	2.90	5.18	8.50	32.8
65	FALL	115	10.8	.250	71.68	11.0	1.03	102	1.25	4.10	7.10	14.1	27.0
65	SPRING	152	17.8	.100	128.00	16.8	1.36	94	1.60	7.41	14.0	22.0	43.5
65	SUMMER	173	17.3	.250	116.00	20.6	1.57	119	1.30	6.00	10.2	19.0	72.0

Rivers and Streams
Descriptive Statistics by Decade and Season
Parameter Turb_NTU_Median

Eco_ Level_ III	SEASON	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
65	WINTER	133	18.2	.250	84.00	16.5	1.43	91	1.30	6.40	14.0	25.0	50.3
71	FALL	45	11.8	.250	82.75	13.9	2.07	117	2.00	4.60	7.55	14.5	35.3
71	SPRING	34	20.0	3.00	72.75	17.8	3.05	89	3.95	9.00	12.1	25.5	63.0
71	SUMMER	47	19.0	1.50	199.90	29.9	4.36	157	2.00	4.95	11.5	24.0	40.0
71	WINTER	33	26.1	.250	125.53	28.7	5.00	110	5.35	9.50	18.5	26.1	108
72	FALL	6	28.7	10.0	64.00	19.9	8.13	69	10.0	13.0	25.0	35.0	64.0
72	SPRING	3	20.8	17.0	26.00	4.68	2.70	23	17.0	17.0	19.3	26.0	26.0
72	SUMMER	5	23.7	.000	50.25	19.9	8.92	84	0.00	13.0	18.0	37.0	50.3
72	WINTER	2	22.4	17.0	27.75	7.60	5.38	34	17.0	17.0	22.4	27.8	27.8
74	FALL	10	23.4	7.60	39.25	11.2	3.53	48	7.60	14.3	22.5	35.0	39.3
74	SPRING	16	30.7	4.00	90.00	22.3	5.57	73	4.00	17.0	23.5	38.3	90.0
74	SUMMER	18	41.9	5.00	130.00	36.9	8.69	88	5.00	15.5	30.6	54.0	130
74	WINTER	15	31.4	10.0	93.50	21.2	5.48	67	10.0	17.5	25.0	37.2	93.5

APPENDIX C

Quality Control/Quality Assurance Rules

Support for the Compilation and Analysis of National Nutrient Data

15 Nutrient Ecoregion/Waterbody Type Summary Chapters

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CONTENTS

1.0 BACKGROUND

The Nutrient Criteria Program has initiated development of a national Nutrient Criteria Database application that will be used to store and analyze nutrient data. The ultimate use of these data will be to derive ecoregion- and waterbody-specific nutrient criteria ranges. EPA converted STOrage and RETrieval (STORET) legacy data, National Stream Quality Accounting Network (NASQAN) data, National Water-Quality Assessment (NAWQA) data, and other relevant nutrient data from universities and States/Tribes into the database. The data imported into the Nutrient Criteria Database will be used to develop national nutrient criteria ranges.

1.1 Purpose

The purpose of this deliverable is to provide EPA with information regarding the data used to create the statistical reports which will be used to derive ecoregion- and waterbody-specific nutrient criteria ranges for Level III ecoregions. There are fourteen aggregate nutrient ecoregions. Each aggregate nutrient ecoregion is divided into smaller ecoregions referred to as Level III ecoregions. EPA will determine criteria ranges for the waterbody types and Level III ecoregions within the following aggregate nutrient ecoregions:

- Lakes and Reservoirs
  - Aggregate Nutrient ecoregions: 2, 6, 7, 8, 9, 11, 12, 13

- Rivers and Streams
  - Aggregate Nutrient ecoregions: 2, 3, 6, 7, 9, 11, 12, 14

1.2 References

This section lists documents that contain baselines, standards, guidelines, policies, and references that apply to the data analysis. Listed editions were valid at the time of publication. All documents are subject to revision, but these specific editions govern the concepts described in this document.

Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs (Draft). EPA, Office of Water, EPA 822-D-99-001, April 1999.

Nutrient Criteria Technical Guidance Manual: Rivers and Streams (Draft). EPA, Office of Water, EPA 822-D-99-003, September 1999.

Guidance for Data Quality Assessment: Practical Methods for Data Analysis. EPA, Office of Research and Development, EPA QA/G-9, January 1998.

