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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 X

EPA-822-B-01-016

AMBIENT WATER QUALITY CRITERIA RECOMMENDATIONS

INFORMATION SUPPORTING THE DEVELOPMENT OF STATE AND TRIBAL NUTRIENT CRITERIA

FOR

RIVERS AND STREAMS IN NUTRIENT ECOREGION X

Texas-Louisiana Coastal and Mississippi Alluvial Plains

including all or parts of the States of:

Texas, Louisiana, Mississippi, Arkansas, Tennessee, Kentucky, Missouri, and Illinois,

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, DC

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FOREWORD

This document presents EPA's nutrient criteria for **Rivers and Streams in Nutrient Ecoregion X**. 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 the Clean Water Act (CWA). Under section 303(c) of the CWA, States and authorized Tribes have the primary responsibility for adopting water quality standards as part of State or Tribal law or regulation. Federal regulations require State and Tribal standards to 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 in creating their own water quality standards.

The term "water quality criteria" is used in two sections of the CWA, section 304(a)(1) and section 303(c)(2). The term has a different impact in each section. On the one hand, 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. On the other hand, in section 303, ambient water quality criteria are developed by States and Tribes as part of their water quality standards, to 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 numerically or as quantified translations of narrative criteria within State or Tribal water quality standards, quantified criteria are critical for assessing attainment of designated uses and measuring progress toward meeting CWA goals.

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 that as many as half of the Nation's surface waters surveyed 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 14 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 has published and will continue to publish technical guidance manuals that describe a process for assessing nutrient conditions in the four waterbody types listed above.

EPA's section 304(a) water quality criteria for nutrients provide numeric water quality criteria and procedures to help establish quantified 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 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.

States and authorized Tribes have several options in adopting these criteria. EPA recommends the following approaches, in order of preference:

1. Wherever possible, develop nutrient criteria that fully reflect local conditions and protect specific designated uses through 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.

EPA developed the nutrient criteria recommendations in this document with the intent that they serve as a starting point for States and Tribes to develop more refined criteria, as appropriate, to reflect local conditions. The values presented in this document generally represent nutrient levels that protect against the adverse effects of nutrient overenrichment. They are based on the information that was available to the Agency at the time of this publication. EPA expects States and Tribes may have additional information and data that may be utilized in the refinement of these criteria. EPA offers to work with States and authorized Tribes to establish the necessary quantitative endpoints to reduce the excess nutrient inputs into our nation's waters and to prevent any further impairments.

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 decisionmakers retain the discretion to adopt approaches on a case-by-case basis that differ from this guidance when appropriate and scientifically defensible. Even though this document contains EPA's scientific recommendations regarding ambient concentrations of nutrients that will 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 the end of 2000. In addition, the Agency formed Regional Technical Assistance Groups (RTAGs), which include State and Tribal representatives working to develop more refined and localized nutrient criteria based on approaches described in the waterbody guidance manuals. This document presents EPA's current recommended criteria for total phosphorus (TP), total nitrogen (TN), chlorophyll *a*, and turbidity for rivers and streams in Nutrient Ecoregion X, which were derived using the procedures described in the *Rivers and Streams Nutrient Criteria Technical Guidance Manual* (U.S. EPA, 2000b).

EPA's ecoregional nutrient criteria address cultural eutrophication—the adverse effects of excess human-caused nutrient inputs. The criteria are empirically derived to represent surface waters that are minimally impacted by human activities and protective of aquatic life and recreational uses. The information contained in this document represents 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 that included, to the extent they were readily available, the following critical elements:

- **Historical and recent nutrient data in Nutrient Ecoregion X.** Data sets from Legacy STORET, NASQAN, EPA Region 7 - Central Plains Center for BioAssessment (CPCB), EPA Region 7 - CPCB 2, and EPA Region 7 - REMAP were used to assess nutrient conditions from 1990 to 2000.

- **Reference sites/reference conditions in Nutrient Ecoregion X.** Reference conditions presented are based on 25th percentiles of all nutrient data, including a comparison of reference conditions for the aggregate ecoregion versus the subecoregions. States and Tribes are urged to determine their own reference sites for rivers and streams 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 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 were 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: Texas, Louisiana, Tennessee, Kentucky, and Illinois. Mississippi indicated that standard or EPA-approved methods were used for some specific parameters.

The following tables contain a summary of aggregate and level III ecoregion values for TN, TP, water column chlorophyll *a*, and turbidity.

BASED ON 25th PERCENTILES ONLY

Nutrient Parameters	Aggregate Nutrient Ecoregion X Reference Conditions
Total phosphorus (µg/L)	128*
Total nitrogen (mg/L) (reported)	0.76
Chlorophyll *a* (µg/L) (spectrophotometric method)	2.10
Turbidity (FTU)	17.5

* This value appears inordinately high and may either be a statistical anomaly or reflect a unique condition. In any case, further regional investigation is indicated to determine the sources, i.e., measurement error, notational error, statistical anomaly, naturally enriched conditions, or cultural impacts.

For subecoregions 34 and 73, the ranges of nutrient parameter reference conditions are as follows:

BASED ON 25th PERCENTILE ONLY

Nutrient Parameters	Range of Level III Subecoregions Reference Conditions
Total phosphorus (µg/L)	125-126*
Total nitrogen (mg/L) (reported)	0.71-0.86
Chlorophyll *a* (µg/L) (fluorometric method)	N/A
Turbidity (FTU)	12.27-19

* This value appears inordinately high and may either be a statistical anomaly or reflect a unique condition. In any case, further regional investigation is indicated to determine the sources, i.e., measurement error, notational error, statistical anomaly, naturally enriched conditions, or cultural impacts.

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; telephone (513) 489-8190 or toll free (800) 490-9198. Please refer to EPA document number EPA-822-B-01-016.

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1.0 INTRODUCTION

Background

Nutrients are essential to the health and diversity of surface waters. However, in excessive amounts nutrients cause eutrophication or hypereutrophication, which results in overgrowth of plant life and decline of the biological community. Excessive nutrients can also result in human health risks, such as the growth of harmful algal blooms, most recently manifested in the *Pfiesteria* outbreaks on the Gulf and East Coasts. Chronic nutrient overenrichment of a waterbody can lead to the following consequences: algal blooms, low dissolved oxygen, fish kills, overabundance of macrophytes, likely increased sedimentation, 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 after siltation 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 (CWA) establishes that, wherever possible, water quality must provide for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water and/or protecting the physical, chemical, and biological integrity of those waters. In adopting water quality standards, States and Tribes designate uses for their waters in consideration of these CWA goals, and establish water quality criteria that contain sufficient parameters to protect that integrity and 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 them how best to deal with the national nutrient problem. The experts recommended that the Agency not develop single criteria values for phosphorus (P) or nitrogen (N) applicable to all waterbodies and regions of the country. Rather, they 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 was published in fall 2001, 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 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* [chl *a*] and some measure of turbidity). Other indicators such as dissolved oxygen, macrophyte or benthic algal growth or speciation, and other fauna and flora changes are also useful. However, the first four variables 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, or natural resources management—especially water resource management, chemistry, and ecology. The RTAG evaluates and recommends appropriate classification techniques, usually physical, for criteria determination 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 10-25 years. This information gives evidence about the background and enrichment trend of the resource.

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

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

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

The final element of the process is 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.

Although States and authorized Tribes do 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 is a balanced incorporation of all five elements.

Because some parts of the country have naturally different soil and parent material nutrient content and different precipitation regimes, the application of the criterion development process should reflect this regional variation. Therefore, an ecoregional approach was chosen. Initially, the continental United States was divided into 14 separate ecoregions of similar geographical characteristics and similar nutrient condition (Figure 1a). 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 from adjacent areas in a holistic sense. Geographic characteristics such as soils, vegetation, climate, geology, and land cover, are relatively similar within each Ecoregion (Omernik, 2000).

The nutrient ecoregions are aggregates of EPA's hierarchical level III ecoregions (see Figure 1b for map of 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 because of 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 and the more refined scales (level III ecoregions and waterbody classes), where data were available to make such assessments, are presented for comparison and completeness of analysis.

Comparison 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 data from sites that represent the least impacted 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 their basic approaches to 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 use 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 uses of existing resources and are holistic indicators of the water quality necessary to protect uses.

States and authorized Tribes can develop and apply nutrient 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

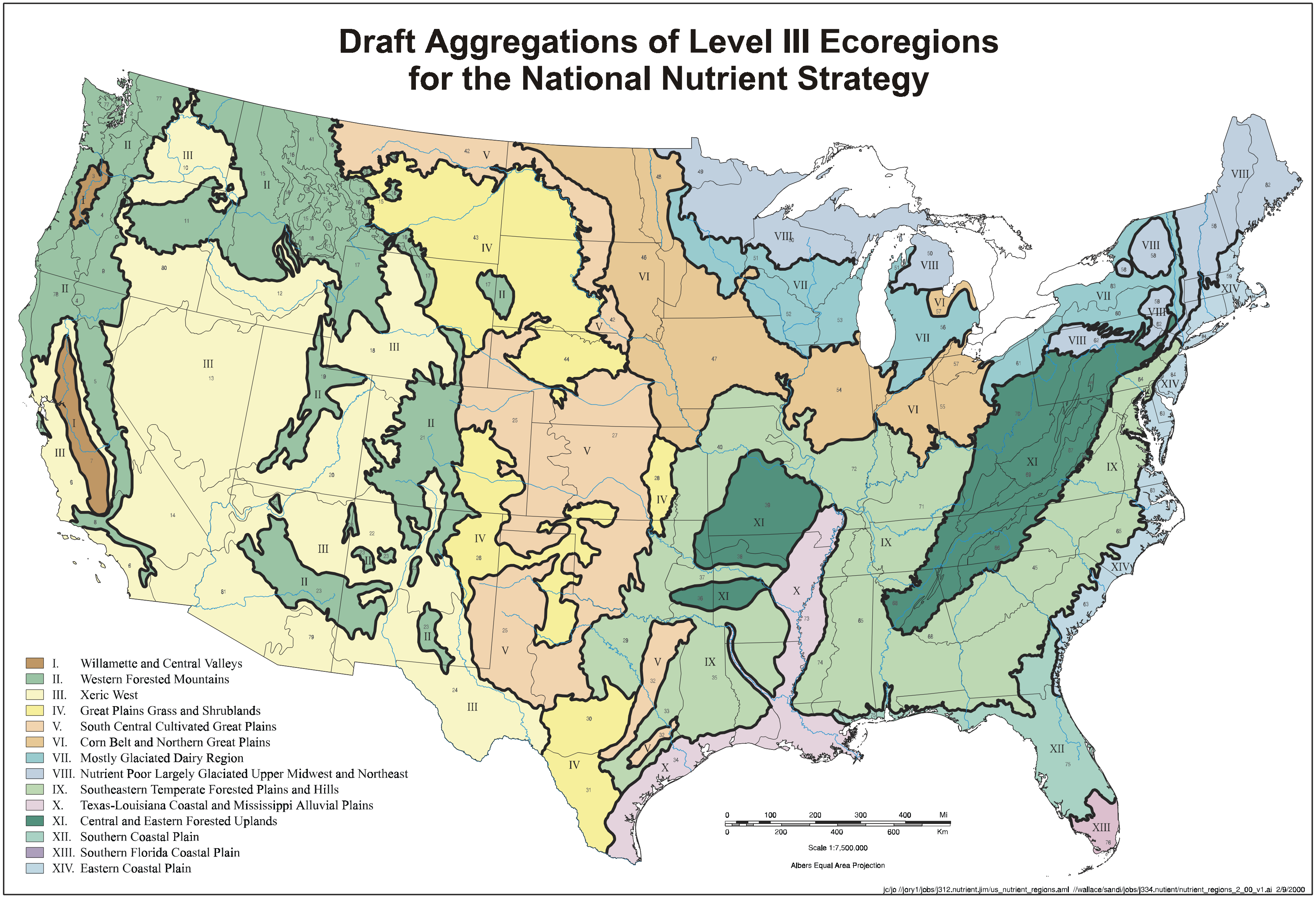


Figure 1a. Fourteen nutrient Ecoregions as delineated by Omernik (2000). Ecoregions were based on geology, land use, ecosystem type, and nutrient conditions.

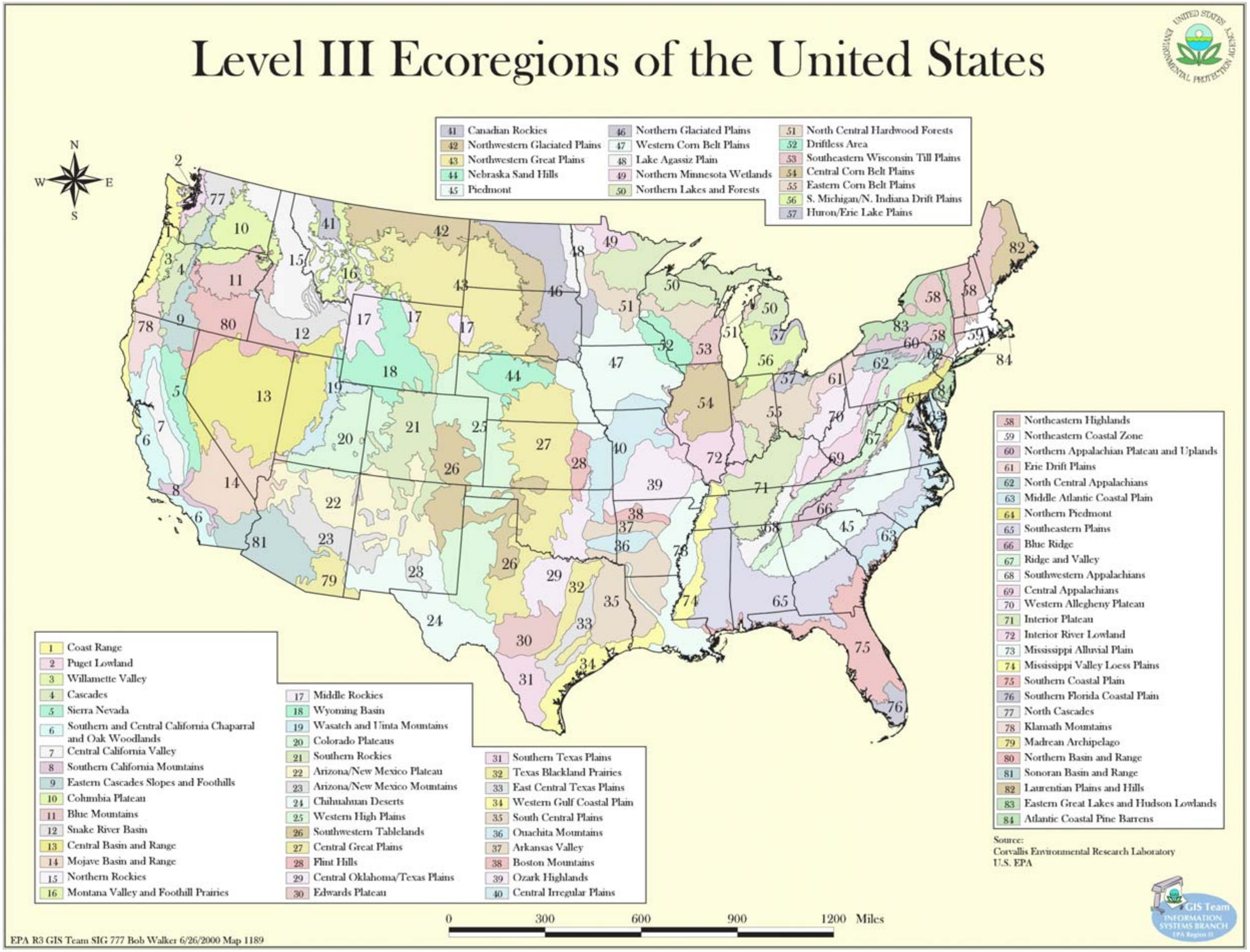


Figure 1b. Level III Ecoregions of the United States.

through designing and conducting a common sampling program. The traditional biological criteria variables of benthic invertebrate and fish sampling can be readily incorporated in a nutrient assessment. To investigate the effectiveness of this tandem approach, EPA has initiated pilot projects in both freshwater and marine environments to pursue the relationship between nutrient overenrichment and apparent declines in diversity 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 and ultimately controlling discharges or releases of pollutants. The recommendations also provide guidance to EPA when it determines that it is necessary to promulgate Federal water quality standards under section 303(c). 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 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 efforts where possible. States and Tribes can address nutrient overenrichment through establishment of numerical criteria or use of 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 will establish procedures to quantitatively translate these statements for both assessment and source control purposes.

Ecoregional nutrient criteria are developed to represent 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 judgment, and evaluation of downstream effects. EPA has used elements of this process to produce the information contained in this document. The 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.

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. EPA has also published methods for modifying 304(a) criteria, such as the water effect ratio, on a site-specific basis where conditions warrant modification to achieve the intended level of protection. For nutrients, however, EPA expects that it will usually be necessary for States and authorized Tribes to be more precise in identifying the nutrient levels that protect aquatic life and recreational uses. This can be achieved through criteria modified to reflect a smaller geographic scale than an ecoregion, such as a subecoregion, the State or Tribe level, or a specific class of waterbodies. Criteria can be refined by grouping data or performing analyses at these smaller geographic scales. Refinement can also occur through further consideration of other elements such as published literature or models.

EPA expects that the values presented in this document generally represent nutrient levels that protect against the adverse effects of cultural 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 uses that need to be protected. For example, more sensitive uses may require more stringent criteria to ensure adequate protection. On the other hand, overly stringent levels of protection against cultural eutrophication may actually fall below 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 using historical data and expert judgment and current reference conditions. These elements of the 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 to develop more refined criteria according to the methods described in EPA's technical guidance manuals for specific waterbody types.

To assist in further refinement of nutrient criteria, EPA has established 10 RTAGs (experts from EPA Regional Offices and States/Tribes). In 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 using the information and recommendations in this document and elsewhere 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 protect uses before impairment occurs and to maintain downstream uses. Early response variables are necessary to warn 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 (how long) and frequency (how often) of occurrence in addition to magnitude (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 or biweekly measurements) is considered appropriate. However, these central tendency measures should apply each season or each year, except under the most extraordinary conditions (e.g., a 100-year flood).

3.0 AREA COVERED BY THIS DOCUMENT

This chapter provides a general description of the aggregate ecoregion and its geographical boundaries. Descriptions of the level III subecoregions contained within the aggregate ecoregion are also provided.