2.0 QA/QC PROCEDURES

In order to develop nutrient criteria, EPA needed to obtain nutrient data from the states. EPA requested nutrient data from the states and forwarded the data sets to INDUS via e-mail and/or US mail. In addition, EPA tasked INDUS to convert data from three national data sets. EPA provided INDUS with a Legacy STORET extraction to convert into the database. The United States Geologic Survey (USGS) sent INDUS a CD-ROM with NASQAN data to convert. INDUS downloaded NAWQA files from the USGS Web site to convert the data. In total, INDUS converted and imported the following national and state data sets into the Nutrient Criteria Database:

- Legacy STORET
- NAWQA
- NASQAN
- Region 1
- Region 2 - Lake Champlain Monitoring Project
- Region 2 - NYSDEC Finger Lakes Monitoring Program
- Region 2 - NY Citizens Lake Assessment Program
- Region 2 - Lake Classification and Inventory Survey
- Region 2 - NYCDEP (1990-1998)
- Region 2 - NYCDEP (Storm Event data)
- Region 2 - New Jersey Nutrient Data (Tidal Waters)
- Region 5
- Region 3
- Region 3 - Nitrite Data
- Region 3 - Choptank River files
- Region 4 - Tennessee Valley Authority
- Region 7 - Central Plains Center for BioAssessment (CPCB)
- Region 7 - REMAP
- Region 2 - Delaware River Basin Commission (1990-1998)
- Region 3 - PA Lake Data
- Region 3 - University of Delaware
- Region 10
- University of Auburn

As part of the conversion process, INDUS performed a number of Quality Assurance/Quality Control (QA/QC) steps to ensure that the data was properly converted into the Nutrient Criteria Database. Section 2 explains the steps performed by INDUS to convert the data.

2.1 National Data Sets

INDUS converted three national data sets into the Nutrient Criteria Database: Legacy STORET data, NASQAN data, and NAWQA data. A previous EPA contractor performed the extraction of Legacy STORET data and documented the QA/QC procedures used on the data. This documentation is included in Appendix A. INDUS performed minimal QA/QC on the Legacy STORET data set because the previous contractor completed the steps outlined in Appendix A. INDUS and EPA also agreed to convert the NAWQA and NASQAN data sets with minimal QA/QC on the assumption that the source agency, the USGS, QA/QC'd the data.

For each of the three national data sets, INDUS ran queries to determine if 1) samples existed without results and 2) if stations existed without samples. Per Task Order Project Officer (TOPO) direction, these records were deleted from the system. For analysis purposes, EPA determined that there was no need to keep station records with no samples and sample records with no results. INDUS also confirmed that each data set contained no duplicate records.

In addition, INDUS deleted all composite results from the Legacy STORET data. Per TOPO direction, it was decided that composite sample results would not be used in the statistical analysis.

2.2 State Data

Each state data set was delivered in a unique format. Many of the data sets were delivered to INDUS without corresponding documentation. INDUS analyzed each state data set in order to determine which parameters should be converted for analysis. INDUS obtained a master parameter table from EPA and converted the parameters in the state data sets according to those that were present in the EPA parameter table. INDUS converted all of the data elements in the state data sets that mapped directly to the Nutrient Criteria Database; data elements that did not map to the Nutrient Criteria Database were not converted. In some cases, state data elements that did not directly map into the Oracle database were inserted into a comment field within the database. Also, INDUS maintained an internal record of which state data elements were inserted into the comment field.

As part of the data clean-up efforts, INDUS determined whether or not there were any duplicate records in the state data sets and deleted the duplicate records. INDUS checked the waterbody, station, and sample entities for duplicate records. In addition, INDUS deleted station records with no samples and sample records with no results. INDUS also deleted waterbody records that were not associated with a station. In each case, INDUS maintained an internal record of how many records were deleted.

If INDUS encountered referential integrity errors, such as samples that referred to stations that did not exist, or if INDUS was unsure of whether a record was a duplicate, INDUS contacted the agency directly via e-mail or phone to resolve any issues that arose. INDUS saved an electronic copy of each e-mail correspondence with the states to ensure that a record of the decision was maintained. INDUS also contacted each agency to determine which laboratory methods were used for each parameter.

Finally, INDUS examined the remark codes of each result record in the state data sets. INDUS mapped the remark codes to the STORET remark codes listed in Table 2 of Appendix A. If any of the state result records were associated with remark codes marked as "Delete" in Table 2 of Appendix A, the result records were not converted into the database.

2.3 Laboratory Methods

Many of the state data sets did not contain laboratory method information. In addition, laboratory method information was not available for the three national data sets. In order to determine missing laboratory method information, EPA tasked another contractor to contact the data owners to obtain the laboratory method. In some cases, the data owners responded and the laboratory methods were added to the database.

2.4 Waterbody Name and Class Information

A large percentage of the data did not have waterbody-specific information. The only waterbody information contained in the three national data sets was the waterbody name, which was embedded in the station 'location description' field. Most of the state data sets contained waterbody name information; however, much of the data was duplicated throughout the data sets. Therefore, the waterbody information was cleaned manually. For the three national data sets, the 'location description' field was extracted from the station table and moved to a temporary table. The 'location description' field was sorted alphabetically. Unique waterbodies were grouped together based on name similarity and whether or not the waterbodies fell within the same county, state, and waterbody type. Finally, the 'location description' field was edited to include only waterbody name information, not descriptive information. For example, 110 MILE CREEK AT POMONA DAM OUTFLOW, KS PO-2 was edited to 110 MILE CREEK. Also, if 100 MILE CREEK was listed ten times in New York, but in four different counties, four 100 MILE CREEK waterbody records were created.

Similar steps were taken to eliminate duplicate waterbody records in the state data sets. If a number of records had similar waterbody names and fell within the same state, county, and waterbody type, the records were grouped to create a unique waterbody record.

Most of the waterbody data did not contain depth, surface area, and volume measurements. EPA needed this information to classify waterbody types. EPA attempted to obtain waterbody class information from the states. EPA sent waterbody files to the regional coordinators and requested that certain class information be completed by each state. The state response was poor; therefore, EPA was not able to perform statistical analysis for the waterbody types by class.

2.5 Ecoregion Data

Aggregate nutrient ecoregions and Level III ecoregions were added to the database using the station latitude and longitude coordinates. If a station was lacking latitude and longitude coordinates or county information, the data were not included in the statistical analysis. Appendix B lists the steps taken to add the two ecoregion types (aggregate and Level III) to the Nutrient Criteria Database. The ecoregion names were pulled from aggregate nutrient ecoregion and Level III ecoregion Geographical Information System (GIS) coverages. In summary, the station latitude and longitude coordinates were used to determine the ecoregion under the following circumstances:

- The latitude and longitude coordinates fell within the county/state listed in the station table.
- The county data was missing.

The county centroid was used to determine the ecoregions under the following circumstances:

- The latitude and longitude coordinates were missing, but the state/county information was available.
- The latitude and longitude coordinates fell outside the county/state listed in the station table. The county information was assumed to be correct; therefore, the county centroid was used.

If the latitude and longitude coordinates fell outside the continental US county coverage file (i.e., the point fell in the ocean or Mexico/Canada), the nearest ecoregion was assigned to the station.

3.0 STATISTICAL ANALYSIS REPORTS

Aggregate nutrient ecoregion tables were created by extracting all observations for a specific aggregate nutrient ecoregion from the nutrient criteria database. Then, the data were reduced to create tables containing only the yearly median values. To create these tables, the median value for each waterbody was calculated using all observations for each waterbody by Level III ecoregion, year, and season. Tables of decade median values were created from the yearly median tables by calculating the median for each waterbody by Level III ecoregion by decade and season.

The Data Source and the Remark Code reports were created using all observations (all reported values). All the other reports were created from either the yearly median tables or the decade median tables. In other words, the descriptive statistics and regressions were run using the median values for each waterbody and not the individual reported values.

Statistical analyses were performed under the assumption that this data set is a random sample. If this assumption cannot be verified, the observations may or may not be valid. Values below the 1st and 99th percentile were removed from the Legacy STORET database prior to the creation of the national database. Also, data were treated according the Legacy STORET remark codes in Appendix A.

The following contains a list of each report and the purpose for creating each report:

- Data Source Created to provide a count of the amount of data and to identify the source(s).
- Remark Codes Created to provide a description of the data.
- Median of Each Waterbody by Year This was an intermediate step performed to obtain a median value for each lake to be used in the yearly descriptive statistics reports and the regression models.
- Median of Each Waterbody by Decade This was an intermediate step performed to obtain a median value for each lake to be used in the decade descriptive statistics.
- Descriptive Statistics Created to provide EPA with the desired statistics for setting criteria levels.
- Regression Models Created to examine the relationships between biological and nutrient variables.

Note: Separate reports were created for each season.

3.1 Data Source Reports

Data source reports were presented in the following formats:

- The number and percentage of data from each data source were summarized in tables for each aggregate nutrient ecoregion by season and waterbody type.

- The number and percentage of data from each data source were summarized in tables for each Level III ecoregion by season and waterbody type.

The 'Frequency' represents the number of data values from a specific data source for each parameter by data source. The 'Row Pct' represents the percentage of data from a specific data source for each parameter.

3.2 Remark Code Reports

Remark code reports were presented in the following formats:

- The number and percentage of data associated with a particular remark code for each parameter were summarized in tables by Level III ecoregion by decade and season.

- The number and percentage of data associated with a particular remark code for each parameter were summarized in tables by Level III ecoregion by year and season.

The 'Frequency' represents the number of data values corresponding to the remark code in the column. The 'Row Pct' represents the percentage of data that was associated with the remark code in that row.

In the database, remark codes that were entered by the states were mapped to Legacy STORET remark codes. Prior to the analysis, the data were treated according to these remark codes. For example, if the remark code was 'K,' then the reported value was divided by two. Appendix A contains a complete list of Legacy STORET remark codes.