3.1 Description of Aggregate Ecoregion X

Ecoregion X is nearly level and is composed of alluvial plains in the Mississippi River Valley and coastal plains along the Gulf of Mexico. It is well known for producing large amounts of cotton and rice and has concentrations of industrial and urban activity. The Mississippi alluvial plain has nutrient-rich soils, a favorable climate, and is one of the most important cash crop areas in the United States; soils in the more irregular Southeastern Temperate Forested Plains and Hills (IX) are not as naturally fertile. The coastal plain is dominated by range, pasture, marshy wildlife habitat, woodland, cropland, and both recreational and urban development. Cotton, soybeans, rice, sorghum, corn, sugarcane, hay, and wheat are grown in Ecoregion X. A higher percentage of the land is in cropland than in bordering nutrient Ecoregions. Wet soils are common and must be artificially drained to be farmed. The wettest areas that are not artificially drained remain in forests and wetlands and are important wildlife habitat. Urban and industrial areas are found in the region and population is increasing. Urbanization, industrial activity, and agricultural runoff have affected the region's water quality. The Mississippi River Valley portion of Ecoregion X extends from its junction with the Ohio River to the Mississippi Delta. It is mostly a broad, flat floodplain that contains many oxbow lakes and bayous; it is physiographically distinct from the neighboring Southeastern Temperate Forested Plains and Hills (IX) and the Central and Eastern Forested Uplands (XI). River terraces and levees provide the main elements of relief. Winters are mild, summers are hot, and both temperature and precipitation increase from north to south. The mean annual temperature is very warm, freeze-free growing season is long, and mean annual precipitation is plentiful and are, respectively, 57-70°F, 200-340 days, and 45-65 inches. Soils are nutrient-rich and have a thermic temperature regime and an aquic or udic moisture regime. The potential natural vegetation of the Mississippi River Valley is mostly southern floodplain forest (dominants: tupelo, oak, bald cypress) with some areas of oak-hickory forest mixed in; southern cordgrass prairie is found on the outer Mississippi Delta. Most of the original bottomland deciduous forest has been cleared and drained for cultivation and, today, the Valley is an important agricultural area. Overall, about 55% of the Mississippi River Valley portion of Ecoregion X is used as cropland, 35% is used as woodland, and 7% is used as pastureland. Cropland comprises about 75% of the north but, in the south, pasture, woodland, forest, marshland, and swamp are more common. The Valley s favorable climate and its productive, nutrient-rich soils support soybean, cotton, rice, sorghum, corn, hay, wheat, and, in Louisiana, sugarcane farming; land in cotton increased by almost a million acres between 1987 and 1992, by far the largest such increase in the United States. Most of the northern and central parts of the region receive heavy treatments of insecticides, herbicides, and fertilizers and have a high potential for pesticide, phosphate fertilizer, and nitrogen fertilizer runoff. Soils are poorly-drained and must be artificially drained to be farmed. Controlling surface water is a major concern of management. Agricultural runoff containing fertilizers, herbicides, pesticides, and livestock waste and channelization have affected surficial water quality. Total phosphorus, total ammonia, and nitrite plus nitrate concentrations are often high in rivers, streams, and ditches due to extensive fertilizer use and discharge from municipal sewage treatment plants (U.S. Geological Survey, 1993). Turbidity is a problem in channelized areas. Pesticide residues are found in the surface waters (USGS, 1993).

The coastal plain portion of Ecoregion X extends westward from the Mississippi River Delta to Brownsville, Texas along the Gulf of Mexico. It is comprised of nearly level coastal lowlands with barrier islands, bays, marshes, and some low dunes in sandy areas. Elevations typically range from sea level to 150 feet but, in some areas, they reach 325 feet. Lowest parts of the area are marshy and are covered by high tides and storm tides. Farther inland, are the higher and more irregular plains of Ecoregions IV, V, and IX. Winters are mild, summers are hot, and precipitation increases from west to east. The mean annual temperature is very warm, freeze-free growing season is long, and mean annual precipitation is plentiful and are, respectively, 66-73°F, 250-350 days, and 25-60 inches. The potential natural vegetation is sea oats prairie on barrier islands , southern cordgrass prairie in the near-shore zone, and seacoast bluestem-coastal sacahuista prairie in higher areas away from the coast to an elevation of about 150 feet; farther inland in eastern Texas and western Louisiana, pine-hardwood forest is mapped to about 325 feet elevation sweetgum, blackgum, post oak, blackjack oak, and southern red oak] and both mesquite-live oak savanna and mesquite-acacia savanna occur in drier areas of southern Texas. Today, near shore areas are mostly native rangeland and wildlife habitat; in addition, there is expanding urban and recreation development especially along the barrier beaches but freshwater is limited and often must be piped in. Farther inland, land-use changes. On the former seacoast bluestem-coastal sacahuista prairie, about 40% of the acreage is now cropland producing rice, soybeans, grain sorghum, cotton, corn, and hay, 30% is range or pasture, and hardwood forest borders the rivers and streams; locally, urban development is rapidly expanding onto agricultural land. Most soils are artificially drained for general farm crops and rice is irrigated from streams and wells. In eastern Texas and western Louisiana, about 75% remains in pine-hardwood forest and produces lumber and pulpwood; the remainder is mostly used as pasture or as sites for small subdivisions. Present-day land use significantly impacts surface and subsurface water quality. Elevated concentrations of nitrate and phosphorus are significant water quality problems in many basins and can be a byproduct of agricultural runoff. Dissolved oxygen depletion has occurred in some sluggish, warm rivers affected by nutrient-laden agricultural runoff. Sulfate concentrations are locally high where streams are impacted by industrial activity but are usually lower than in nutrient regions underlain by gypsum or salt beds. Urban runoff, municipal wastewater effluent, and livestock impact the level of nutrient and fecal coliform bacteria in streams and rivers. Industrial activity has released contaminants including heavy metals to surface waters. In addition, groundwater overdraft has caused saline intrusion into fresh water aquifers.

3.2 Geographical Boundaries of Aggregate Ecoregion X

The northern boundary of Ecoregion X begins along the borders of Illinois, Missouri, and Kentucky at the junction of the Ohio River and Mississippi River (Figure 2). The region continues south along the Mississippi River Valley, encompassing portions of Missouri, Tennessee, Arkansas, Mississippi, and Louisiana.

At the junction of the Mississippi River and Red River, the region continues northwest up the Red River through Louisiana and into Arkansas.

The coastal plain portion of Ecoregion X extends westward from the Mississippi River Delta along the Gulf of Mexico through Louisiana and down to the southern tip of Texas.

3.3 Level III Subecoregions Within Aggregate Ecoregion X

There are two level III subecoregions contained within Aggregate Ecoregion X (Figure 3). The following are brief descriptions provided by Omernik (1999) of the climate, vegetative cover, topography, and other ecological information pertaining to these subecoregions.

34. Western Gulf Coastal Plain

The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region the plains are more irregular and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Recent urbanization and industrialization have become concerns in this region.

73. Mississippi Alluvial Plain

This riverine ecoregion extends from southern Illinois, at the confluence of the Ohio River with the Mississippi River, south to the Gulf of Mexico. It is mostly a flat, broad floodplain with river terraces and levees providing the main elements of relief. Soils tend to be poorly drained, except for the areas of sandy soils. Winters are mild and summers are hot, with temperatures and precipitation increasing from north to south. Bottomland deciduous forest vegetation covered the region before much of it was cleared for cultivation. Presently, most of the northern and central parts of the region are in cropland and receive heavy treatments of insecticides and herbicides. Soybeans, cotton, and rice are the major crops.

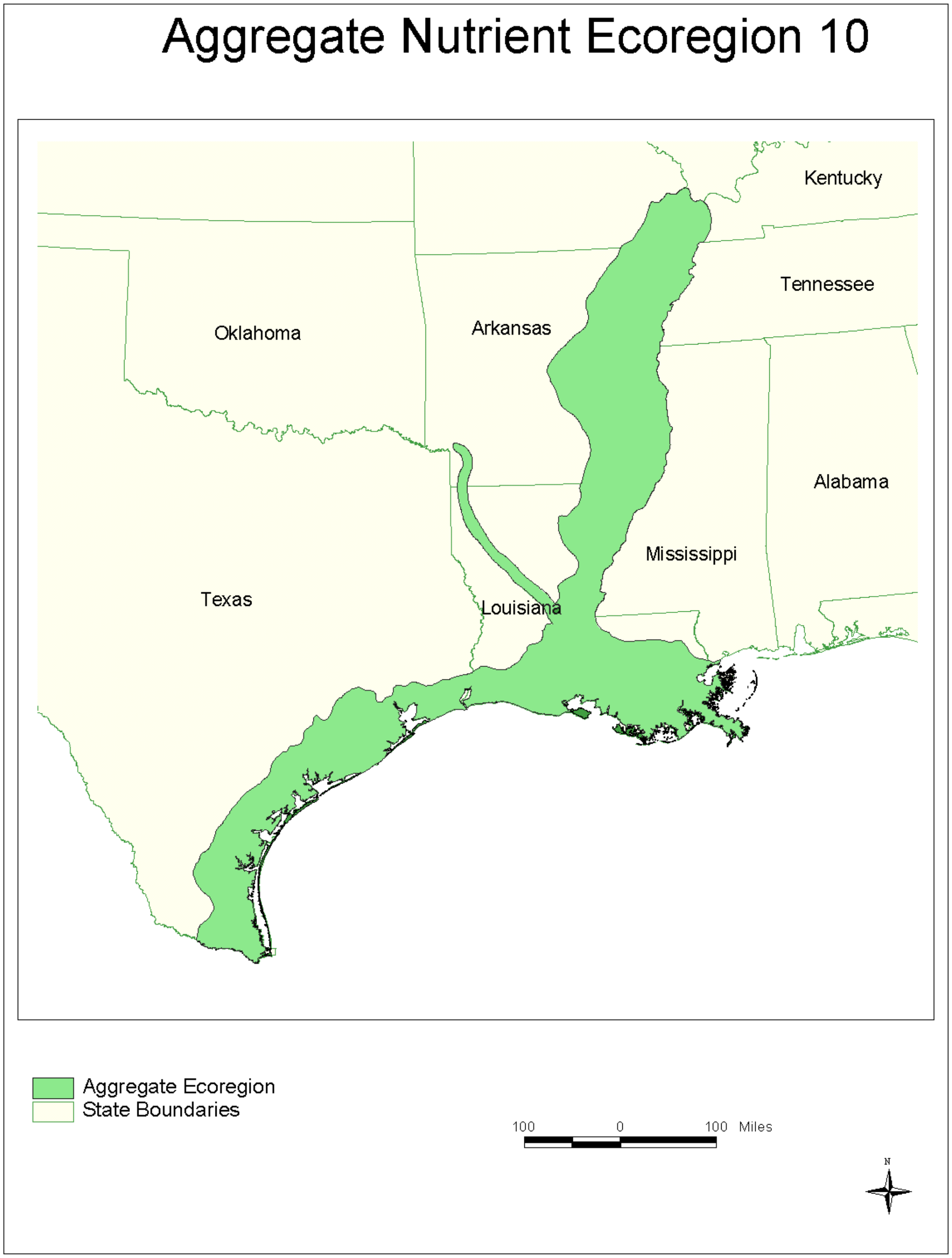


Figure 2. Aggregate Ecoregion X.

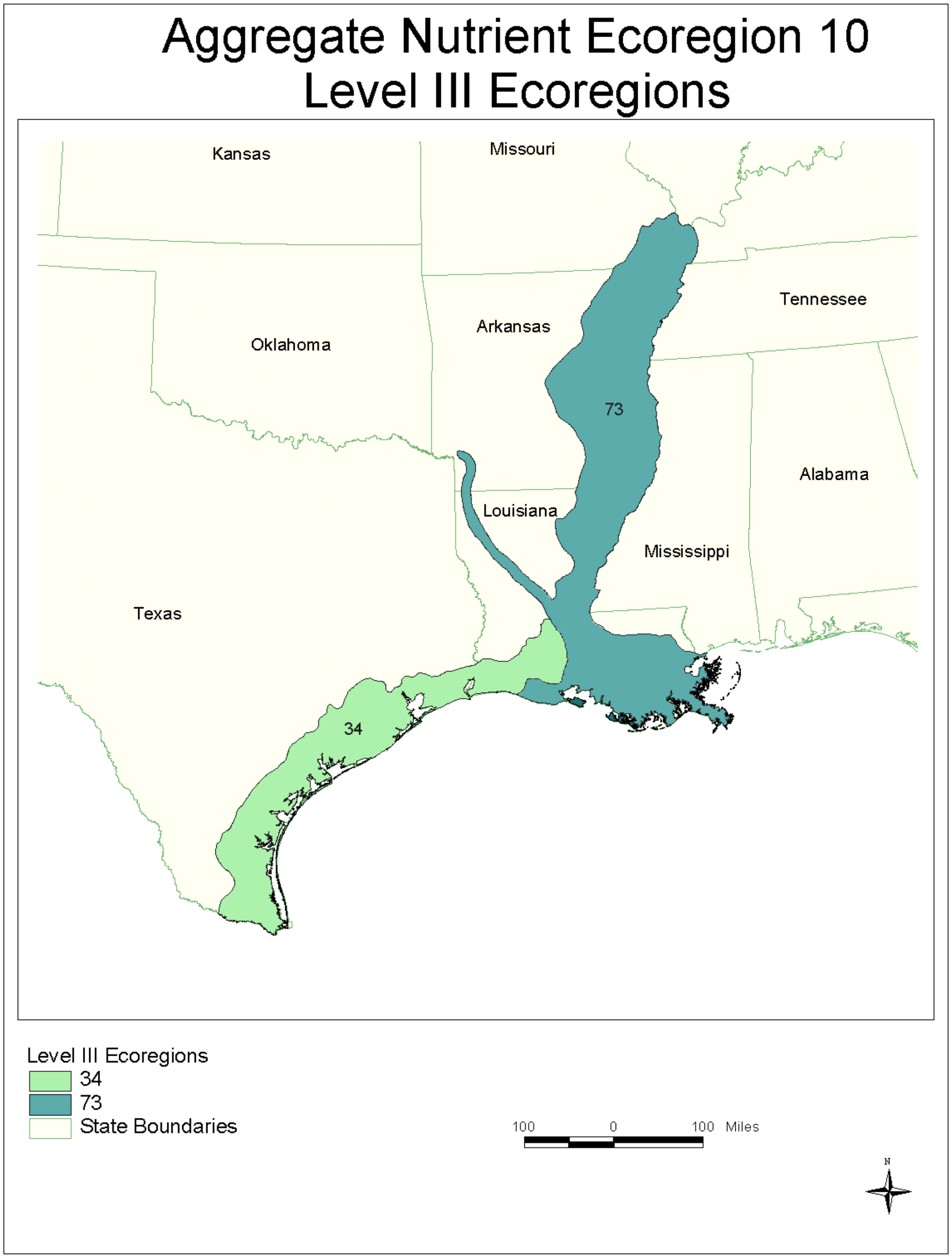


Figure 3. Aggregate Ecoregion X with level III Ecoregions shown.

3.4 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. See the paper by Dale Robertson (USGS, 2001b) for an alternative approach to ecoregions entitled "An Alternative Regarding the Scheme for Defining Nutrient Criteria for Rivers and Streams."

4.0 DATA REVIEW FOR RIVERS AND STREAMS IN AGGREGATE ECOREGION X

This 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*). EPA considers these parameters 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 enrichment for most 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, EPA Region 7 - Central Plains Center for BioAssessment (CPCB), EPA Region 7 - CPCB 2, and EPA Region 7 - REMAP were used to assess nutrient conditions from 1990 to 2000. 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 X (TP, TN, chl *a*, and turbidity)

EPA recommends that States/Tribes assess long-term trends observed over the past 50 years to assess the relative stability of the systems. 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 past 10 years (e.g., what do seasonal variations 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, stormwater sewers, hazardous waste sites) were used in the statistical analyses.

States within Ecoregion X were contacted regarding the quality of their data and information on the methods used to sample and analyze their waters. The following States indicated standard methods or approved EPA methods were used: Texas, Louisiana, Tennessee, Kentucky, and Illinois. Mississippi indicated that standard or EPA-approved methods were used for some specific nutrient parameters. Arkansas and Missouri did not provide information prior to the publication of this document.

4.4 Data for All Rivers and Streams Within Aggregate Ecoregion X

Figure 4 shows the location of the sampling stations within each subecoregion. Table 1 presents all data records for all parameters for Aggregate Ecoregion X 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. The 75th percentile is preferred by EPA because 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 to attempt to approximate the preferred approach. 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], the letter from Tennessee Department of Environment and Conservation to Geoffrey Grubbs [TNDEC, 2000], the unpublished paper titled "Estimating the Natural Background Concentrations of Nutrients in Streams and Rivers of the Conterminous United States" [USGS, 2001], and the letter from Matthew Liebman, U.S. EPA Region 1 Nutrient Criteria Coordinator to Geoffrey Grubbs [U.S. EPA, 2000c]). New York State has also presented evidence that the 25th percentile and the 75th percentile compare well based on user perceptions of water resources (NYSDEC, 2000).

Tables 2 and 3a-b 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. Tables 3a-b present potential reference conditions for rivers and streams in the level III subecoregions within the aggregate ecoregion. Note that the footnotes for Table 2 apply to Tables 3a-b. Appendixes A and B provides a complete presentation of all descriptive statistics for both the aggregate ecoregion and the level III subecoregions.

Tables 4 and 5 are presented for comparison purposes. They allow the reader to determine where, in the trophic state, the recommended reference conditions fall within traditionally viewed trophic boundaries.