Note: For the reports, a remark code of 'Z' indicates that no remark codes were recorded. It does not correspond to Legacy STORET code 'Z.'

3.3 Median of Each Waterbody

To reduce the data and to ensure heavily sampled waterbodies or years were not over represented in the analysis, median value tables (described above) were created. The yearly median tables and decade median tables were delivered to the EPA in electronic format as csv (comma separated value or comma delimited) files.

3.4 Descriptive Statistic Reports

The number of waterbodies, median, mean, minimum, maximum, 5th, 25th , 75th , 95th percentiles, standard deviation, standard error, and coefficient of variation were calculated. The tables (described above) containing the decade median values for each waterbody for each parameter were used to create descriptive statistics reports for:

- Level III ecoregions by decade and season
- Aggregate nutrient ecoregions by decade and season

In addition, the tables containing the yearly median values for each waterbody for each parameter were used to create descriptive statistics reports for:

- Level III ecoregions by year and season

3.5 Regression Models

Simple linear regressions using the least squares method were performed to examine the relationships between biological and nutrient variables in lakes and reservoirs, and rivers and streams. Regressions were performed using the yearly median tables. Chlorophyll(s) in micrograms per liter (ug/L), secchi in meters (m), dissolved oxygen in milligrams per liter (mg/L), turbidity, and pH were the biological variables in these models. When there was little or no data for chlorophyll, then pH or dissolved oxygen was substituted for chlorophyll. Secchi data were used in the lake and reservoir models, and turbidity data were used in the river and stream models. The nutrient variables in these models include: total phosphorus in ug/L, total nitrogen in mg/L, total kjeldahl nitrogen in mg/L, and nitrate and nitrite in mg/L. Regressions were also run for total nitrogen and total phosphorus for ecoregions where both these variables were measured.

Note: At the time of creation of this document only regressions for aggregate nutrient ecoregion 7 for lakes and reservoirs were delivered to the EPA. Regressions for the remaining aggregate nutrient ecoregions will be delivered in August 2000.

4.0 TIME PERIOD

Data collected from January 1990 to December 1999 were used in the statistical analysis reports. To capture seasonal differences, the data were classified as follows:

- Aggregate nutrient ecoregions: 6, 7, and 8
  - Spring: April to May
  - Summer: June to August
  - Fall: September to October
  - Winter: November to March

- Aggregate nutrient ecoregions: 1, 2, 9, 10, 11, 12, and 13
  - Spring: March to May
  - Summer: June to August
  - Fall: September to November
  - Winter: December to February

5.0 DATA SOURCES AND PARAMETERS FOR THE AGGREGATE NUTRIENT ECOREGIONS

This section provides information for the nutrient aggregate ecoregions that were analyzed by waterbody type. Each section lists the data sources for the aggregate nutrient ecoregion including: 1) the data sources, 2) the parameters included in the analysis, and 3) the Level III ecoregions within the aggregate nutrient ecoregions.

Note: For analysis purposes, the following parameters were combined to form Phosphorous, Dissolved Inorganic (DIP):

Phosphorus, Dissolved Inorganic (DIP)
Phosphorus, Dissolved (DP)
Phosphorus, Dissolved Reactive (DRP)
Orthophosphate, dissolved, mg/L as P
Orthophosphate (OPO4_PO4)

5.1 Lakes and Reservoirs

5.1.1 Aggregate Nutrient Ecoregion 2

<u>Data Sources:</u>

Legacy STORET
EPA Region 10

<u>Parameter:</u>

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Phosphorus, Total Reactive	(ug/L)
SECCHI	(m)
pH	

Level III ecoregions:

1, 2, 4, 5, 9, 11, 15, 16, 17, 19, 21, 23, 41, 77, 78

5.1.2 Aggregate Nutrient Ecoregion 6

Data Sources:

Legacy STORET

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

Level III ecoregions:

46, 47, 48, 54, 55, 57

5.1.3 Aggregate Nutrient Ecoregion 7

Data Sources:

LCMPD
Legacy STORET
NYCDEP
EPA Region 1

Parameters:

Chlorophyll A, Fluorometric Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)

Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

<u>Level III ecoregions:</u>

51, 52, 53, 56, 60, 61, 83

5.1.4 Aggregate Nutrient Ecoregion 8

<u>Data Sources:</u>

LCMPD
Legacy STORET
NYCDEP
NYCDEC
EPA Region 1
EPA Region 3

<u>Parameters:</u>

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B	(ug/L)
Chlorophyll C	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

<u>Level III ecoregions:</u>

49, 50, 58, 62, 82

5.1.5 Aggregate Nutrient Ecoregion 9

Data Sources:

Auburn University
Legacy STORET
EPA Region 4

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Pheophytin	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

Level III ecoregions:

29, 33, 35, 37, 40, 45, 64, 65, 71, 72, 74

5.1.6 Aggregate Nutrient Ecoregion 11

Data Sources:

Auburn University
Legacy STORET
NYSDEC
EPA Region 3
EPA Region 4

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Pheophytin	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)

Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

Level III ecoregions:

36, 38, 39, 66, 67, 68, 69, 70

5.1.7 Aggregate Nutrient Ecoregion 12

Data Sources:

Legacy STORET

Parameters:

Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

Level III ecoregions:

75

5.1.8 Aggregate Nutrient Ecoregion 13

Data Sources:

Legacy STORET

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
SECCHI	(m)

Level III ecoregions:

76

5.2 Rivers and Streams

5.2.1 Aggregate Nutrient Ecoregion 2

Data Sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 10

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Phosphorus, Total (TP) Reactive	(ug/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)

Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

1, 2, 4, 5, 8, 9, 11, 15, 16, 17, 19, 21, 23, 41, 77, 78

5.2.2 Aggregate Nutrient Ecoregion 3

Data Sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 10

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

6, 10, 12, 13, 14, 18, 20, 22, 24, 79, 80, 81

5.2.3 Aggregate Nutrient Ecoregion 6

Data Sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 5
EPA Region 7

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Organic, Phosphorus	(ug/L)
Phosphorus, Total (TP)	(ug/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

46, 47, 48, 54, 55, 57

5.2.4 Aggregate Nutrient Ecoregion 7

Data Sources:

LCMPD
Legacy STORET
NASQAN
NAWQA
NYCDEP

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Organic, Phosphorus	(ug/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

51, 52, 53, 56, 60, 61, 83

5.2.5 Aggregate Nutrient Ecoregion 9

Data Sources:

Auburn University
Legacy STORET
NASQAN
NAWQA
EPA Region 3
EPA Region 5
EPA Region 7

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)

Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll B, Phytoplankton, Spectrophotometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Organic, Phosphorus	(ug/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

29, 33, 35, 37, 40, 45, 64, 65, 71, 72, 74

5.2.6 Aggregate Nutrient Ecoregion 11

Data Sources:

Auburn University
Legacy STORET
NASQAN
NAWQA
EPA Region 3
EPA Region 5
EPA Region 7

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Organic, Phosphorus	(ug/L)

Phosphorus, Orthophosphate, Total as P	(ug/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

36, 38, 39, 66, 67, 68, 69, 70

5.2.7 Aggregate Nutrient Ecoregion 12

Data Sources:

Legacy STORET
NASQAN
NAWQA

Parameters:

Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Chlorophyll B, Phytoplankton, Spectrophotometric	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(NTU)

Level III ecoregions:

75

5.2.8 Aggregate Nutrient Ecoregion 14

Data Sources:

Legacy STORET
NASQAN
NAWQA
NYCDEP
EPA Region 1
EPA Region 3

Parameters:

Chlorophyll A, Fluorometric, Corrected	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric Acid	(ug/L)
Chlorophyll A, Phytoplankton, Spectrophotometric, Uncorrected	(ug/L)
Chlorophyll A, Trichromatic, Uncorrected	(ug/L)
Phosphorous, Dissolved Inorganic (DIP)	(ug/L)
Dissolved Oxygen (DO)	(mg/L)
Nitrite and Nitrate, (NO2+NO3)	(mg/L)
Phosphorus, Orthophosphate, Total as P	(ug/L)
Nitrogen, Total Kjeldahl (TKN)	(mg/L)
Nitrogen, Total (TN)	(mg/L)
Phosphorus, Total (TP)	(ug/L)
Turbidity	(FTU)
Turbidity	(JCU)
Turbidity	(NTU)

Level III ecoregions:

59, 63, 84

APPENDIX A

Process Used to QA/QA the Legacy STORET Nutrient Data Set

1. STORET water quality parameters and Station and Sample data items were retrieved from USEPA's mainframe computer. Table 1 lists all retrieved parameters and data items.

TABLE 1: PARAMETERS AND DATA ITEMS RETRIEVED FROM STORET

Parameters Retrieved (STORET Parameter Code)	Station Data Items Included (STORET Item Name)	Sample Data Items Included (STORET Item Name)
TN - mg/l (600) TKN - mg/l (625) Total Ammonia (NH3+NH4) - mg/l (610) Total NO2+NO3 - mg/l (630) Total Nitrite - mg/l (615) Total Nitrate - mg/l (620) Organic N - mg/L (605) TP - mg/l (665) Chlor *a* - ug/L (spectrophotometric method, 32211) Chlor *a* - ug/L (fluorometric method corrected, 32209) Chlor *a* - ug/L (trichromatic method corrected, 32210) Secchi Transp. - inches (77) Secchi Transp. - meters (78) +Turbidity JCUs (70) +Turbidity FTUs (76) +Turbidity NTUs field (82078) +Turbidity NTUs lab (82079) +DO - mg/L (300) +Water Temperature (degrees C, 10/degrees F, 11)	Station Type (TYPE) Agency Code (AGENCY) Station No. (STATION) Latitude - std. decimal degrees (LATSTD) Longitude - std. decimal degrees (LONGSTD) Station Location (LOCNAME) County Name (CONAME) State Name (STNAME) Ecoregion Name - Level III (ECONAME) Ecoregion Code -Level III (ECOREG) Station Elevation (ELEV) Hydrologic Unit Code (CATUNIT) RF1 Segment and Mile (RCHMIL) RF1ON/OFF tag (ONOFF)	Sample Date (DATE) Sample Time (TIME) Sample Depth (DEPTH) Composite Sample Code (SAMPMETH)
+ If data record available at a station included data only for this or other such marked parameters, data record was deleted from data set.		

The following set of retrieval rules were applied to the retrieval process:

- Data were retrieved for waterbodies specified only as 'lake', 'stream', 'reservoir', or 'estuary' under "Station Type" parameter. Any stations specified as 'well,' 'spring,' or 'outfall' were eliminated from the retrieved data set.

- Data were retrieved for station types described as 'ambient' (e.g., no pipe or facility discharge data) under the "Station Type" parameter.

- Data were retrieved that were designated as 'water' samples only. This includes 'bottom' and 'vertically integrated' water samples.

- Data were retrieved that were designated as either 'grab' samples and 'composite' samples (mean result only).

- No limits were specified for sample depths.

- Data were retrieved for all fifty states, Puerto Rico, and the District of Columbia.

- The time period specified for data retrieval was January 1990 to September 1998.

- No data marked as "Retired Data" (i.e., data from a generally unknown source) were retrieved.

- Data marked as "National Urban Runoff data" (i.e., data associated with sampling conducted after storm events to assess nonpoint source pollutants) were included in the retrieval. Such data are part of STORET's 'Archived' data.

- Intensive survey data (i.e., data collected as part of specific studies) were retrieved.

2. Any values falling below the 1st percentile and any values falling above the 99th percentile were transformed into 'missing' values (i.e., values were effectively removed from the data set, but were not permanently eliminated).

3. Based on the STORET 'Remark Code' associated with each retrieved data point, the following rules were applied (Table 2):

TABLE 2: STORET REMARK CODE RULES

STORET Remark Code	Keep or Delete Data Point
blank - Data not remarked.	Keep
A - Value reported is the mean of two or more determinations.	Keep
B - Results based upon colony counts outside the acceptable ranges.	Delete
C - Calculated. Value stored was not measured directly, but was calculated from other data available.	Keep
D - Field measurement.	Keep

E - Extra sample taken in compositing process.	Delete
F - In the case of species, F indicates female sex.	Delete
G - Value reported is the maximum of two or more determinations.	Delete
H - Value based on field kit determination; results may not be accurate.	Delete
I - The value reported is less than the practical quantification limit and greater than or equal to the method detection limit.	Keep, but used one-half the reported value as the new value.
J - Estimated. Value shown is not a result of analytical measurement.	Delete
K - Off-scale low. Actual value not known, but known to be less than value shown.	Keep, but used one-half the reported value as the new value.
L - Off-scale high. Actual value not known, but known to be greater than value shown.	Keep
M - Presence of material verified, but not quantified. Indicates a positive detection, at a level too low to permit accurate quantification.	Keep, but used one half the reported value as the new value.
N - Presumptive evidence of presence of material.	Delete
O - Sample for, but analysis lost. Accompanying value is not meaningful for analysis.	Delete
P - Too numerous to count.	Delete
Q - Sample held beyond normal holding time.	Delete
R - Significant rain in the past 48 hours.	Delete
S - Laboratory test.	Keep
T - Value reported is less than the criteria of detection.	Keep, but replaced reported value with 0.

U - Material was analyzed for, but not detected. Value stored is the limit of detection for the process in use.	Keep, but replaced reported value with 0.
V - Indicates the analyte was detected in both the sample and associated method blank.	Delete
W - Value observed is less than the lowest value reportable under remark "T."	Keep, but replaced reported value with 0.
X - Value is quasi vertically-integrated sample.	No data point with this remark code in data set.
Y - Laboratory analysis from unpreserved sample. Data may not be accurate.	Delete
Z - Too many colonies were present to count.	Delete
If a parameter (excluding water temperature) value was less than or equal to zero and no remark code was present, the value was transformed into a missing value. Rationale - Parameter concentrations should never be zero without a proper explanation. A method detection limit should at least be listed.	