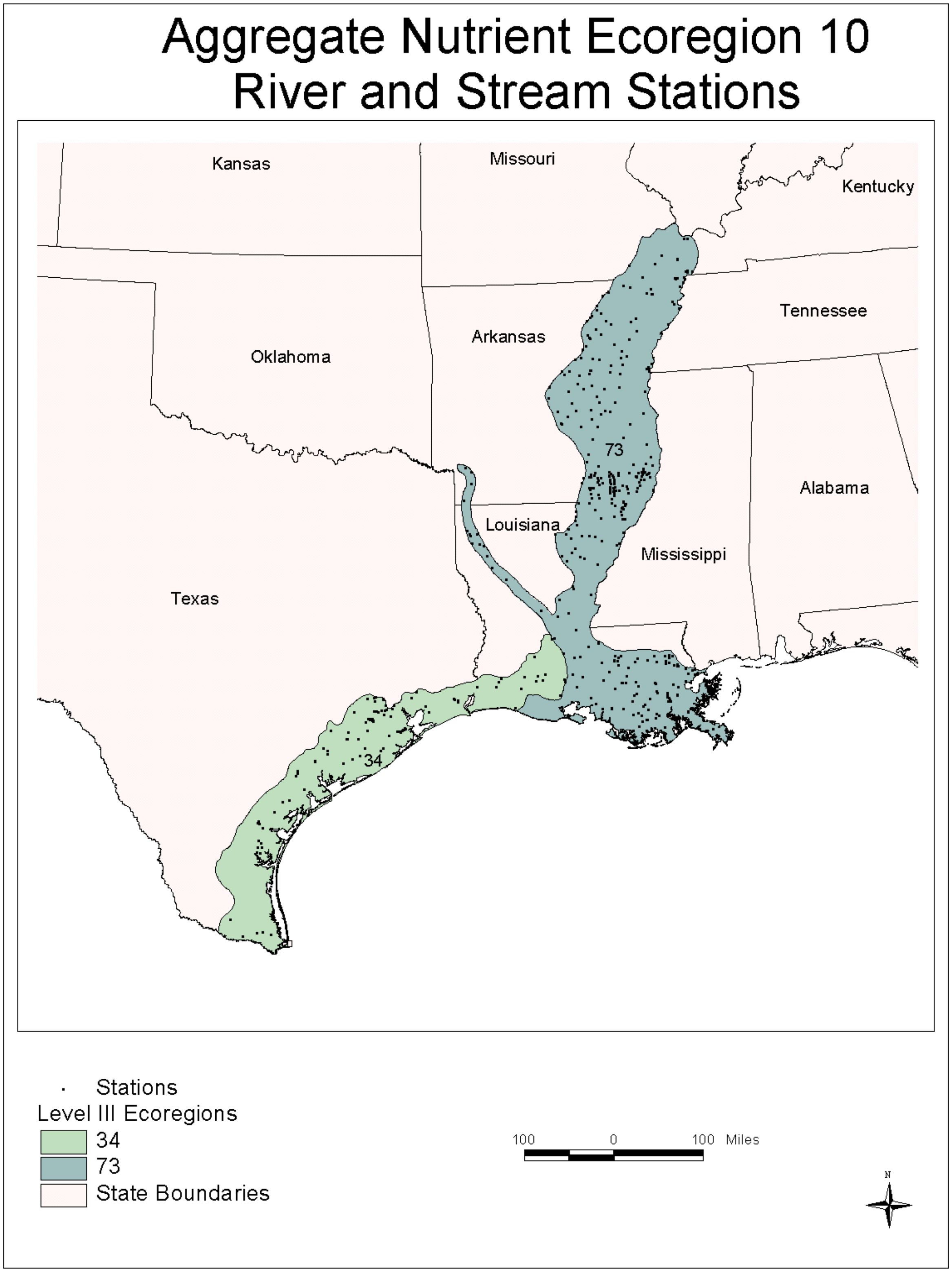


Figure 4. Sampling locations within each level III Ecoregion.

Table 1. River and stream records* for Aggregate Ecoregion X—Texas-Louisiana Coastal and Mississippi Alluvial Plains

	Aggregate Ecoregion X	Sub ecoR 34	Sub ecoR 73
# of named streams	321	73	248
# of stream stations	624	128	496
Key nutrient parameters (listed below)			
- # of records for turbidity (all methods)	10,370	1,535	8,835
- # of records for chlorophyll *a* (all methods)	1,382	731	638
- # of records for total Kjeldhal nitrogen (TKN)	10,335	2,545	7,790
- # of records for nitrite + nitrate (NO_2+NO_3)	12,399	1,855	10,544
- # of records for total nitrogen (TN)	834	202	632
- # of records for total phosphorus (TP)	14,419	2,877	11,542
Total # of records for key nutrient parameters	49,739	9,745	39,981

*The number of rivers and streams presented in this table is based on the number of rivers and streams for which nutrient data were provided in the National Nutrient database. This does not imply that this is the total of rivers and streams within the Ecoregion. States and Tribes should determine the representativeness of the tabular data by comparing this information with any additional material they may have.

Definitions: (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.

Table 2. Reference conditions for Aggregate Ecoregion X 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)	220	0.03	2.95	0.71	
NO_2+NO_3-N (mg/L)	253	0.00	6.77	0.14	
TN (mg/L) - calculated				0.85	
TN (mg/L) - reported	36	0.16	5.01	0.76	
TP (µg/L)	295	4	1,610	128	
Turbidity (NTU)	170	2.50	140.50	19.50	
Turbidity (FTU)	84	2.84	145	17.50	
Turbidity (JCU)	3	10.75	11	10.75 (zz)	
Chlorophyll *a* (µg/L) - F	6	1.1	1.4	1.1	
Chlorophyll *a* (µg/L) - S	36	0.2	35.7	2.1	
Chlorophyll *a* (µg/L) - T	15	1.3	40.5	6.4	
Periphyton Chl *a* (mg/m^2)	—	—	—	—	

* 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.
† 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 µg/L, summer 15 µg/L, fall 12 µg/L, and winter 5 µg/L, the median value of all seasons' P25 will be 11µg/L.
‡ As determined by the Regional Technical Assistance Groups (RTAGs).

Abbreviations: P25, 25th percentile of all data; P75, 75th percentile of all data; 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; —, not applicable.

Definitions: (1) Number of Streams refers to the largest number of streams and rivers for which data existed for a given season within an aggregate nutrient ecoregion. (2) 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. (3) 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 fewer than 3 seasons were used to derive the median, the entry is flagged (z). (4) 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 fewer than 4 streams/season in order to retain all information for all seasons. In calculating the 25th percentile for a season with fewer than 4 stream medians, the statistical program automatically used the minimum value within the fewer-than-4 population. If fewer than 4 streams were used in developing a seasonal quartile and or all-seasons median, the entry is flagged (zz).

Note: For seasonal values, refer to Appendix A, "Descriptive Statistics Data Tables for Aggregate Ecoregion."

Table 3a. Reference conditions for Ecoregion X streams subecoregion 34

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)	64	0.26	2.05	0.74	
NO_2+NO_3-N (mg/L)	51	0.01	6.77	0.14	
TN (mg/L) - calculated				0.88	
TN (mg/L) - reported	9	0.50	5.01	0.86	
TP (µg/L)	67	16	1,455	126	
Turbidity (NTU)	16	10.25	91.88	37.75	
Turbidity (FTU)	16	4.49	99.25	12.27	
Turbidity (JCU)	3 (z)	7.80	10	7.80 (zz)	
Chlorophyll *a* (µg/L) - F	—	—	—	—	
Chlorophyll *a* (µg/L) - S	36	0.2	35.7	2.1	
Chlorophyll *a* (µg/L) - T	—	—	—	—	
Periphyton Chl *a* (mg/m^2)	—	—	—	—	

Table 3b. Reference conditions for Ecoregion X streams subecoregion 73

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)	158	0.06	2.95	0.69	
NO_2+NO_3-N (mg/L)	203	—	2.90	0.13	
TN (mg/L) - calculated				0.82	
TN (mg/L) - reported	27	0.16	2.68	0.71	
TP (µg/L)	228	5	1,325	125	
Turbidity (NTU)	154	2.50	140.50	18.69	
Turbidity (FTU)	68	3	145	19	
Turbidity (JCU)	1 (z)	12	12	12	
Chlorophyll *a* (µg/L) - F	6	1.1	1.4	1.1	
Chlorophyll *a* (µg/L) - S	—	—	—	—	
Chlorophyll *a* (µg/L) - T	15	1.3	40.5	6.4	
Periphyton Chl *a* (mg/m^2)	—	—	—	—	

* 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.
† 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 µg/L, summer 15 µg/L, fall 12 µg/L, and winter 5 µg/L, the median value of all seasons' P25 will be 11µg/L.
‡ As determined by the Regional Technical Assistance Groups (RTAGs).

Abbreviations: P25, 25th percentile of all data; P75, 75th percentile of all data; 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; —, not applicable.

Definitions: (1) Number of Streams 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). (2) 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. (3) 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 fewer than 3 seasons were used to derive the median, the entry is flagged (z). (4). 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 fewer than 4 streams/season in order to retain all information for all seasons. In calculating the 25th percentile for a season with fewer than 4 stream medians, the statistical program automatically used the minimum value within the fewer-than-4 population. If fewer than 4 streams were used in developing a seasonal quartile and or all-seasons median, the entry is flagged (zz).

Note: For seasonal and yearly values, refer to Appendix B, "Descriptive Statistics Data Tables for Level III Subecoregions Within Aggregate Ecoregion."

Table 4. Suggested boundaries for trophic classification of streams from cumulative frequency distributions. The boundary between oligotrophic and mesotrophic systems represents the lowest third of the distribution and the boundary between mesotrophic and eutrophic marks the top third of the distribution.

Variable (units)	Oligotrophic-mesotrophic boundary	Mesotrophic-eutrophic boundary	Sample size (N)
mean benthic chlorophyll ($mg\ m^{-2}$)[a]	20	70	286
maximum benthic chlorophyll ($mg\ m^{-2}$)[a]	60	200	176
sestonic chlorophyll ($\mu g\ L^{-1}$)[b]	10	30	292
TN ($\mu g\ L^{-1}$)[a,c]	700	1,500	1,070
TP ($\mu g\ L^{-1}$)[a,b,c]	25	75	1,366

Note: This table is provided to allow the reader to make comparisons between the ecoregional criteria provided in this document and traditional nutrient and biological endpoints.

[a]Data from Dodds et al. (1998); [b]data from Van Nieuwenhuyse and Jones (1996); [c]data from Omernik (1977).

Table 5. Nutrient (µg/L) and algal biomass criteria limits recommended to prevent nuisance conditions and water quality degradation in streams based either on nutrient-chlorophyll *a* relationships or preventing risks to stream impairment as indicated.

TN	TP	DIN	SRP	Chlorophyll *a*	Impairment Risk	Source
Periphyton Maximum in mg/m^2						
				100-200	nuisance growth	Welch et al. 1988, 1989
275-650	38-90			100-200	nuisance growth	Dodds et al. 1997
1,500	75			200	eutrophy	Dodds et al. 1998
300	20			150	nuisance growth	Clark Fork River Tri-State Council, MT
	20				*Cladophora* nuisance growth	Chetelat et al. 1999
	10-20				*Cladophora* nuisance growth	Stevenson unpubl. data
		430	60		eutrophy	UK Environ. Agency 1988
		100[a]	10[a]	200	nuisance growth	Biggs 2000
		25	3	100	reduced invertebrate diversity	Nordin 1985
			15	100	nuisance growth	Quinn 1991
		1,000	10[b]	~100	eutrophy	Sosiak pers. comm.
Plankton Mean in µg/L						
TN	**TP**	**DIN**	**SRP**	**Chlorophyll *a***	**Impairment Risk**	**Source**
300[c]	42			8	eutrophy	Van Nieuwenhuyse and Jones 1996
	70			15	chlorophyll action level	OAR 2000
250[c]	35			8	eutrophy	OECD 1992 (for lakes)

[a]30-day biomass accrual time.
[b]Total dissolved P.
[c]Based on Redfield ratio of 7.2N:1P (Smith et al. 1997).

4.6 Classification of River/Stream Type

Assessing the data by stream type should 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 X** for which data existed. For example, if one stream had 300 observations for phosphorus over the decade or 1 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 (Figures 5a, 5b).

Preferred Data Choices and Recommendations When Data Are Missing

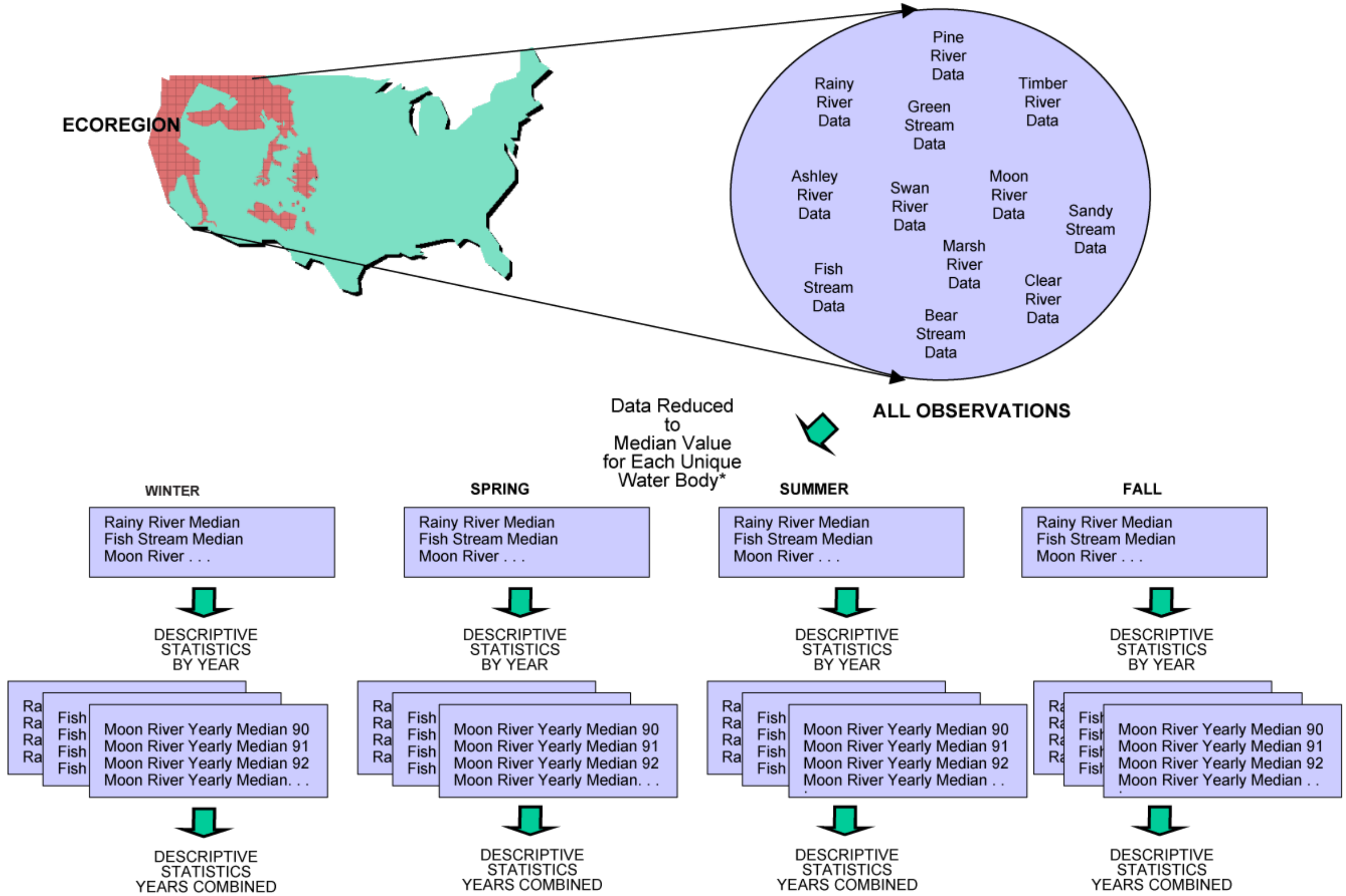
1. **Where data are missing** or are very low in total records for a given parameter, use 25th percentiles for parameters within an adjacent, similar subecoregion within the same aggregate nutrient ecoregion, **or** when a similar subecoregion cannot be determined, use the the 25th percentile for the aggregate ecoregion or consider the **lowest** 25th percentile from a subecoregion (level III) within the aggregate nutrient ecoregion. Without data, one may assume that the subecoregion in question is 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 are added, resulting in a calculated TN value. The number of samples (N) for calculated TN is not filled in because 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 observations are preferred over all other methods. However, when no data exist for fluorometric and spectrophotometric methods, trichromatic values may be used. Data from the various 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, page 101, of the *Rivers and Streams*



**Unique Water Body - is a water body that is unique to a state, a subecoregion, a county, the year, and the season.*

Figure 5a. Illustration of data reduction process for stream data.

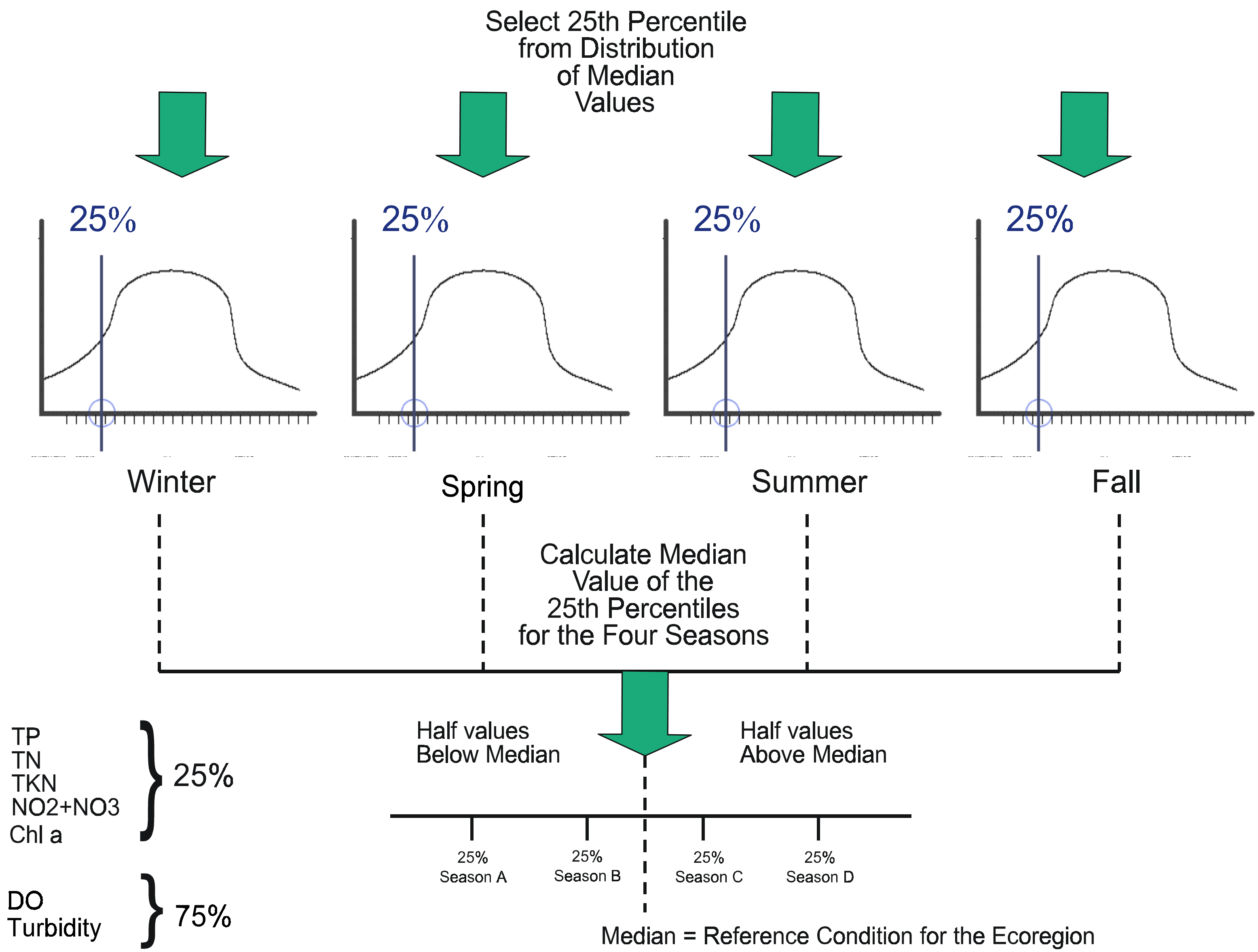


Figure 5b. Illustration of reference condition calculation.