4. Station records were eliminated from the data set if any of the following descriptors were present within the "Station Type" parameter:

- **MONITR -** Source monitoring site, which monitors a known problem or to detect a specific problem.
- **HAZARD -** Site of hazardous or toxic wastes or substances.
- **ANPOOL -** Anchialine pool, underground pools with subsurface connections to watertable and ocean.
- **DOWN -** Downstream (i.e., within a potentially polluted area) from a facility which has a potential to pollute.
- **IMPDMT -** Impoundment. Includes waste pits, treatment lagoons, and settling and evaporation ponds.
- **STMSWR -** Storm water sewer.
- **LNDFL -** Landfill.
- **CMBMI -** Combined municipal and industrial facilities.
- **CMBSRC -** Combined source (intake and outfall).

Rationale - these descriptors potentially indicate a station location that at which an ambient water sample would not be obtained (i.e., such sampling locations are potentially biased) or the sample location is not located within one of the designated water body types (i.e, ANPOOL).

5. Station records were eliminated from data set if the station location did not fall within any established cataloging unit boundaries based on their latitude and longitude.

6. Using nutrient ecoregion GIS coverage provided by USEPA, all station locations with latitude and longitude coordinates were tagged with a nutrient ecoregion identifier (nutrient region identifiers are values 1 - 14) and the associated nutrient ecoregion name. Because no nutrient ecoregions exist for Alaska, Hawaii, and Puerto Rico, stations located in these states were tagged with "dummy" nutrient ecoregion numbers (20 = Alaska, 21 = Hawaii, 22 = Puerto Rico).

7. Using information provided by TVA, 59 station locations that were marked as 'stream' locations under the "Station Type" parameter were changed to 'reservoir' locations.

8. The nutrient data retrieved from STORET were assessed for the presence of duplicate data records. The duplicate data identification process consisted of three steps: 1) identification of records that matched exactly in terms of each variable retrieved; 2) identification of records that matched exactly in terms of each variable retrieved except for their station identification numbers; and 3) identification of records that matched exactly in terms of each variable retrieved except for their collecting agency codes. The data duplication assessment procedures were conducted using SAS programs.
Prior to initiating the data duplication assessment process, the STORET nutrient data set contained:

    41,210 station records
    924,420 sample records

- Identification of exactly matching records
All data records were sorted to identify those records that matched exactly. For two records to match exactly, all variables retrieved had to be the same. For example, they had to have the same water quality parameters, parameter results and associated remark codes, and have the same station data item and sample data item information. Exactly matching records were considered to be exact duplicates, and one duplicate record of each identified matching set were eliminated from the nutrient data set. A total of 924 sample records identified as duplicates by this process were eliminated from the data set.

- Identification of matching records with the exception of station identification number
All data records were sorted to identify those records that matched exactly except for their station identification number (i.e., they had the same water quality

parameters, parameter results and associated remark codes, and the same station and sample data item information with the exception of station identification number). Although the station identification numbers were different, the latitude and longitude for the stations were the same indicating a duplication of station data due to the existence of two station identification numbers for the same station. For each set of matching records, one of the station identification numbers was randomly selected and its associated data were eliminated from the data set. A total of 686 sample records were eliminated from the data set through this process.

- Identification of matching records with the exception of collecting agency codes
  All data records were sorted to identify those records that matched exactly except for their collecting agency codes (i.e., they had the same water quality parameters, parameter results and associated remark codes, and the same station and sample data item information with the exception of agency code). The presence of two matching data records each with a different agency code attached to it suggested that one agency had utilized data collected by the other agency and had entered the data into STORET without realizing that it already had been placed in STORET by the other agency. No matching records with greater than two different agency codes were identified. For determining which record to delete from the data set, the following rules were developed:

  - If one of the matching records had a USGS agency code, the USGS record was retained and the other record was deleted.
  - Higher level agency monitoring program data were retained. For example, federal program data (indicated by a "1" at the beginning of the STORET agency code) were retained against state (indicated by a "2") and local (indicated by values higher than 2) program data.
  - If two matching records had the same level agency code, the record from the agency with the greater number of overall observations (potentially indicating the data set as the source data set) was retained.

  A total of 2,915 sample records were eliminated through this process.