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 because this is the only variable for which the value of the parameter **increases** with greater clarity (for lakes and reservoirs only).

7. **Turbidity units:** 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 because 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. According to EPA statistical analyses, 5% or fewer of the reported observations are "below detection." Because of this low incidence, these data were retained and factored into the statistical analysis as reported according to the protocols described in Appendix C, "Quality Control/Quality Assurance Rules."

5.0 REFERENCE SITES AND CONDITIONS IN AGGREGATE ECOREGION X

Reference conditions represent the natural, least impacted conditions, or what is considered to be the most attainable conditions. This chapter 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-b in Section 4.0.

- RTAG discussion and rationale for selection of reference sites and conditions in Ecoregion X. 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. There 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

Appendix C of the Rivers and Streams Technical Guidance Manual (U.S. EPA, 2000b), and Chapter 9 of the Lakes and Reservoirs Technical Guidance Manual (U.S. EPA, 2000a) should be consulted for further details.

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

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 EPA's 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 worksheet (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-b and other literature and information readily available to the EPA Headquarters 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 Setting Seasonal Criteria

The recommendations presented in this document are based in part on medians of all the 25th percentile seasonal data (decadal), and as such reflect 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 that reflect **each** particular season or **given 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 require increased monitoring within each season to assess compliance. If a case can be made that one season is more appropriate than another season, or more appropriate than the annual median, criteria should be season specific. For example, in most parts of the country, spring and summer are the most common growth periods, so criteria for chlorophyll *a* and Secchi may be set for spring and summer only. However, caution should be used when developing criteria for TN and TP because the peak loading of these nutrients may take place in seasons other than summer, such as winter and spring. For these reasons, EPA developed annual criteria and provided additional seasonal information in appendices.

7.3 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 conditions developed for the Cascades); (2) use the 25th percentiles 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.

7.4 Site-Specific Criteria Development

Criteria may be refined in a number of ways. The best way 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). See paper by Dale Robertson (USGS, 2001b), an alternative approach to ecoregions entitled "An Alternative Regarding the Scheme for Defining Nutrient Criteria for Rivers and Streams."
- 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

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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: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1999 to 2000
Chloro_A_Fluor_cor_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	4	1.25	1.1000	1.40	0.17	0.09	14	1.10	1.10	1.25	1.40	1.40
SPRING	3	5.85	3.1000	7.57	2.41	1.39	41	3.10	3.10	6.88	7.57	7.57
SUMMER	6	0.93	.70000	1.10	0.19	0.08	20	0.70	0.70	1.00	1.10	1.10

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1999 to 2000
Chloro_A_Pheo_cor_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	2	0.90	.60000	1.20	0.42	0.30	47	0.60	0.60	0.90	1.20	1.20
SPRING	3	2.85	2.0200	3.85	0.93	0.53	32	2.02	2.02	2.69	3.85	3.85
SUMMER	3	1.10	.90000	1.40	0.26	0.15	24	0.90	0.90	1.00	1.40	1.40

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1995
Chloro_A_Phyto_Chro_flu_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	2	2.70	2.2000	3.20	0.71	0.50	26	2.20	2.20	2.70	3.20	3.20
SPRING	2	1.64	1.4500	1.83	0.27	0.19	16	1.45	1.45	1.64	1.83	1.83
SUMMER	2	2.44	1.7250	3.15	1.01	0.71	41	1.73	1.73	2.44	3.15	3.15
WINTER	2	1.28	1.0625	1.50	0.31	0.22	24	1.06	1.06	1.28	1.50	1.50

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X

Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1996
Chloro_A_Phyto_Spec_A_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	31	5.63	.25000	17.45	4.65	0.84	83	0.25	2.20	4.60	8.41	15.65
SPRING	33	8.64	.25000	66.90	13.01	2.27	151	0.25	2.00	4.79	8.60	35.85
SUMMER	36	10.06	.25000	33.00	9.01	1.50	90	1.90	3.46	7.41	14.78	32.00
WINTER	30	5.13	.25000	38.40	9.14	1.67	178	0.25	0.25	1.49	2.80	26.70

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1993
Chloro_A_Trich_unco_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	10	26.05	4.9500	68.90	24.65	7.80	95	4.95	8.00	13.48	55.40	68.90
SPRING	13	11.02	1.3000	27.50	8.56	2.38	78	1.30	4.71	7.05	15.90	27.50
SUMMER	15	17.18	1.3000	46.70	12.75	3.29	74	1.30	8.70	14.27	26.10	46.70
WINTER	11	12.82	1.1000	34.23	12.97	3.91	101	1.10	1.85	6.73	25.93	34.23

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1995
Chloro_B_Phyto_Chro_flu_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	2	0.15	.10000	0.20	0.07	0.05	47	0.10	0.10	0.15	0.20	0.20
SPRING	2	0.07	.05000	0.09	0.03	0.02	39	0.05	0.05	0.07	0.09	0.09
SUMMER	2	0.14	.10000	0.18	0.05	0.04	39	0.10	0.10	0.14	0.18	0.18
WINTER	2	0.06	.05000	0.08	0.02	0.01	28	0.05	0.05	0.06	0.08	0.08

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1999
DIP_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	30	119.70	5.0000	1350.00	240.11	43.84	201	12.50	40.00	65.00	95.00	290.00
SPRING	28	78.62	10.000	420.00	90.74	17.15	115	18.75	36.25	47.50	73.75	317.50
SUMMER	32	108.91	7.5000	1000.00	171.69	30.35	158	12.50	47.50	78.75	98.75	250.00
WINTER	28	93.26	12.500	650.00	139.20	26.31	149	16.25	42.50	52.50	72.50	485.00

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 2000
Dissolved_Oxygen_mg_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	248	6.43	1.1000	14.10	2.04	0.13	32	3.05	5.25	6.60	7.70	9.50
SPRING	265	6.93	1.3000	13.28	1.84	0.11	27	3.60	5.85	7.00	8.30	9.70
SUMMER	267	5.52	1.0000	12.80	1.91	0.12	35	2.30	4.20	5.78	6.80	8.10
WINTER	256	8.57	2.5000	12.80	1.96	0.12	23	4.70	7.45	8.60	9.98	11.45

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 2000
Nitrite_Nitrate_NO2_NO3_mg_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	234	0.37	.00000	7.44	0.83	0.05	227	0.01	0.05	0.12	0.29	1.27
SPRING	243	0.54	.00000	6.83	0.84	0.05	154	0.04	0.16	0.26	0.57	1.88
SUMMER	253	0.49	.00000	5.90	0.74	0.05	152	0.02	0.13	0.24	0.47	1.87
WINTER	241	0.53	.00250	6.72	0.89	0.06	167	0.05	0.15	0.25	0.50	1.90

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1998
Nitrogen_Tot_Kjeldhal_mg_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	216	0.85	.01000	3.24	0.41	0.03	48	0.37	0.60	0.76	1.06	1.60
SPRING	215	1.05	.30000	4.40	0.51	0.03	48	0.47	0.71	0.93	1.27	1.78
SUMMER	220	0.98	.05000	2.65	0.40	0.03	41	0.43	0.72	0.95	1.24	1.69
WINTER	215	0.95	.01000	2.48	0.39	0.03	41	0.44	0.70	0.90	1.15	1.64

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1999 to 2000
Organic_P_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	4	30.51	11.920	49.09	21.46	10.73	70	11.92	11.92	30.51	49.09	49.09
SPRING	3	197.51	38.300	383.16	173.94	100.43	88	38.30	38.30	171.08	383.16	383.16
SUMMER	6	45.32	25.480	61.37	16.32	6.66	36	25.48	25.48	49.12	61.37	61.37

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1995
Phosph_Ortho_Tot_as_P_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	29	105.83	5.0000	590.00	116.63	21.66	110	10.00	54.00	80.00	105.00	390.00
SPRING	29	106.55	10.000	457.50	81.86	15.20	77	16.25	65.00	95.00	125.00	182.50
SUMMER	29	149.48	15.000	1475.00	263.11	48.86	176	30.00	80.00	90.00	130.00	372.50
WINTER	29	147.86	27.500	1115.00	210.91	39.17	143	30.00	70.00	100.00	115.00	585.00

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 2000
Total_Nitrogen_mg_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	33	1.02	.03000	4.80	0.89	0.15	87	0.03	0.60	0.76	1.20	2.10
SPRING	32	1.46	.10000	5.23	0.97	0.17	66	0.50	0.87	1.19	1.86	2.95
SUMMER	36	1.28	.21000	4.20	0.99	0.17	77	0.21	0.66	0.95	1.75	3.83
WINTER	29	1.58	.53000	6.60	1.33	0.25	84	0.58	0.90	1.20	1.83	5.35

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 2000
Total_Phosphorus_ug_L

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	264	207.75	5.0000	1650.00	208.76	12.85	100	50.00	110.00	155.00	220.00	647.50
SPRING	281	273.99	2.5000	2100.00	239.34	14.28	87	50.00	135.00	210.00	340.00	650.00
SUMMER	295	233.58	2.5000	1400.00	217.01	12.63	93	50.00	120.00	185.00	242.50	630.00
WINTER	267	260.47	5.0000	1570.00	216.57	13.25	83	65.00	135.00	200.00	310.00	690.00

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 1997
Turbidity_FTU

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	58	27.93	3.9000	83.75	19.42	2.55	70	4.10	13.00	25.00	38.00	68.00
SPRING	80	54.04	2.7750	150.00	36.39	4.07	67	7.10	21.00	52.50	70.75	120.00
SUMMER	69	36.75	2.7000	140.00	30.57	3.68	83	6.20	15.00	28.50	51.75	120.00
WINTER	84	59.72	2.9000	190.00	41.57	4.54	70	4.30	20.00	57.50	88.38	132.00

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1993 to 1997
Turbidity_JCU

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	1	18.00	18.000	18.00	.	.	.	18.00	18.00	18.00	18.00	18.00
SPRING	1	12.00	12.000	12.00	.	.	.	12.00	12.00	12.00	12.00	12.00
SUMMER	1	9.50	9.5000	9.50	.	.	.	9.50	9.50	9.50	9.50	9.50
WINTER	3	9.27	7.8000	10.00	1.27	0.73	14	7.80	7.80	10.00	10.00	10.00

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1990 to 2000
Turbidity_NTU

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	161	22.09	.00000	83.75	14.76	1.16	67	4.20	10.90	20.00	30.00	49.00
SPRING	165	57.40	2.8000	435.00	52.98	4.12	92	12.75	23.00	38.00	75.00	145.00
SUMMER	170	32.90	3.2500	111.00	21.47	1.65	65	7.00	16.00	28.00	44.50	78.00
WINTER	162	54.01	2.2000	170.00	36.60	2.88	68	11.60	24.50	47.00	75.00	127.50

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Decade and Season
from 1999 to 2000
pH_S_U

season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
FALL	4	8.50	7.8400	9.15	0.76	0.38	9	7.84	7.84	8.50	9.15	9.15
SPRING	3	8.32	7.7100	9.06	0.69	0.40	8	7.71	7.71	8.18	9.06	9.06
SUMMER	6	8.13	7.8900	8.43	0.20	0.08	2	7.89	8.02	8.07	8.32	8.43

Data were not always available for all years.

APPENDIX B

Descriptive Statistics Data Tables for Level III Subecoregions Within Aggregate Ecoregion

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1999 to 2000
Chloro_A_Fluor_cor_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	4	1.25	1.1000	1.40	0.17	0.09	14	1.10	1.10	1.25	1.40	1.40
73	SPRING	3	5.85	3.1000	7.57	2.41	1.39	41	3.10	3.10	6.88	7.57	7.57
73	SUMMER	6	0.93	.70000	1.10	0.19	0.08	20	0.70	0.70	1.00	1.10	1.10

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1999 to 2000
Chloro_A_Pheo_cor_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	2	0.90	.60000	1.20	0.42	0.30	47	0.60	0.60	0.90	1.20	1.20
73	SPRING	3	2.85	2.0200	3.85	0.93	0.53	32	2.02	2.02	2.69	3.85	3.85
73	SUMMER	3	1.10	.90000	1.40	0.26	0.15	24	0.90	0.90	1.00	1.40	1.40

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1995
Chloro_A_Phyto_Chro_flu_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	2	2.70	2.2000	3.20	0.71	0.50	26	2.20	2.20	2.70	3.20	3.20
73	SPRING	2	1.64	1.4500	1.83	0.27	0.19	16	1.45	1.45	1.64	1.83	1.83
73	SUMMER	2	2.44	1.7250	3.15	1.01	0.71	41	1.73	1.73	2.44	3.15	3.15
73	WINTER	2	1.28	1.0625	1.50	0.31	0.22	24	1.06	1.06	1.28	1.50	1.50

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1996
Chloro_A_Phyto_Spec_A_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	31	5.63	.25000	17.45	4.65	0.84	83	0.25	2.20	4.60	8.41	15.7
34	SPRING	33	8.64	.25000	66.90	13.0	2.27	151	0.25	2.00	4.79	8.60	35.9
34	SUMMER	36	10.06	.25000	33.00	9.01	1.50	90	1.90	3.46	7.41	14.8	32.0
34	WINTER	30	5.13	.25000	38.40	9.14	1.67	178	0.25	0.25	1.49	2.80	26.7

Data were not always available for all years.

Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1993
Chloro_A_Trich_unco_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	10	26.05	4.9500	68.90	24.7	7.80	95	4.95	8.00	13.5	55.4	68.9
73	SPRING	13	11.02	1.3000	27.50	8.56	2.38	78	1.30	4.71	7.05	15.9	27.5
73	SUMMER	15	17.18	1.3000	46.70	12.7	3.29	74	1.30	8.70	14.3	26.1	46.7
73	WINTER	11	12.82	1.1000	34.23	13.0	3.91	101	1.10	1.85	6.73	25.9	34.2

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1995
Chloro_B_Phyto_Chro_flu_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	2	0.15	.10000	0.20	0.07	0.05	47	0.10	0.10	0.15	0.20	0.20
73	SPRING	2	0.07	.05000	0.09	0.03	0.02	39	0.05	0.05	0.07	0.09	0.09
73	SUMMER	2	0.14	.10000	0.18	0.05	0.04	39	0.10	0.10	0.14	0.18	0.18
73	WINTER	2	0.06	.05000	0.08	0.02	0.01	28	0.05	0.05	0.06	0.08	0.08

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1999
DIP_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	9	236.67	5.0000	1350.00	427	142	180	5.00	40.0	90.0	175	1350
34	SPRING	9	143.75	18.750	420.00	140	46.6	97	18.8	50.0	105	168	420
34	SUMMER	9	181.25	12.500	1000.00	316	105	174	12.5	26.3	67.5	125	1000
34	WINTER	9	180.83	12.500	650.00	227	75.7	126	12.5	45.0	85.0	160	650
73	FALL	21	69.58	12.500	175.07	42.8	9.34	62	25.0	40.0	60.0	80.0	153
73	SPRING	19	47.76	10.000	115.00	23.4	5.37	49	10.0	35.0	45.0	57.5	115
73	SUMMER	23	80.61	7.5000	247.02	47.9	9.98	59	15.0	52.5	80.0	95.0	130
73	WINTER	19	51.78	16.250	120.00	21.7	4.97	42	16.3	40.0	50.0	57.5	120

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 2000
Dissolved_Oxygen_mg_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	56	6.39	1.9000	10.60	1.96	0.26	31	2.85	4.78	6.83	7.83	9.13
34	SPRING	61	6.83	1.3000	11.70	1.85	0.24	27	3.90	5.85	7.10	7.95	9.70
34	SUMMER	60	5.89	1.7750	11.60	1.88	0.24	32	2.74	4.75	6.00	7.14	8.33
34	WINTER	60	8.25	2.7000	12.80	1.74	0.23	21	5.46	7.20	8.40	9.40	10.9
73	FALL	192	6.45	1.1000	14.10	2.07	0.15	32	3.05	5.29	6.60	7.63	9.50
73	SPRING	204	6.96	1.4500	13.28	1.84	0.13	26	3.60	5.86	7.00	8.30	9.65
73	SUMMER	207	5.42	1.0000	12.80	1.91	0.13	35	2.15	4.20	5.70	6.70	8.05
73	WINTER	196	8.67	2.5000	12.60	2.02	0.14	23	4.55	7.53	8.80	10.2	11.6

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 2000
Nitrite_Nitrate_NO2_NO3_mg_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	47	0.84	.01000	7.44	1.63	0.24	194	0.02	0.06	0.20	0.57	4.86
34	SPRING	51	1.10	.01500	6.83	1.48	0.21	135	0.05	0.22	0.40	1.32	4.60
34	SUMMER	50	0.87	.00250	5.90	1.31	0.19	150	0.01	0.14	0.37	0.71	4.00
34	WINTER	51	1.02	.03000	6.72	1.62	0.23	158	0.06	0.15	0.28	0.75	4.70
73	FALL	187	0.25	.00000	3.11	0.38	0.03	152	0.01	0.05	0.11	0.26	1.10
73	SPRING	192	0.40	.00000	2.69	0.46	0.03	115	0.04	0.15	0.24	0.42	1.54
73	SUMMER	203	0.39	.00000	2.25	0.47	0.03	119	0.02	0.11	0.24	0.41	1.64
73	WINTER	190	0.40	.00250	3.73	0.48	0.04	120	0.04	0.15	0.24	0.45	1.55

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1998
Nitrogen_Tot_Kjeldhal_mg_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	58	0.81	.22500	1.80	0.27	0.04	34	0.37	0.65	0.79	1.00	1.21
34	SPRING	63	1.15	.30000	2.71	0.50	0.06	43	0.47	0.80	1.10	1.45	1.83
34	SUMMER	64	0.95	.05000	1.90	0.38	0.05	40	0.30	0.68	0.97	1.17	1.56
34	WINTER	58	1.00	.34500	2.20	0.33	0.04	33	0.53	0.80	0.98	1.15	1.56
73	FALL	158	0.87	.01000	3.24	0.45	0.04	52	0.31	0.60	0.76	1.10	1.64
73	SPRING	152	1.00	.30000	4.40	0.51	0.04	50	0.51	0.70	0.86	1.20	1.78
73	SUMMER	156	1.00	.10000	2.65	0.41	0.03	41	0.48	0.73	0.93	1.25	1.83
73	WINTER	157	0.94	.01000	2.48	0.41	0.03	43	0.38	0.67	0.85	1.13	1.67