As a result of the duplicate data identification process, a total of 4,525 sample records and 36 individual station records were removed from the STORET nutrient data set. The resulting nutrient data set contains the following:

41,174 station records
919,895 sample records

APPENDIX B

Process for Adding Aggregate Nutrient Ecoregions and Level III Ecoregions

Steps for assigning Level III ecoregions and aggregate nutrient ecoregion codes and names to the Nutrient Criteria Database (performed using ESRI's ARCView v 3.2 and its GeoProcessing Wizard). This process is performed twice; once for the Level III ecoregions and once for the aggregate nutrient ecoregions:

- Add the station .dbf data table, with latitude and longitude data, to project by 'Add Event Theme'
- Convert to the shapefile format
- Create 'stcojoin' field, populate the 'stcojoin' field with the following formula: 'County.LCase+State.LCase'
- Add field 'stco_flag' to the station shapefile
- Spatially join the station data with the county shapefile (cntys_jned.shp)
- Select 'stcojoin' (station shapefile) field = 'stco_join2' (county shapefile) field
- Calculate stco_flag = 0 for selected features
- Step through all blank stco_flag records, assign the appropriate stco_flags, see list on the following page
- Select all stco_flags = 4 or 7, switch selection
- Calculate ctyfips (station) to cntyfips (county)
- Stop editing and save edits, remove all joins
- Add in 2 new fields 'x-coord1' and 'y-coord1' into station table
- Select all stco_flags = 1, 2, and 6
- Link county coverage with station coverage
- Populate 'x-coord1' and 'y-coord1' with 'x-coord' and 'y-coord' from county coverage
- Select all stco_flags = 1, 2, and 6, export to new .dbf file
- Add new .dbf file as event theme
- Convert to shapefile format
- Add the following fields to both tables (original station and station126 shapefiles): 'eco_omer', 'name_omer', 'dis_aggr', 'code_aggr', 'name_aggr'
- Spatially join station126 and eco-omer coverage
- Populate the 'eco_omer' field with the 'eco' value
- Repeat the previous step using the nearest method (line coverage) to determine ecoregion assignment for the line coverage, if some records are blank
- Spatially join the ecoregion line coverage to station coverage, link the LPoly# (from the spatially joined table) to Poly# (of the ecoregion polygon coverage)
- Populate the Eco fields with the appropriate information.
- Follow the same steps to the Rpoly#
- Remove all table joins
- Link the useco-om table with station126 table and populate 'name-omer' field
- Spatially join station aggr coverage and populate the rest of the fields. Follow the same procedures as outlined above
- Remove all joins
- Make sure the new Eco field added into the station126 shapefile are different than

the ones in the original station shapefile

- Join station126 and station coverage by station-id
- Populate all the Eco fields in the original station coverage
- Remove all joins
- Save table
- Make sure that all ctyfips records are populated; the county shapefile may have to be joined to populate the records, if the stco_flag = 4
- Create 2 new fields, 'NewCounty' and 'NewState'
- Populate these new fields with a spatial join to the county coverage
- Select by feature (ecoregion shapefile) all of the records in the station shapefile
- Switch selection (to get records outside of the ecoregion shapefile)
- If any of the selected records have stco_flag = 0 (they are outside the ecoregion shapefile boundary), calculate them to stco_flag = 3

stco_flags (state/county flags in order of importance)

0 The state and county values from the data set matched the state and county values from the spatial join.
(Ecoregions were assigned based on the latitude/longitude coordinates.)

1 The state and county values from the data set did not match the state and county values from the spatial join, but the point was inside the county coverage boundary.
(Ecoregions were assigned based on the county centroid.)

2 The state and county values from the data set did not match the state and county values from the spatial join because the point was outside the county coverage boundary; therefore, there was nothing to compare to the point (i.e., the point falls in the ocean/Canada/Mexico). This occurred for some coastal samples.
(Ecoregions were assigned based on the county centroid.)

3 The state and county values from the data set matched the state and county from the spatial join, but the point was outside the ecoregion boundary.
(Ecoregions were assigned to the closest ecoregion to the point.)
(No ecoregions were assigned to AK, HI, PR, BC, and GU.)

4 Latitude/longitude coordinates were provided, but there was no county information.
(Ecoregions were assigned based on the latitude/longitude coordinates.)

5 The state and county values from the data set did not match the state and county values from the spatial join due to spelling or naming convention errors.
The matches were performed manually.
(Ecoregions were assigned based on the latitude/longitude coordinates.)

6 No latitude/longitude coordinates were provided, only state and county information was available.
(Ecoregions were assigned based on the county centroid.)

7 No latitude/longitude coordinates were provided, only state information was available; therefore, no matches were possible.
(Ecoregions were not assigned. Data is not included in the analysis.)

APPENDIX C

Glossary

Coefficient of Variation- Equal to the standard deviation divided by the mean multiplied by 100.

Maximum- The highest value.

Mean- The arithmetic average.

Median- The 50th percentile or middle value. Half of the values are above the median, and half of the values are below the median.

Minimum- The lowest value.

Standard Deviation- Equal to the square root of the variance with the variance defined as the sum of the squared deviations divided by the sample size minus one.

Standard Error- Standard error of the mean is equal to the standard deviation divided by the square root of the sample size.