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1999 to 2000
Organic_P_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	4	30.51	11.920	49.09	21.5	10.7	70	11.9	11.9	30.5	49.1	49.1
73	SPRING	3	197.51	38.300	383.16	174	100	88	38.3	38.3	171	383	383
73	SUMMER	6	45.32	25.480	61.37	16.3	6.66	36	25.5	25.5	49.1	61.4	61.4

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 1995
Phosph_Ortho_Tot_as_P_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	9	173.89	10.000	590.00	192	63.9	110	10.0	50.0	110	160	590
34	SPRING	9	134.17	10.000	457.50	134	44.8	100	10.0	56.3	113	150	458
34	SUMMER	9	266.11	30.000	1475.00	465	155	175	30.0	42.5	87.5	140	1475
34	WINTER	9	270.33	30.000	1115.00	358	119	132	30.0	80.0	110	200	1115
73	FALL	20	75.20	5.0000	170.00	37.5	8.38	50	22.5	54.5	70.0	90.0	160
73	SPRING	20	94.13	32.500	175.00	41.8	9.35	44	32.5	67.5	87.5	108	169
73	SUMMER	20	97.00	15.000	180.00	39.9	8.91	41	27.5	80.0	90.0	128	163
73	WINTER	20	92.75	27.500	190.00	37.1	8.29	40	33.8	70.0	91.3	110	165

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 2000
Total_Nitrogen_mg_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	9	1.16	.35000	4.80	1.38	0.46	119	0.35	0.60	0.74	0.88	4.80
34	SPRING	9	1.80	.62500	5.23	1.40	0.47	78	0.63	1.18	1.35	2.05	5.23
34	SUMMER	9	1.55	.37000	4.20	1.42	0.47	92	0.37	0.79	1.00	1.16	4.20
34	WINTER	9	2.22	.67000	6.60	2.18	0.73	98	0.67	0.92	1.20	1.90	6.60
73	FALL	24	0.97	.03000	2.10	0.65	0.13	67	0.03	0.58	0.76	1.50	2.05
73	SPRING	23	1.33	.10000	2.95	0.74	0.15	56	0.50	0.84	1.10	1.68	2.70
73	SUMMER	27	1.19	.21000	2.90	0.82	0.16	69	0.21	0.46	0.95	1.80	2.70
73	WINTER	20	1.30	.53000	2.45	0.58	0.13	45	0.56	0.87	1.12	1.66	2.35

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 2000
Total_Phosphorus_ug_L

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	59	277.42	30.000	1065.00	257	33.5	93	40.0	105	195	320	975
34	SPRING	64	369.18	2.5000	1510.00	326	40.7	88	60.0	148	269	498	1030
34	SUMMER	67	340.58	2.5000	1400.00	368	44.9	108	50.0	105	200	420	1258
34	WINTER	60	350.96	30.000	1570.00	342	44.1	97	50.0	148	215	419	1223
73	FALL	205	187.69	5.0000	1650.00	189	13.2	100	50.0	110	150	200	420
73	SPRING	217	245.91	5.0000	2100.00	200	13.5	81	50.0	130	205	320	565
73	SUMMER	228	202.13	10.000	1000.00	132	8.72	65	50.0	120	180	230	430
73	WINTER	207	234.24	5.0000	970.00	155	10.8	66	70.0	130	195	300	540

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X

Rivers and Streams

Descriptive Statistics by Subecoregion, Decade and Season

from 1990 to 1997

Turbidity_FTU

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	12	20.84	6.2000	83.75	23.3	6.72	112	6.20	6.48	11.3	23.0	83.8
34	SPRING	16	48.32	2.7750	110.00	38.5	9.63	80	2.78	14.0	39.7	89.9	110
34	SUMMER	16	23.62	2.7000	88.50	21.1	5.28	89	2.70	10.5	19.0	28.3	88.5
34	WINTER	16	49.48	10.000	110.00	28.9	7.22	58	10.0	26.0	40.5	75.5	110
73	FALL	46	29.78	3.9000	77.50	18.1	2.67	61	4.10	15.7	27.8	40.0	62.5
73	SPRING	64	55.48	2.9000	150.00	36.0	4.50	65	9.60	22.8	55.0	70.0	120
73	SUMMER	53	40.72	3.1000	140.00	32.0	4.40	79	7.20	20.5	32.0	55.0	120
73	WINTER	68	62.13	2.9000	190.00	43.9	5.32	71	3.50	17.5	61.3	91.3	140

Data were not always available for all years.

Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1993 to 1997
Turbidity_JCU

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	WINTER	3	9.27	7.8000	10.00	1.27	0.73	14	7.80	7.80	10.0	10.0	10.0
73	FALL	1	18.00	18.000	18.00	.	.	.	18.0	18.0	18.0	18.0	18.0
73	SPRING	1	12.00	12.000	12.00	.	.	.	12.0	12.0	12.0	12.0	12.0
73	SUMMER	1	9.50	9.5000	9.50	.	.	.	9.50	9.50	9.50	9.50	9.50

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1990 to 2000
Turbidity_NTU

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	FALL	13	25.23	6.2500	49.75	13.5	3.74	53	6.25	18.5	26.0	31.0	49.8
34	SPRING	13	89.04	14.000	150.00	43.7	12.1	49	14.0	57.0	97.8	115	150
34	SUMMER	16	34.69	6.5000	78.75	20.5	5.11	59	6.50	16.8	31.9	51.5	78.8
34	WINTER	13	65.42	15.500	105.00	29.1	8.07	44	15.5	57.5	70.0	78.0	105
73	FALL	148	21.82	.00000	83.75	14.9	1.22	68	4.20	10.7	19.8	30.0	49.0
73	SPRING	152	54.69	2.8000	435.00	52.9	4.29	97	12.6	21.4	36.1	66.0	145
73	SUMMER	154	32.72	3.2500	111.00	21.6	1.74	66	7.00	16.0	27.9	44.0	78.0
73	WINTER	149	53.01	2.2000	170.00	37.1	3.04	70	10.9	24.0	42.7	71.3	129

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Decade and Season
from 1999 to 2000
pH_S_U

subecoregion	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	FALL	4	8.50	7.8400	9.15	0.76	0.38	9	7.84	7.84	8.50	9.15	9.15
73	SPRING	3	8.32	7.7100	9.06	0.69	0.40	8	7.71	7.71	8.18	9.06	9.06
73	SUMMER	6	8.13	7.8900	8.43	0.20	0.08	2	7.89	8.02	8.07	8.32	8.43

Data were not always available for all years.

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1999 to 2000
Chloro_A_Fluor_cor_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1999	FALL	4	1.25	1.1000	1.40	0.17	0.09	14	1.10	1.10	1.25	1.40	1.40
73	1999	SUMMER	6	0.93	.70000	1.10	0.19	0.08	20	0.70	0.70	1.00	1.10	1.10
73	2000	SPRING	3	5.85	3.1000	7.57	2.41	1.39	41	3.10	3.10	6.88	7.57	7.57

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1999 to 2000
Chloro_A_Pheo_cor_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1999	FALL	2	0.90	.60000	1.20	0.42	0.30	47	0.60	0.60	0.90	1.20	1.20
73	1999	SUMMER	3	1.10	.90000	1.40	0.26	0.15	24	0.90	0.90	1.00	1.40	1.40
73	2000	SPRING	3	2.85	2.0200	3.85	0.93	0.53	32	2.02	2.02	2.69	3.85	3.85

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1995
Chloro_A_Phyto_Chro_flu_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1990	FALL	2	2.25	2.2000	2.30	0.07	0.05	3	2.20	2.20	2.25	2.30	2.30
73	1990	SPRING	2	1.60	1.5000	1.70	0.14	0.10	9	1.50	1.50	1.60	1.70	1.70
73	1990	SUMMER	2	1.05	1.0000	1.10	0.07	0.05	7	1.00	1.00	1.05	1.10	1.10
73	1990	WINTER	2	1.65	1.5000	1.80	0.21	0.15	13	1.50	1.50	1.65	1.80	1.80
73	1991	FALL	2	4.75	4.3000	5.20	0.64	0.45	13	4.30	4.30	4.75	5.20	5.20
73	1991	SPRING	2	1.05	.90000	1.20	0.21	0.15	20	0.90	0.90	1.05	1.20	1.20
73	1991	SUMMER	2	4.15	2.4000	5.90	2.47	1.75	60	2.40	2.40	4.15	5.90	5.90
73	1991	WINTER	2	0.65	.60000	0.70	0.07	0.05	11	0.60	0.60	0.65	0.70	0.70
73	1992	FALL	2	3.23	3.2000	3.25	0.04	0.02	1	3.20	3.20	3.23	3.25	3.25
73	1992	SPRING	2	3.88	2.3500	5.40	2.16	1.53	56	2.35	2.35	3.88	5.40	5.40
73	1992	SUMMER	2	2.53	1.6500	3.40	1.24	0.88	49	1.65	1.65	2.53	3.40	3.40
73	1992	WINTER	2	1.36	1.2250	1.50	0.19	0.14	14	1.23	1.23	1.36	1.50	1.50
73	1993	FALL	2	2.40	2.2000	2.60	0.28	0.20	12	2.20	2.20	2.40	2.60	2.60
73	1993	SPRING	2	1.88	1.8000	1.95	0.11	0.08	6	1.80	1.80	1.88	1.95	1.95
73	1993	SUMMER	2	2.20	1.2000	3.20	1.41	1.00	64	1.20	1.20	2.20	3.20	3.20
73	1993	WINTER	2	2.08	1.8000	2.35	0.39	0.28	19	1.80	1.80	2.08	2.35	2.35
73	1994	FALL	2	2.85	.70000	5.00	3.04	2.15	107	0.70	0.70	2.85	5.00	5.00
73	1994	SPRING	2	1.10	.80000	1.40	0.42	0.30	39	0.80	0.80	1.10	1.40	1.40
73	1994	SUMMER	2	2.05	1.8500	2.25	0.28	0.20	14	1.85	1.85	2.05	2.25	2.25
73	1994	WINTER	2	0.63	.55000	0.70	0.11	0.08	17	0.55	0.55	0.63	0.70	0.70
73	1995	SPRING	2	1.85	1.2000	2.50	0.92	0.65	50	1.20	1.20	1.85	2.50	2.50
73	1995	SUMMER	2	2.45	1.8000	3.10	0.92	0.65	38	1.80	1.80	2.45	3.10	3.10
73	1995	WINTER	1	0.90	.90000	0.90	.	.	.	0.90	0.90	0.90	0.90	0.90

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1996
Chloro_A_Phyto_Spec_A_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	16	5.03	.25000	14.40	4.86	1.22	97	0.25	1.50	3.05	7.55	14.40
34	1990	SPRING	18	13.50	.25000	66.90	17.29	4.08	128	0.25	2.00	4.80	23.10	66.90
34	1990	SUMMER	21	9.87	.25000	32.00	9.95	2.17	101	0.25	3.20	4.00	16.00	29.10
34	1990	WINTER	15	8.88	.25000	25.60	8.20	2.12	92	0.25	2.90	5.10	12.20	25.60
34	1991	FALL	24	5.33	.25000	22.70	5.74	1.17	108	0.25	1.81	4.00	7.40	21.10
34	1991	SPRING	20	9.54	.25000	66.90	16.35	3.66	171	0.25	1.23	3.90	6.65	51.38
34	1991	SUMMER	23	12.72	.25000	40.80	11.64	2.43	92	0.25	2.00	12.60	22.50	33.00
34	1991	WINTER	21	4.45	.25000	19.40	5.69	1.24	128	0.25	1.20	2.40	5.55	19.10
34	1992	FALL	17	17.86	.25000	91.10	22.44	5.44	126	0.25	4.90	9.40	25.45	91.10
34	1992	SPRING	26	11.46	.25000	50.50	13.45	2.64	117	0.25	0.25	7.45	17.00	48.30
34	1992	SUMMER	26	13.97	.25000	61.70	17.06	3.35	122	0.25	3.00	6.46	20.90	60.40
34	1992	WINTER	22	3.61	.25000	26.70	5.66	1.21	157	0.25	0.25	2.51	4.40	8.55
34	1993	FALL	24	8.39	.25000	61.00	13.34	2.72	159	0.25	0.25	4.30	8.79	29.60
34	1993	SPRING	16	14.16	.25000	108.00	26.16	6.54	185	0.25	2.00	7.62	11.64	108.00
34	1993	SUMMER	22	16.26	.25000	54.20	14.77	3.15	91	0.25	4.50	9.73	23.45	40.80
34	1993	WINTER	23	8.47	.25000	52.90	13.02	2.71	154	0.25	0.25	2.80	11.30	38.40
34	1994	FALL	17	3.54	.25000	19.80	5.21	1.26	147	0.25	0.25	0.25	4.81	19.80
34	1994	SPRING	25	9.69	.25000	60.90	14.20	2.84	147	0.25	0.25	3.78	14.50	28.50
34	1994	SUMMER	16	8.08	.25000	33.10	9.63	2.41	119	0.25	1.09	2.66	15.35	33.10
34	1994	WINTER	19	3.48	.25000	19.10	5.06	1.16	145	0.25	0.25	1.34	4.15	19.10
34	1995	FALL	20	6.85	.25000	32.10	7.83	1.75	114	0.25	0.25	5.31	10.23	23.75
34	1995	SPRING	21	6.87	.25000	58.90	14.23	3.11	207	0.25	0.25	1.60	4.33	33.86
34	1995	SUMMER	21	2.70	.25000	15.90	4.53	0.99	168	0.25	0.25	0.25	2.27	12.30
34	1995	WINTER	19	3.80	.25000	40.00	9.28	2.13	244	0.25	0.25	0.25	2.22	40.00
34	1996	FALL	2	10.40	8.0000	12.80	3.39	2.40	33	8.00	8.00	10.40	12.80	12.80
34	1996	SPRING	20	10.06	.25000	35.20	9.82	2.20	98	0.25	2.85	6.95	15.35	30.75
34	1996	SUMMER	19	16.34	.25000	73.00	21.24	4.87	130	0.25	4.01	6.86	22.00	73.00
34	1996	WINTER	16	14.38	.25000	69.90	22.42	5.61	156	0.25	0.25	1.02	27.85	69.90

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1993
Chloro_A_Trich_unco_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1990	FALL	10	33.13	4.9500	96.15	36.29	11.48	110	4.95	8.00	13.48	68.90	96.15
73	1990	SPRING	13	8.33	1.3000	20.70	5.50	1.53	66	1.30	4.71	6.72	12.45	20.70
73	1990	SUMMER	15	15.30	1.3000	52.85	12.32	3.18	81	1.30	8.70	13.40	17.70	52.85
73	1990	WINTER	10	9.19	1.0000	22.85	8.49	2.69	92	1.00	1.75	6.20	18.95	22.85
73	1991	FALL	4	24.89	10.350	34.60	10.31	5.16	41	10.35	18.38	27.30	31.40	34.60
73	1991	WINTER	11	15.43	1.1000	58.50	19.60	5.91	127	1.10	1.80	3.20	29.40	58.50
73	1992	FALL	4	52.28	26.400	69.10	18.23	9.12	35	26.40	40.90	56.80	63.65	69.10
73	1992	SPRING	4	22.98	15.900	28.80	6.60	3.30	29	15.90	17.35	23.60	28.60	28.80
73	1992	SUMMER	4	40.25	34.400	46.70	6.35	3.18	16	34.40	34.80	39.95	45.70	46.70
73	1992	WINTER	4	26.89	11.600	45.60	14.72	7.36	55	11.60	15.65	25.18	38.13	45.60
73	1993	SPRING	4	23.10	19.200	27.50	3.75	1.88	16	19.20	20.05	22.85	26.15	27.50
73	1993	SUMMER	4	33.10	21.700	42.50	8.62	4.31	26	21.70	27.35	34.10	38.85	42.50
73	1993	WINTER	4	25.68	14.050	48.50	15.85	7.93	62	14.05	14.98	20.08	36.38	48.50

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
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Chloro_B_Phyto_Chro_flu_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1990	FALL	2	0.13	.05000	0.20	0.11	0.08	85	0.05	0.05	0.13	0.20	0.20
73	1990	SPRING	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1990	SUMMER	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1990	WINTER	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1991	FALL	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1991	SPRING	2	0.08	.05000	0.10	0.04	0.03	47	0.05	0.05	0.08	0.10	0.10
73	1991	SUMMER	2	0.20	.10000	0.30	0.14	0.10	71	0.10	0.10	0.20	0.30	0.30
73	1991	WINTER	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1992	FALL	2	0.23	.20000	0.25	0.04	0.03	16	0.20	0.20	0.23	0.25	0.25
73	1992	SPRING	2	0.14	.07500	0.20	0.09	0.06	64	0.08	0.08	0.14	0.20	0.20
73	1992	SUMMER	2	0.29	.10000	0.48	0.27	0.19	92	0.10	0.10	0.29	0.48	0.48
73	1992	WINTER	2	0.10	.10000	0.10	0.00	0.00	0	0.10	0.10	0.10	0.10	0.10
73	1993	FALL	2	0.15	.10000	0.20	0.07	0.05	47	0.10	0.10	0.15	0.20	0.20
73	1993	SPRING	2	0.10	.10000	0.10	0.00	0.00	0	0.10	0.10	0.10	0.10	0.10
73	1993	SUMMER	2	0.15	.10000	0.20	0.07	0.05	47	0.10	0.10	0.15	0.20	0.20
73	1993	WINTER	2	0.15	.10000	0.20	0.07	0.05	47	0.10	0.10	0.15	0.20	0.20
73	1994	FALL	2	0.35	.05000	0.65	0.42	0.30	121	0.05	0.05	0.35	0.65	0.65
73	1994	SPRING	2	0.08	.05000	0.10	0.04	0.03	47	0.05	0.05	0.08	0.10	0.10
73	1994	SUMMER	2	0.14	.12500	0.15	0.02	0.01	13	0.13	0.13	0.14	0.15	0.15
73	1994	WINTER	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1995	SPRING	2	0.05	.05000	0.05	0.00	0.00	0	0.05	0.05	0.05	0.05	0.05
73	1995	SUMMER	2	0.08	.05000	0.10	0.04	0.03	47	0.05	0.05	0.08	0.10	0.10
73	1995	WINTER	1	0.13	.12500	0.13	.	.	.	0.13	0.13	0.13	0.13	0.13

Aggregate Nutrient Ecoregion: X
Rivers and Streams
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from 1990 to 1999
DIP_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	8	172.19	5.0000	550.00	207.87	73.49	121	5.00	31.25	100.00	280.00	550.00
34	1990	SPRING	8	207.81	17.500	670.00	232.64	82.25	112	17.50	50.00	92.50	345.00	670.00
34	1990	SUMMER	5	153.00	25.000	350.00	137.32	61.41	90	25.00	45.00	110.00	235.00	350.00
34	1990	WINTER	5	266.00	5.0000	705.00	306.38	137.02	115	5.00	70.00	80.00	470.00	705.00
34	1991	FALL	6	140.83	5.0000	400.00	146.44	59.78	104	5.00	40.00	95.00	210.00	400.00
34	1991	SPRING	8	123.75	5.0000	455.00	146.84	51.92	119	5.00	37.50	65.00	162.50	455.00
34	1991	SUMMER	5	141.50	12.500	370.00	144.20	64.49	102	12.50	45.00	90.00	190.00	370.00
34	1991	WINTER	5	238.00	55.000	635.00	244.76	109.46	103	55.00	60.00	130.00	310.00	635.00
34	1992	FALL	7	77.86	5.0000	275.00	97.59	36.89	125	5.00	10.00	40.00	135.00	275.00
34	1992	SPRING	8	111.25	25.000	410.00	127.75	45.17	115	25.00	35.00	65.00	127.50	410.00
34	1992	SUMMER	8	73.44	7.5000	310.00	99.33	35.12	135	7.50	20.00	40.00	75.00	310.00
34	1992	WINTER	8	108.44	12.500	485.00	153.63	54.32	142	12.50	47.50	60.00	77.50	485.00
34	1993	FALL	7	281.07	12.500	1400.00	501.94	189.72	179	12.50	40.00	85.00	290.00	1400.0
34	1993	SPRING	9	113.33	15.000	420.00	130.53	43.51	115	15.00	45.00	60.00	100.00	420.00
34	1993	SUMMER	8	218.75	12.500	1300.00	440.84	155.86	202	12.50	26.25	45.00	147.50	1300.0
34	1993	WINTER	4	163.75	30.000	365.00	143.66	71.83	88	30.00	67.50	130.00	260.00	365.00
34	1994	FALL	5	255.00	5.0000	900.00	371.37	166.08	146	5.00	5.00	175.00	190.00	900.00
34	1994	SPRING	6	125.83	7.5000	210.00	88.38	36.08	70	7.50	27.50	150.00	210.00	210.00
34	1994	SUMMER	6	235.00	27.500	1000.00	378.63	154.57	161	27.50	40.00	96.25	150.00	1000.0
34	1994	WINTER	4	140.00	15.000	290.00	116.26	58.13	83	15.00	55.00	127.50	225.00	290.00
34	1995	FALL	3	512.50	12.500	1350.00	729.83	421.37	142	12.50	12.50	175.00	1350.0	1350.0
34	1995	SPRING	5	261.00	5.0000	935.00	383.62	171.56	147	5.00	40.00	145.00	180.00	935.00
34	1995	SUMMER	5	192.00	25.000	670.00	272.78	121.99	142	25.00	40.00	60.00	165.00	670.00
34	1995	WINTER	3	393.33	20.000	935.00	480.16	277.22	122	20.00	20.00	225.00	935.00	935.00
73	1990	FALL	19	52.89	5.0000	120.00	31.50	7.23	60	5.00	25.00	50.00	65.00	120.00
73	1990	SPRING	16	44.53	12.500	125.00	29.41	7.35	66	12.50	22.50	40.00	52.50	125.00
73	1990	SUMMER	18	64.58	7.5000	110.00	29.56	6.97	46	7.50	40.00	67.50	90.00	110.00
73	1990	WINTER	16	51.88	7.5000	130.00	31.58	7.89	61	7.50	37.50	47.50	60.00	130.00
73	1991	FALL	15	58.17	12.500	95.00	25.57	6.60	44	12.50	40.00	60.00	80.00	95.00
73	1991	SPRING	18	50.31	15.000	155.50	31.88	7.51	63	15.00	30.00	45.00	55.00	155.50
73	1991	SUMMER	18	81.94	7.5000	135.00	42.09	9.92	51	7.50	50.00	97.50	115.00	135.00
73	1991	WINTER	16	59.38	12.500	140.00	38.28	9.57	64	12.50	30.00	55.00	77.50	140.00

Rivers and Streams
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DIP_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1992	FALL	16	63.44	5.0000	185.00	46.19	11.55	73	5.00	35.00	60.00	85.00	185.00
73	1992	SPRING	14	44.29	12.500	95.00	22.63	6.05	51	12.50	27.50	37.50	65.00	95.00
73	1992	SUMMER	19	71.58	7.5000	145.00	36.58	8.39	51	7.50	50.00	60.00	95.00	145.00
73	1992	WINTER	16	50.16	7.5000	120.00	26.87	6.72	54	7.50	32.50	50.00	65.00	120.00
73	1993	FALL	12	73.54	12.500	125.00	32.41	9.36	44	12.50	50.00	75.00	100.00	125.00
73	1993	SPRING	15	58.50	7.5000	115.00	29.79	7.69	51	7.50	40.00	55.00	75.00	115.00
73	1993	SUMMER	18	72.08	12.500	135.00	32.77	7.72	45	12.50	50.00	75.00	90.00	135.00
73	1993	WINTER	18	61.25	7.5000	120.00	27.39	6.46	45	7.50	40.00	57.50	75.00	120.00
73	1994	FALL	4	70.00	50.000	100.00	22.73	11.37	32	50.00	52.50	65.00	87.50	100.00
73	1994	SPRING	12	50.63	7.5000	115.00	29.47	8.51	58	7.50	40.00	45.00	62.50	115.00
73	1994	SUMMER	15	68.33	10.000	165.00	38.62	9.97	57	10.00	35.00	75.00	90.00	165.00
73	1994	WINTER	13	40.38	30.000	70.00	11.81	3.27	29	30.00	30.00	40.00	45.00	70.00
73	1995	FALL	1	70.00	70.000	70.00	.	.	.	70.00	70.00	70.00	70.00	70.00
73	1995	SPRING	6	59.17	20.000	95.00	28.88	11.79	49	20.00	45.00	52.50	90.00	95.00
73	1995	SUMMER	7	49.64	7.5000	70.00	21.43	8.10	43	7.50	35.00	60.00	60.00	70.00
73	1995	WINTER	5	35.00	20.000	45.00	11.73	5.24	34	20.00	25.00	40.00	45.00	45.00
73	1999	FALL	2	158.05	141.03	175.07	24.07	17.02	15	141.03	141.03	158.05	175.07	175.07
73	1999	SUMMER	3	147.16	82.340	247.02	87.75	50.66	60	82.34	82.34	112.13	247.02	247.02

Aggregate Nutrient Ecoregion: X
Rivers and Streams
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Dissolved_Oxygen_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	36	7.21	2.6000	11.50	2.20	0.37	31	2.80	5.98	7.50	8.58	10.80
34	1990	SPRING	38	6.27	1.4000	9.60	1.96	0.32	31	2.30	4.90	6.50	7.85	9.10
34	1990	SUMMER	39	6.28	1.7500	14.20	2.22	0.35	35	2.80	4.90	6.10	7.20	12.00
34	1990	WINTER	35	8.19	2.6000	12.00	1.96	0.33	24	5.00	7.20	8.00	9.60	11.80
34	1991	FALL	33	6.62	2.0000	11.80	2.00	0.35	30	2.40	5.15	6.85	7.80	9.30
34	1991	SPRING	47	6.37	1.3000	12.00	2.29	0.33	36	2.80	4.50	6.60	7.90	9.50
34	1991	SUMMER	46	5.23	1.2500	11.00	2.24	0.33	43	1.85	3.50	5.30	6.40	9.70
34	1991	WINTER	34	9.23	5.4000	13.60	1.75	0.30	19	5.80	8.20	9.10	10.00	13.60
34	1992	FALL	29	7.81	3.0000	10.40	1.57	0.29	20	4.60	7.00	8.00	8.90	10.20
34	1992	SPRING	49	6.60	2.3000	11.40	1.78	0.25	27	3.10	5.90	6.80	7.60	8.80
34	1992	SUMMER	51	6.01	1.6000	11.60	2.04	0.29	34	2.70	4.80	6.10	7.40	9.50
34	1992	WINTER	46	8.63	5.2500	14.70	1.82	0.27	21	5.80	7.40	8.60	9.95	10.80
34	1993	FALL	41	6.73	2.3000	12.70	2.04	0.32	30	4.00	5.30	6.90	7.90	9.60
34	1993	SPRING	32	6.74	2.8000	11.20	1.81	0.32	27	4.00	5.68	6.88	8.10	8.90
34	1993	SUMMER	37	5.69	1.7000	10.00	2.08	0.34	37	2.10	4.30	5.80	7.30	9.10
34	1993	WINTER	34	8.06	3.1000	13.30	2.44	0.42	30	3.80	6.50	7.80	9.60	13.00
34	1994	FALL	37	5.91	1.1000	10.00	2.26	0.37	38	1.50	4.40	6.00	7.40	9.70
34	1994	SPRING	35	7.18	3.9000	10.20	1.74	0.29	24	4.60	5.60	7.30	8.50	10.20
34	1994	SUMMER	35	5.36	2.1000	9.80	1.69	0.29	31	2.10	4.50	5.30	6.40	8.20
34	1994	WINTER	34	8.01	4.9000	12.20	2.00	0.34	25	5.40	6.30	7.65	9.70	11.10
34	1995	FALL	38	6.12	1.3000	10.60	2.29	0.37	37	1.60	4.60	6.45	8.00	9.65
34	1995	SPRING	37	7.03	3.6000	10.30	1.65	0.27	23	4.00	6.30	6.90	8.40	9.70
34	1995	SUMMER	37	5.54	2.0000	8.80	1.75	0.29	32	2.50	4.70	5.80	6.70	8.50
34	1995	WINTER	36	7.58	2.1000	11.15	2.01	0.33	26	4.40	6.00	7.70	8.98	10.50
34	1996	FALL	27	5.05	.25000	8.20	2.34	0.45	46	0.30	3.00	5.40	7.15	7.90
34	1996	SPRING	34	6.89	3.1000	11.50	2.27	0.39	33	3.50	5.30	7.05	8.70	11.00
34	1996	SUMMER	35	5.29	.25000	11.80	2.48	0.42	47	0.60	3.50	5.50	6.90	9.50
34	1996	WINTER	38	8.49	3.3000	14.70	1.94	0.31	23	5.70	7.30	8.45	9.50	11.50
34	1997	FALL	13	4.71	2.5000	7.60	1.51	0.42	32	2.50	3.50	4.60	5.90	7.60
34	1997	SPRING	13	4.54	2.3500	7.30	1.59	0.44	35	2.35	3.55	4.40	5.80	7.30
34	1997	SUMMER	13	3.85	1.0000	6.90	1.93	0.54	50	1.00	1.90	4.00	5.50	6.90
34	1997	WINTER	14	6.95	2.8000	9.80	2.04	0.55	29	2.80	5.85	7.40	8.20	9.80

Rivers and Streams
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Dissolved_Oxygen_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1998	SPRING	13	5.88	3.5000	10.10	1.90	0.53	32	3.50	4.20	5.50	6.70	10.10
34	1998	WINTER	13	7.27	5.4500	9.20	1.16	0.32	16	5.45	6.30	7.40	8.05	9.20
73	1990	FALL	116	6.93	.95000	12.35	2.19	0.20	32	2.60	5.50	7.08	8.40	10.30
73	1990	SPRING	123	6.97	1.1000	10.70	1.91	0.17	27	3.20	5.80	7.10	8.30	9.60
73	1990	SUMMER	108	5.59	1.0625	10.90	2.00	0.19	36	2.20	4.25	5.85	7.00	8.55
73	1990	WINTER	111	8.43	3.1000	12.70	1.99	0.19	24	3.70	7.10	8.60	9.90	11.35
73	1991	FALL	63	8.03	.50000	12.30	1.98	0.25	25	5.40	7.25	8.40	9.40	10.50
73	1991	SPRING	121	6.54	.90000	10.80	2.20	0.20	34	2.70	5.25	6.70	8.30	9.75
73	1991	SUMMER	123	5.06	.40000	9.20	2.26	0.20	45	1.40	3.20	5.10	6.90	8.45
73	1991	WINTER	79	9.54	2.5000	12.60	1.84	0.21	19	5.40	8.60	9.90	10.70	11.80
73	1992	FALL	77	6.91	.20000	11.20	2.46	0.28	36	2.20	5.60	7.45	8.60	10.20
73	1992	SPRING	130	7.16	.60000	12.00	1.87	0.16	26	4.30	6.00	7.30	8.40	9.95
73	1992	SUMMER	130	5.36	.20000	9.50	1.93	0.17	36	1.80	4.20	5.68	6.70	8.40
73	1992	WINTER	135	8.86	2.2000	12.50	2.39	0.21	27	4.20	7.30	9.30	10.75	12.00
73	1993	FALL	111	6.51	.55000	10.80	2.10	0.20	32	2.60	5.15	6.70	8.00	9.80
73	1993	SPRING	115	6.80	1.4000	13.70	2.24	0.21	33	3.20	5.30	6.80	8.50	10.00
73	1993	SUMMER	128	5.37	.70000	8.70	1.86	0.16	35	1.80	4.45	5.70	6.80	7.80
73	1993	WINTER	133	8.68	1.1000	13.20	2.41	0.21	28	4.30	6.90	9.00	10.30	12.45
73	1994	FALL	139	5.67	.45000	9.50	1.90	0.16	34	1.70	4.65	5.80	7.10	8.30
73	1994	SPRING	108	6.97	1.4000	11.20	1.96	0.19	28	3.45	5.83	7.05	8.48	9.80
73	1994	SUMMER	141	5.25	.75000	12.80	2.01	0.17	38	1.90	3.80	5.30	6.70	8.00
73	1994	WINTER	112	8.45	1.5000	13.40	2.37	0.22	28	3.20	7.55	8.80	10.00	12.00
73	1995	FALL	137	6.17	.50000	10.00	1.94	0.17	31	2.65	5.00	6.30	7.50	9.45
73	1995	SPRING	137	6.81	2.5000	13.70	1.89	0.16	28	3.80	5.60	6.80	8.10	9.50
73	1995	SUMMER	113	5.11	.20000	11.90	2.11	0.20	41	1.90	3.75	5.20	6.70	7.60
73	1995	WINTER	134	8.81	1.6000	13.00	2.13	0.18	24	4.30	7.90	9.30	10.35	11.40
73	1996	FALL	135	5.70	.95000	9.60	1.93	0.17	34	1.70	4.50	6.00	7.00	8.40
73	1996	SPRING	111	7.49	2.2000	11.40	1.79	0.17	24	4.20	6.50	7.40	8.70	10.50
73	1996	SUMMER	109	5.14	.50000	9.20	1.79	0.17	35	1.45	4.10	5.30	6.45	8.10
73	1996	WINTER	135	8.52	4.0000	13.80	2.10	0.18	25	4.80	7.10	8.40	10.10	12.00
73	1997	FALL	89	6.16	1.4000	10.10	1.77	0.19	29	2.80	5.25	6.40	7.40	8.90
73	1997	SPRING	97	6.34	1.2500	10.00	1.92	0.19	30	2.30	5.35	6.50	7.75	9.50

Rivers and Streams
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Dissolved_Oxygen_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1997	SUMMER	95	5.29	.75000	10.65	1.86	0.19	35	1.90	4.10	5.50	6.60	7.80
73	1997	WINTER	97	7.76	.20000	11.80	2.39	0.24	31	3.60	6.70	8.40	9.25	10.50
73	1998	SPRING	45	7.46	2.5000	10.80	1.98	0.30	27	3.40	6.80	7.40	8.60	10.30
73	1998	WINTER	69	7.36	2.9000	11.25	1.88	0.23	26	3.90	6.20	7.70	8.55	10.55
73	1999	FALL	4	11.79	9.4700	14.10	2.67	1.34	23	9.47	9.47	11.79	14.10	14.10
73	1999	SUMMER	6	8.40	7.3800	9.67	1.04	0.43	12	7.38	7.38	8.14	9.67	9.67
73	2000	SPRING	3	10.49	6.2700	13.28	3.72	2.15	35	6.27	6.27	11.91	13.28	13.28
73	2000	SUMMER	3	5.27	4.2000	6.30	1.05	0.61	20	4.20	4.20	5.30	6.30	6.30

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
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Nitrite_Nitrate_NO2_NO3_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	29	0.88	.02000	5.90	1.44	0.27	163	0.03	0.07	0.30	0.84	4.40
34	1990	SPRING	24	0.85	.02500	3.20	0.95	0.19	113	0.09	0.23	0.44	0.97	3.00
34	1990	SUMMER	26	1.48	.00500	7.40	2.34	0.46	159	0.03	0.07	0.40	1.10	7.10
34	1990	WINTER	24	1.97	.02500	7.40	2.46	0.50	125	0.05	0.16	0.24	3.40	6.80
34	1991	FALL	15	0.56	.01000	2.70	0.82	0.21	148	0.01	0.11	0.13	0.45	2.70
34	1991	SPRING	34	1.13	.01000	5.65	1.54	0.26	137	0.05	0.20	0.37	1.29	5.50
34	1991	SUMMER	32	1.15	.05000	6.40	1.78	0.31	155	0.09	0.22	0.26	1.31	5.90
34	1991	WINTER	19	2.32	.10000	5.90	1.93	0.44	83	0.10	0.46	1.50	4.70	5.90
34	1992	FALL	16	0.81	.01000	3.30	1.24	0.31	153	0.01	0.02	0.27	0.81	3.30
34	1992	SPRING	32	1.31	.07000	8.00	1.90	0.34	145	0.09	0.29	0.60	1.20	6.10
34	1992	SUMMER	33	0.81	.00500	4.70	1.12	0.19	138	0.03	0.13	0.37	0.81	3.80
34	1992	WINTER	30	0.50	.05000	3.70	0.77	0.14	152	0.07	0.14	0.26	0.52	2.60
34	1993	FALL	17	0.91	.00500	6.30	1.67	0.41	183	0.01	0.09	0.19	0.83	6.30
34	1993	SPRING	22	0.63	.00500	5.30	1.19	0.25	189	0.08	0.16	0.24	0.38	2.70
34	1993	SUMMER	20	0.74	.00500	4.60	1.18	0.26	160	0.02	0.12	0.34	0.74	4.00
34	1993	WINTER	17	0.26	.03000	1.11	0.32	0.08	122	0.03	0.09	0.15	0.21	1.11
34	1994	FALL	23	0.91	.00500	7.44	1.91	0.40	211	0.01	0.04	0.20	0.56	4.94
34	1994	SPRING	18	0.62	.07000	3.45	0.75	0.18	121	0.07	0.32	0.39	0.60	3.45
34	1994	SUMMER	17	0.75	.02000	5.00	1.22	0.30	163	0.02	0.21	0.38	0.66	5.00
34	1994	WINTER	25	0.49	.04000	4.70	0.94	0.19	192	0.05	0.13	0.23	0.44	1.70
34	1995	FALL	34	0.57	.01000	6.83	1.41	0.24	248	0.01	0.04	0.10	0.25	3.82
34	1995	SPRING	37	0.75	.01000	4.75	1.04	0.17	138	0.03	0.19	0.36	0.80	3.60
34	1995	SUMMER	37	0.46	.00250	2.60	0.58	0.10	127	0.00	0.10	0.34	0.48	2.50
34	1995	WINTER	32	0.85	.02000	6.60	1.60	0.28	189	0.03	0.12	0.23	0.56	4.97
34	1996	FALL	13	0.15	.02000	0.31	0.09	0.03	61	0.02	0.08	0.14	0.22	0.31
34	1996	SPRING	17	0.81	.02000	4.38	1.13	0.27	139	0.02	0.16	0.52	0.74	4.38
34	1996	SUMMER	16	0.56	.01500	3.19	0.87	0.22	155	0.02	0.10	0.15	0.71	3.19
34	1996	WINTER	18	0.83	.09000	6.84	1.76	0.41	212	0.09	0.16	0.27	0.37	6.84
34	1997	FALL	13	0.24	.03000	0.83	0.24	0.07	100	0.03	0.10	0.16	0.21	0.83
34	1997	SPRING	13	0.21	.02000	0.55	0.14	0.04	68	0.02	0.13	0.18	0.24	0.55
34	1997	SUMMER	13	0.29	.06000	0.61	0.19	0.05	67	0.06	0.11	0.25	0.38	0.61
34	1997	WINTER	13	0.16	.00500	0.60	0.15	0.04	94	0.01	0.09	0.14	0.19	0.60

Rivers and Streams
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subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1998	SPRING	13	0.15	.02000	0.24	0.06	0.02	44	0.02	0.09	0.15	0.19	0.24
34	1998	WINTER	13	0.09	.02000	0.15	0.04	0.01	47	0.02	0.07	0.09	0.10	0.15
73	1990	FALL	113	0.37	.00500	1.70	0.46	0.04	126	0.02	0.06	0.17	0.36	1.42
73	1990	SPRING	105	0.36	.02250	1.20	0.29	0.03	80	0.05	0.17	0.28	0.49	1.14
73	1990	SUMMER	108	0.43	.00500	2.65	0.63	0.06	146	0.01	0.08	0.21	0.34	2.10
73	1990	WINTER	106	0.37	.00500	1.20	0.31	0.03	82	0.05	0.17	0.25	0.56	1.03
73	1991	FALL	59	0.28	.00500	1.41	0.31	0.04	110	0.01	0.04	0.17	0.49	0.84
73	1991	SPRING	122	0.44	.00500	2.51	0.56	0.05	126	0.04	0.10	0.20	0.52	1.77
73	1991	SUMMER	124	0.45	.00500	2.95	0.70	0.06	157	0.01	0.03	0.20	0.38	2.35
73	1991	WINTER	70	0.39	.00500	1.50	0.35	0.04	89	0.07	0.17	0.27	0.46	1.20
73	1992	FALL	75	0.36	.00500	1.30	0.44	0.05	124	0.01	0.05	0.14	0.47	1.22
73	1992	SPRING	121	0.48	.00500	2.68	0.63	0.06	131	0.03	0.12	0.21	0.48	2.04
73	1992	SUMMER	126	0.42	.00500	2.07	0.45	0.04	108	0.01	0.11	0.25	0.59	1.43
73	1992	WINTER	133	0.51	.00250	5.26	0.70	0.06	139	0.01	0.15	0.27	0.53	2.09
73	1993	FALL	121	0.46	.00500	9.10	0.94	0.09	205	0.01	0.08	0.17	0.37	1.67
73	1993	SPRING	115	0.45	.00500	4.64	0.58	0.05	130	0.02	0.15	0.29	0.49	1.62
73	1993	SUMMER	133	0.51	.00500	2.20	0.60	0.05	117	0.01	0.10	0.26	0.65	2.01
73	1993	WINTER	128	0.34	.00500	2.10	0.41	0.04	122	0.02	0.10	0.19	0.34	1.40
73	1994	FALL	147	0.25	.00500	2.89	0.36	0.03	146	0.01	0.04	0.12	0.29	0.83
73	1994	SPRING	119	0.43	.00500	2.80	0.45	0.04	104	0.02	0.14	0.26	0.60	1.30
73	1994	SUMMER	151	0.45	.00500	1.83	0.39	0.03	87	0.01	0.18	0.32	0.64	1.20
73	1994	WINTER	119	0.37	.00500	7.50	0.73	0.07	197	0.01	0.12	0.21	0.35	1.18
73	1995	FALL	138	0.20	.00500	3.11	0.38	0.03	194	0.01	0.01	0.06	0.20	0.85
73	1995	SPRING	148	0.34	.00500	2.88	0.47	0.04	140	0.01	0.09	0.19	0.32	1.52
73	1995	SUMMER	147	0.37	.00500	2.53	0.44	0.04	117	0.01	0.07	0.22	0.49	1.35
73	1995	WINTER	145	0.33	.00500	1.90	0.36	0.03	108	0.03	0.14	0.23	0.36	1.26
73	1996	FALL	137	0.25	.00500	3.75	0.44	0.04	174	0.01	0.05	0.13	0.25	0.87
73	1996	SPRING	144	0.47	.00500	3.32	0.47	0.04	101	0.05	0.18	0.32	0.55	1.41
73	1996	SUMMER	104	0.51	.00500	2.80	0.64	0.06	126	0.02	0.11	0.25	0.51	1.90
73	1996	WINTER	142	0.43	.00500	6.33	0.67	0.06	156	0.03	0.14	0.24	0.42	1.26
73	1997	FALL	94	0.28	.00250	2.12	0.36	0.04	128	0.00	0.05	0.13	0.40	0.90
73	1997	SPRING	105	0.36	.00500	2.96	0.47	0.05	130	0.03	0.12	0.20	0.38	1.37

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subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1997	SUMMER	102	0.46	.01000	3.87	0.54	0.05	116	0.04	0.17	0.26	0.56	1.46
73	1997	WINTER	102	0.32	.00500	3.57	0.48	0.05	149	0.01	0.10	0.20	0.31	1.17
73	1998	SPRING	48	0.38	.02000	2.09	0.51	0.07	134	0.07	0.10	0.16	0.37	1.56
73	1998	WINTER	69	0.36	.02000	3.81	0.65	0.08	178	0.02	0.08	0.14	0.27	1.42
73	1999	FALL	4	0.00	.00000	0.00	0.00	0.00	.	0.00	0.00	0.00	0.00	0.00
73	1999	SUMMER	6	0.03	.00000	0.07	0.03	0.01	94	0.00	0.00	0.03	0.07	0.07
73	2000	SPRING	3	0.11	.00000	0.32	0.18	0.11	173	0.00	0.00	0.00	0.32	0.32

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subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	28	0.89	.25000	2.15	0.40	0.08	46	0.35	0.62	0.83	1.14	1.49
34	1990	SPRING	26	1.12	.25000	2.90	0.64	0.13	57	0.40	0.60	1.06	1.56	1.97
34	1990	SUMMER	31	1.04	.10000	1.90	0.39	0.07	37	0.40	0.80	1.00	1.35	1.63
34	1990	WINTER	28	1.20	.40000	2.60	0.55	0.10	46	0.46	0.79	1.15	1.38	2.20
34	1991	FALL	15	0.94	.30000	1.80	0.46	0.12	50	0.30	0.65	0.87	1.35	1.80
34	1991	SPRING	34	1.20	.35000	2.40	0.45	0.08	37	0.50	0.84	1.22	1.43	2.00
34	1991	SUMMER	32	1.20	.75000	1.76	0.26	0.05	22	0.90	1.00	1.20	1.38	1.67
34	1991	WINTER	19	1.08	.59500	2.00	0.44	0.10	41	0.60	0.70	0.82	1.50	2.00
34	1992	FALL	19	0.68	.20000	1.30	0.34	0.08	49	0.20	0.36	0.71	0.90	1.30
34	1992	SPRING	32	1.04	.30000	2.07	0.50	0.09	48	0.40	0.60	0.98	1.43	1.82
34	1992	SUMMER	33	0.85	.05000	1.75	0.40	0.07	48	0.30	0.54	0.85	1.05	1.66
34	1992	WINTER	31	1.06	.50000	3.80	0.62	0.11	59	0.50	0.70	0.94	1.14	2.03
34	1993	FALL	42	0.80	.05000	1.83	0.32	0.05	41	0.37	0.62	0.79	0.96	1.19
34	1993	SPRING	33	0.98	.40000	2.12	0.43	0.07	43	0.40	0.75	0.97	1.10	1.98
34	1993	SUMMER	40	0.93	.05000	3.54	0.62	0.10	66	0.13	0.50	0.84	1.17	1.75
34	1993	WINTER	38	1.06	.26000	3.21	0.59	0.10	55	0.27	0.66	1.00	1.28	2.80
34	1994	FALL	34	0.81	.40000	1.40	0.23	0.04	29	0.50	0.62	0.80	0.98	1.25
34	1994	SPRING	42	1.19	.39000	3.02	0.57	0.09	48	0.40	0.76	1.07	1.47	2.13
34	1994	SUMMER	33	1.01	.30000	2.38	0.45	0.08	44	0.40	0.77	0.96	1.17	1.99
34	1994	WINTER	39	1.11	.20000	1.88	0.37	0.06	33	0.50	0.86	1.02	1.44	1.77
34	1995	FALL	37	0.82	.26000	1.60	0.31	0.05	38	0.30	0.58	0.82	1.01	1.52
34	1995	SPRING	40	1.25	.30000	2.85	0.62	0.10	50	0.44	0.77	1.20	1.66	2.43
34	1995	SUMMER	41	0.71	.05000	1.44	0.36	0.06	50	0.11	0.49	0.75	0.94	1.17
34	1995	WINTER	37	0.99	.32000	1.83	0.41	0.07	42	0.34	0.65	0.93	1.33	1.74
34	1996	FALL	19	1.11	.65000	1.86	0.32	0.07	29	0.65	0.87	1.06	1.19	1.86
34	1996	SPRING	34	1.21	.32000	2.71	0.65	0.11	54	0.48	0.79	1.06	1.47	2.62
34	1996	SUMMER	36	1.31	.44000	2.79	0.58	0.10	45	0.47	0.85	1.24	1.69	2.70
34	1996	WINTER	31	0.85	.11000	1.73	0.39	0.07	46	0.17	0.60	0.83	1.17	1.39
34	1997	FALL	13	0.83	.39000	1.72	0.36	0.10	44	0.39	0.57	0.66	1.00	1.72
34	1997	SPRING	16	1.99	.85000	4.08	0.88	0.22	44	0.85	1.40	1.85	2.46	4.08
34	1997	SUMMER	13	1.09	.53000	1.99	0.42	0.12	38	0.53	0.85	1.09	1.21	1.99
34	1997	WINTER	19	1.23	.77000	1.77	0.27	0.06	22	0.77	1.00	1.24	1.49	1.77

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subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1998	SPRING	13	1.66	.49000	2.98	0.68	0.19	41	0.49	1.32	1.46	2.10	2.98
34	1998	WINTER	13	1.34	.54000	2.29	0.51	0.14	38	0.54	0.93	1.31	1.67	2.29
73	1990	FALL	100	1.02	.07500	3.82	0.62	0.06	61	0.38	0.64	0.87	1.26	2.08
73	1990	SPRING	99	1.00	.30000	2.20	0.37	0.04	37	0.50	0.74	0.93	1.20	1.70
73	1990	SUMMER	100	1.04	.10000	3.80	0.53	0.05	51	0.52	0.74	0.87	1.23	2.03
73	1990	WINTER	87	1.12	.17500	2.70	0.46	0.05	41	0.63	0.81	0.98	1.31	2.11
73	1991	FALL	37	0.65	.07500	1.10	0.22	0.04	34	0.18	0.50	0.66	0.80	1.00
73	1991	SPRING	97	0.98	.30000	2.60	0.46	0.05	47	0.50	0.69	0.83	1.10	2.04
73	1991	SUMMER	99	0.99	.05000	1.91	0.32	0.03	32	0.54	0.75	0.94	1.19	1.66
73	1991	WINTER	47	0.98	.20000	2.45	0.49	0.07	50	0.29	0.71	0.90	1.05	2.15
73	1992	FALL	57	0.86	.07500	3.15	0.58	0.08	68	0.20	0.50	0.70	0.93	2.45
73	1992	SPRING	100	0.89	.20000	2.45	0.42	0.04	47	0.42	0.65	0.79	0.99	1.71
73	1992	SUMMER	106	1.01	.10000	2.90	0.51	0.05	50	0.39	0.70	0.89	1.28	2.00
73	1992	WINTER	109	0.92	.07500	5.09	0.62	0.06	67	0.35	0.59	0.76	1.11	1.67
73	1993	FALL	94	0.82	.37000	2.34	0.34	0.03	41	0.48	0.61	0.76	0.93	1.42
73	1993	SPRING	99	0.87	.25000	2.80	0.35	0.03	40	0.47	0.64	0.79	1.06	1.43
73	1993	SUMMER	102	0.87	.07500	1.90	0.36	0.04	41	0.40	0.62	0.84	1.08	1.50
73	1993	WINTER	108	0.84	.02500	2.10	0.38	0.04	45	0.40	0.59	0.80	1.01	1.57
73	1994	FALL	86	0.74	.29000	2.75	0.38	0.04	51	0.37	0.51	0.61	0.86	1.49
73	1994	SPRING	92	0.94	.15000	2.61	0.44	0.05	47	0.42	0.62	0.80	1.17	1.90
73	1994	SUMMER	92	0.92	.07500	2.88	0.41	0.04	44	0.52	0.68	0.84	1.11	1.67
73	1994	WINTER	95	0.93	.30000	4.30	0.51	0.05	54	0.43	0.62	0.80	1.13	1.67
73	1995	FALL	84	0.99	.31000	2.61	0.50	0.05	51	0.42	0.64	0.83	1.23	2.06
73	1995	SPRING	91	1.16	.39000	3.80	0.60	0.06	52	0.58	0.82	1.04	1.28	2.45
73	1995	SUMMER	91	0.91	.26000	2.95	0.43	0.05	47	0.39	0.65	0.77	1.11	1.67
73	1995	WINTER	89	0.91	.21000	3.84	0.52	0.06	58	0.42	0.61	0.76	1.00	1.83
73	1996	FALL	91	0.90	.22000	2.39	0.48	0.05	53	0.33	0.58	0.75	1.14	2.17
73	1996	SPRING	95	1.12	.21000	5.20	0.76	0.08	68	0.50	0.70	0.83	1.40	2.13
73	1996	SUMMER	90	1.17	.09000	3.56	0.71	0.08	61	0.49	0.76	0.95	1.36	2.75
73	1996	WINTER	93	0.87	.19000	2.64	0.47	0.05	54	0.29	0.54	0.75	1.09	1.82
73	1997	FALL	89	0.81	.01000	3.66	0.52	0.05	64	0.23	0.50	0.70	1.03	1.63
73	1997	SPRING	85	0.99	.30000	2.23	0.38	0.04	38	0.56	0.71	0.94	1.20	1.75

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subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1997	SUMMER	80	1.06	.17000	3.31	0.53	0.06	50	0.48	0.70	0.95	1.28	2.13
73	1997	WINTER	101	0.98	.01000	2.38	0.45	0.04	46	0.44	0.69	0.87	1.15	1.83
73	1998	SPRING	48	0.96	.56000	1.93	0.31	0.04	32	0.59	0.75	0.88	1.11	1.62
73	1998	WINTER	69	1.04	.14000	3.31	0.47	0.06	45	0.35	0.77	1.01	1.22	1.76

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Descriptive Statistics by Subecoregion, Year and Season
from 1999 to 2000
Organic_P_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1999	FALL	4	30.51	11.920	49.09	21.46	10.73	70	11.92	11.92	30.51	49.09	49.09
73	1999	SUMMER	6	45.32	25.480	61.37	16.32	6.66	36	25.48	25.48	49.12	61.37	61.37
73	2000	SPRING	3	197.51	38.300	383.16	173.94	100.43	88	38.30	38.30	171.08	383.16	383.16

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1995
Phosph_Ortho_Tot_as_P_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	9	176.11	5.0000	590.00	199.78	66.59	113	5.00	50.00	130.00	130.00	590.00
34	1990	WINTER	1	110.00	110.00	110.00	.	.	.	110.00	110.00	110.00	110.00	110.00
34	1991	FALL	6	146.25	12.500	390.00	141.98	57.96	97	12.50	45.00	107.50	215.00	390.00
34	1991	SPRING	9	155.00	10.000	485.00	151.69	50.56	98	10.00	12.50	170.00	215.00	485.00
34	1991	SUMMER	7	532.14	30.000	2700.00	963.88	364.31	181	30.00	90.00	160.00	420.00	2700.0
34	1991	WINTER	7	470.71	55.000	1800.00	622.60	235.32	132	55.00	60.00	290.00	660.00	1800.0
34	1992	FALL	7	101.43	10.000	380.00	134.47	50.82	133	10.00	10.00	50.00	170.00	380.00
34	1992	SPRING	8	126.25	20.000	430.00	128.86	45.56	102	20.00	57.50	92.50	130.00	430.00
34	1992	SUMMER	9	110.56	30.000	325.00	105.70	35.23	96	30.00	40.00	55.00	120.00	325.00
34	1992	WINTER	9	174.56	30.000	510.00	175.43	58.48	101	30.00	60.00	90.00	171.00	510.00
73	1990	FALL	16	74.69	5.0000	260.00	54.57	13.64	73	5.00	50.00	65.00	85.00	260.00
73	1990	SPRING	3	126.67	100.00	160.00	30.55	17.64	24	100.00	100.00	120.00	160.00	160.00
73	1990	SUMMER	3	73.33	30.000	120.00	45.09	26.03	61	30.00	30.00	70.00	120.00	120.00
73	1990	WINTER	10	74.50	10.000	150.00	44.75	14.15	60	10.00	55.00	75.00	110.00	150.00
73	1991	FALL	17	72.35	5.0000	150.00	33.31	8.08	46	5.00	55.00	80.00	80.00	150.00
73	1991	SPRING	20	103.50	40.000	280.00	55.92	12.50	54	45.00	65.00	95.00	135.00	220.00
73	1991	SUMMER	17	97.21	12.500	200.00	50.64	12.28	52	12.50	55.00	95.00	130.00	200.00
73	1991	WINTER	18	95.83	15.000	190.00	46.69	11.01	49	15.00	65.00	87.50	120.00	190.00
73	1992	FALL	14	79.18	30.000	170.00	44.27	11.83	56	30.00	40.00	71.75	100.00	170.00
73	1992	SPRING	15	72.33	15.000	185.00	39.64	10.23	55	15.00	50.00	70.00	90.00	185.00
73	1992	SUMMER	20	99.25	20.000	180.00	36.39	8.14	37	45.00	80.00	90.00	117.50	175.00
73	1992	WINTER	18	93.89	10.000	180.00	45.65	10.76	49	10.00	70.00	95.00	130.00	180.00
73	1993	FALL	6	95.17	41.000	140.00	38.96	15.91	41	41.00	65.00	100.00	125.00	140.00
73	1993	SPRING	3	84.00	50.000	102.00	29.46	17.01	35	50.00	50.00	100.00	102.00	102.00
73	1993	SUMMER	6	127.50	30.000	280.00	85.07	34.73	67	30.00	70.00	125.00	135.00	280.00
73	1993	WINTER	3	74.00	60.000	82.00	12.17	7.02	16	60.00	60.00	80.00	82.00	82.00
73	1994	FALL	7	63.00	15.000	100.00	29.41	11.11	47	15.00	36.00	65.00	90.00	100.00
73	1994	SPRING	7	63.79	15.000	100.00	29.05	10.98	46	15.00	45.00	60.00	90.00	100.00
73	1994	SUMMER	8	62.75	15.000	90.00	29.53	10.44	47	15.00	36.00	77.50	85.00	90.00
73	1994	WINTER	7	95.00	45.000	180.00	44.44	16.80	47	45.00	70.00	80.00	120.00	180.00
73	1995	FALL	2	40.00	40.000	40.00	0.00	0.00	0	40.00	40.00	40.00	40.00	40.00
73	1995	SPRING	5	99.00	70.000	130.00	28.81	12.88	29	70.00	70.00	100.00	125.00	130.00

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1995
Phosph_Ortho_Tot_as_P_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1995	SUMMER	6	61.67	40.000	90.00	20.41	8.33	33	40.00	40.00	60.00	80.00	90.00
73	1995	WINTER	4	81.25	65.000	100.00	14.36	7.18	18	65.00	72.50	80.00	90.00	100.00

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Total_Nitrogen_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	9	1.43	.35000	5.70	1.69	0.56	118	0.35	0.60	0.80	1.10	5.70
34	1990	SPRING	9	1.73	.40000	3.80	1.12	0.37	65	0.40	0.95	1.10	2.30	3.80
34	1990	SUMMER	7	1.79	.60000	4.20	1.65	0.62	92	0.60	0.80	0.95	4.20	4.20
34	1990	WINTER	7	2.79	.40000	7.30	2.55	0.96	91	0.40	1.10	2.00	5.30	7.30
34	1991	FALL	6	1.35	.35000	4.05	1.35	0.55	100	0.35	0.74	0.90	1.15	4.05
34	1991	SPRING	9	1.84	.50000	5.25	1.36	0.45	74	0.50	1.40	1.55	1.80	5.25
34	1991	SUMMER	7	2.40	1.0500	7.50	2.41	0.91	101	1.05	1.10	1.20	3.50	7.50
34	1991	WINTER	7	2.89	.90000	6.60	2.19	0.83	76	0.90	1.15	2.10	5.35	6.60
34	1992	FALL	7	1.29	.30000	4.40	1.42	0.54	110	0.30	0.30	0.90	1.30	4.40
34	1992	SPRING	8	1.77	.58000	5.20	1.48	0.52	84	0.58	1.02	1.28	1.90	5.20
34	1992	SUMMER	8	1.18	.37000	3.95	1.17	0.41	99	0.37	0.48	0.89	1.20	3.95
34	1992	WINTER	9	1.43	.67000	4.50	1.19	0.40	83	0.67	0.91	1.00	1.20	4.50
34	1993	FALL	5	1.50	.40000	4.80	1.86	0.83	124	0.40	0.50	0.80	1.00	4.80
34	1993	SPRING	8	1.80	.40000	6.35	1.89	0.67	105	0.40	0.85	1.33	1.65	6.35
34	1993	SUMMER	5	1.55	.68000	3.95	1.36	0.61	88	0.68	0.88	1.10	1.12	3.95
34	1993	WINTER	3	1.40	1.4000	1.40	0.00	0.00	0	1.40	1.40	1.40	1.40	1.40
34	1994	FALL	4	1.85	.50000	5.00	2.11	1.06	114	0.50	0.65	0.95	3.05	5.00
34	1994	SPRING	5	2.00	.60000	4.65	1.63	0.73	81	0.60	0.95	1.40	2.40	4.65
34	1994	SUMMER	5	1.28	.40000	3.40	1.24	0.55	97	0.40	0.40	1.00	1.20	3.40
34	1994	WINTER	4	2.50	1.0000	5.70	2.16	1.08	87	1.00	1.20	1.65	3.80	5.70
34	1995	FALL	2	0.64	.40000	0.87	0.33	0.24	52	0.40	0.40	0.64	0.87	0.87
34	1995	SPRING	4	2.30	.65000	5.65	2.27	1.14	99	0.65	0.95	1.45	3.65	5.65
34	1995	SUMMER	4	1.65	.70500	3.70	1.38	0.69	84	0.71	0.85	1.10	2.45	3.70
34	1995	WINTER	2	3.50	.80000	6.20	3.82	2.70	109	0.80	0.80	3.50	6.20	6.20
73	1990	FALL	18	1.31	.40000	3.20	0.79	0.19	60	0.40	0.70	1.08	2.00	3.20
73	1990	SPRING	17	1.23	.45000	2.40	0.49	0.12	40	0.45	0.90	1.20	1.40	2.40
73	1990	SUMMER	18	1.64	.30000	3.30	1.01	0.24	62	0.30	0.95	1.20	2.80	3.30
73	1990	WINTER	17	1.27	.45000	2.10	0.49	0.12	39	0.45	1.00	1.20	1.55	2.10
73	1991	FALL	15	1.01	.47000	1.50	0.33	0.09	33	0.47	0.74	0.94	1.30	1.50
73	1991	SPRING	19	1.70	.67000	3.60	0.87	0.20	51	0.67	0.92	1.45	2.30	3.60
73	1991	SUMMER	19	1.87	.61500	4.30	1.12	0.26	60	0.62	0.98	1.50	2.40	4.30
73	1991	WINTER	17	1.34	.59000	2.45	0.54	0.13	40	0.59	0.97	1.30	1.50	2.45

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Total_Nitrogen_mg_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1992	FALL	17	1.10	.20000	2.00	0.63	0.15	57	0.20	0.57	0.80	1.70	2.00
73	1992	SPRING	15	1.36	.55000	3.35	0.91	0.23	67	0.55	0.74	0.81	2.00	3.35
73	1992	SUMMER	19	1.26	.60000	2.15	0.50	0.11	39	0.60	0.83	1.10	1.65	2.15
73	1992	WINTER	17	1.48	.56000	2.80	0.80	0.19	54	0.56	0.90	1.30	2.30	2.80
73	1993	FALL	13	1.53	.71000	2.40	0.63	0.18	41	0.71	1.10	1.30	2.20	2.40
73	1993	SPRING	16	1.34	.58000	2.70	0.58	0.14	43	0.58	0.96	1.10	1.80	2.70
73	1993	SUMMER	17	1.65	.44500	3.40	0.98	0.24	59	0.45	0.80	1.62	2.55	3.40
73	1993	WINTER	19	1.32	.49000	2.50	0.66	0.15	50	0.49	0.72	1.10	1.80	2.50
73	1994	FALL	5	1.10	.82000	1.30	0.19	0.09	17	0.82	1.00	1.20	1.20	1.30
73	1994	SPRING	13	1.22	.47000	2.40	0.55	0.15	45	0.47	0.80	1.00	1.50	2.40
73	1994	SUMMER	14	1.29	.70000	2.20	0.49	0.13	38	0.70	0.86	1.25	1.70	2.20
73	1994	WINTER	13	1.26	.57000	2.20	0.55	0.15	43	0.57	0.83	1.20	1.70	2.20
73	1995	FALL	3	0.63	.51000	0.74	0.12	0.07	18	0.51	0.51	0.64	0.74	0.74
73	1995	SPRING	7	1.53	.58000	3.00	0.84	0.32	55	0.58	0.88	1.40	2.20	3.00
73	1995	SUMMER	8	1.32	.40000	2.30	0.69	0.24	52	0.40	0.73	1.30	1.90	2.30
73	1995	WINTER	6	1.14	.74500	1.80	0.41	0.17	36	0.75	0.81	1.04	1.40	1.80
73	1999	FALL	4	0.07	.03000	0.10	0.04	0.02	62	0.03	0.03	0.07	0.10	0.10
73	1999	SUMMER	6	0.27	.21000	0.38	0.08	0.03	30	0.21	0.21	0.23	0.38	0.38
73	2000	SPRING	3	0.56	.10000	1.09	0.50	0.29	88	0.10	0.10	0.50	1.09	1.09

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Total_Phosphorus_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	38	334.08	20.000	1500.00	325.30	52.77	97	45.00	140.00	235.00	410.00	1025.0
34	1990	SPRING	39	685.64	50.000	12000.0	1907.1	305.38	278	50.00	130.00	280.00	470.00	1860.0
34	1990	SUMMER	43	449.42	50.000	2300.00	557.26	84.98	124	80.00	145.00	270.00	530.00	2000.0
34	1990	WINTER	35	500.14	40.000	2000.00	544.42	92.02	109	50.00	170.00	260.00	770.00	1910.0
34	1991	FALL	33	465.53	17.500	2250.00	474.29	82.56	102	40.00	140.00	355.00	655.00	1720.0
34	1991	SPRING	45	434.00	40.000	1680.00	349.85	52.15	81	70.00	170.00	340.00	615.00	1190.0
34	1991	SUMMER	48	431.15	30.000	2700.00	520.08	75.07	121	50.00	160.00	272.50	410.00	1600.0
34	1991	WINTER	33	600.45	50.000	2400.00	649.41	113.05	108	50.00	190.00	370.00	690.00	2300.0
34	1992	FALL	30	411.83	30.000	2290.00	548.37	100.12	133	30.00	90.00	235.00	510.00	2130.0
34	1992	SPRING	49	370.71	60.000	1800.00	368.45	52.64	99	65.00	150.00	300.00	390.00	1520.0
34	1992	SUMMER	51	340.69	20.000	1830.00	359.85	50.39	106	60.00	125.00	200.00	380.00	1200.0
34	1992	WINTER	47	342.45	40.000	1740.00	306.43	44.70	89	60.00	170.00	245.00	410.00	895.00
34	1993	FALL	42	269.52	50.000	1340.00	285.16	44.00	106	60.00	120.00	170.00	240.00	930.00
34	1993	SPRING	33	306.52	40.000	1010.00	217.24	37.82	71	60.00	155.00	240.00	400.00	905.00
34	1993	SUMMER	40	338.75	50.000	1920.00	464.28	73.41	137	50.00	100.00	200.00	310.00	1715.0
34	1993	WINTER	38	343.42	60.000	1565.00	310.70	50.40	90	60.00	180.00	255.00	420.00	1400.0
34	1994	FALL	36	222.22	30.000	1650.00	267.46	44.58	120	50.00	85.00	170.00	240.00	440.00
34	1994	SPRING	44	327.84	2.5000	1650.00	300.23	45.26	92	50.00	120.00	285.00	420.00	940.00
34	1994	SUMMER	37	238.24	30.000	1210.00	218.58	35.93	92	50.00	90.00	180.00	280.00	580.00
34	1994	WINTER	37	277.03	10.000	1200.00	277.98	45.70	100	30.00	110.00	190.00	310.00	1160.0
34	1995	FALL	35	220.86	30.000	1500.00	304.09	51.40	138	30.00	80.00	130.00	190.00	1010.0
34	1995	SPRING	38	269.41	2.5000	1000.00	206.43	33.49	77	40.00	130.00	237.50	370.00	690.00
34	1995	SUMMER	41	184.02	2.5000	630.00	141.95	22.17	77	30.00	90.00	145.00	250.00	460.00
34	1995	WINTER	36	237.50	30.000	940.00	202.73	33.79	85	40.00	100.00	200.00	310.00	800.00
34	1996	FALL	19	272.37	100.00	480.00	118.08	27.09	43	100.00	190.00	250.00	390.00	480.00
34	1996	SPRING	34	381.32	40.000	2125.00	485.06	83.19	127	50.00	100.00	177.50	420.00	1550.0
34	1996	SUMMER	35	194.21	2.5000	520.00	132.13	22.33	68	40.00	100.00	150.00	270.00	490.00
34	1996	WINTER	31	326.29	20.000	2110.00	474.04	85.14	145	30.00	90.00	160.00	280.00	1435.0
34	1997	FALL	13	155.77	80.000	240.00	57.80	16.03	37	80.00	100.00	150.00	200.00	240.00
34	1997	SPRING	16	413.13	65.000	870.00	205.02	51.25	50	65.00	300.00	412.50	482.50	870.00
34	1997	SUMMER	13	198.08	80.000	310.00	76.69	21.27	39	80.00	130.00	180.00	270.00	310.00
34	1997	WINTER	19	232.89	30.000	720.00	151.06	34.66	65	30.00	170.00	200.00	270.00	720.00

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Total_Phosphorus_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1998	SPRING	13	252.69	70.000	520.00	147.12	40.80	58	70.00	150.00	210.00	330.00	520.00
34	1998	WINTER	13	188.08	60.000	400.00	96.15	26.67	51	60.00	120.00	185.00	265.00	400.00
73	1990	FALL	125	197.26	10.000	1430.00	174.04	15.57	88	60.00	110.00	150.00	240.00	420.00
73	1990	SPRING	126	246.12	20.000	660.00	147.24	13.12	60	50.00	120.00	230.00	350.00	540.00
73	1990	SUMMER	125	225.54	30.000	1810.00	187.95	16.81	83	60.00	130.00	200.00	270.00	450.00
73	1990	WINTER	111	278.46	3.7500	1400.00	225.78	21.43	81	60.00	120.00	225.00	340.00	670.00
73	1991	FALL	66	171.48	2.5000	1700.00	223.49	27.51	130	45.00	100.00	140.00	175.00	250.00
73	1991	SPRING	125	259.57	16.250	1370.00	225.80	20.20	87	80.00	130.00	210.00	300.00	700.00
73	1991	SUMMER	127	221.85	10.000	1640.00	219.77	19.50	99	60.00	120.00	180.00	260.00	410.00
73	1991	WINTER	80	234.13	40.000	720.00	142.68	15.95	61	85.00	145.00	200.00	290.00	580.00
73	1992	FALL	86	174.28	22.500	1100.00	152.30	16.42	87	50.00	90.00	130.00	190.00	410.00
73	1992	SPRING	129	202.50	20.000	730.00	141.86	12.49	70	40.00	100.00	170.00	260.00	470.00
73	1992	SUMMER	134	235.99	2.5000	1800.00	202.76	17.52	86	60.00	140.00	187.50	260.00	610.00
73	1992	WINTER	139	210.30	26.250	970.00	154.20	13.08	73	60.00	105.00	170.00	260.00	480.00
73	1993	FALL	124	218.76	2.5000	1650.00	239.59	21.52	110	45.00	105.00	160.00	250.00	475.00
73	1993	SPRING	123	233.29	20.000	1420.00	204.50	18.44	88	45.00	105.00	190.00	300.00	510.00
73	1993	SUMMER	142	203.24	2.5000	1400.00	192.54	16.16	95	50.00	100.00	167.50	250.00	510.00
73	1993	WINTER	140	211.45	2.5000	940.00	130.19	11.00	62	60.00	120.00	200.00	270.00	425.00
73	1994	FALL	147	196.13	2.5000	1710.00	218.08	17.99	111	35.00	90.00	140.00	230.00	530.00
73	1994	SPRING	120	235.25	2.5000	1430.00	206.71	18.87	88	30.00	120.00	170.00	307.50	645.00
73	1994	SUMMER	152	243.41	3.7500	860.00	160.50	13.02	66	60.00	135.00	205.00	312.50	570.00
73	1994	WINTER	123	230.47	21.250	2070.00	254.58	22.95	110	60.00	100.00	160.00	260.00	580.00
73	1995	FALL	139	179.42	5.0000	1735.00	205.18	17.40	114	40.00	80.00	130.00	190.00	610.00
73	1995	SPRING	151	260.97	20.000	1900.00	244.52	19.90	94	40.00	135.00	200.00	320.00	610.00
73	1995	SUMMER	149	200.43	20.000	1580.00	176.30	14.44	88	45.00	100.00	165.00	240.00	485.00
73	1995	WINTER	147	187.87	2.5000	1190.00	154.21	12.72	82	40.00	100.00	160.00	220.00	425.00
73	1996	FALL	142	198.59	5.0000	1865.00	202.02	16.95	102	60.00	100.00	150.00	220.00	425.00
73	1996	SPRING	139	242.01	5.0000	2300.00	269.03	22.82	111	30.00	90.00	150.00	335.00	710.00
73	1996	SUMMER	111	221.82	2.5000	2350.00	263.20	24.98	119	40.00	105.00	170.00	240.00	570.00
73	1996	WINTER	147	239.06	5.0000	950.00	176.89	14.59	74	50.00	110.00	190.00	315.00	610.00
73	1997	FALL	94	177.61	10.000	1680.00	194.92	20.10	110	60.00	100.00	127.50	195.00	455.00
73	1997	SPRING	106	219.20	5.0000	1220.00	166.33	16.16	76	70.00	110.00	187.50	260.00	490.00

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Total_Phosphorus_ug_L

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1997	SUMMER	101	226.68	50.000	1000.00	165.70	16.49	73	70.00	120.00	180.00	260.00	525.00
73	1997	WINTER	104	260.24	5.0000	2020.00	268.80	26.36	103	50.00	112.50	180.00	277.50	695.00
73	1998	SPRING	47	176.81	5.0000	750.00	119.24	17.39	67	40.00	100.00	170.00	210.00	355.00
73	1998	WINTER	69	220.58	40.000	870.00	129.66	15.61	59	80.00	130.00	190.00	300.00	390.00
73	1999	FALL	4	188.56	186.99	190.12	1.81	0.90	1	186.99	186.99	188.56	190.12	190.12
73	1999	SUMMER	6	192.49	107.82	296.14	85.49	34.90	44	107.82	107.82	173.50	296.14	296.14
73	2000	SPRING	3	319.41	205.35	509.16	165.44	95.52	52	205.35	205.35	243.73	509.16	509.16

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 1997
Turbidity_FTU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	10	34.25	6.4500	120.00	45.78	14.48	134	6.45	7.00	10.75	29.00	120.00
34	1990	SPRING	8	40.86	9.1000	130.00	38.75	13.70	95	9.10	18.00	30.00	45.88	130.00
34	1990	SUMMER	10	19.66	1.6500	56.50	15.70	4.96	80	1.65	11.60	16.50	25.00	56.50
34	1990	WINTER	11	31.85	2.4000	75.00	22.19	6.69	70	2.40	16.00	24.00	47.00	75.00
34	1991	FALL	9	32.71	3.9000	113.50	36.39	12.13	111	3.90	7.85	17.00	49.00	113.50
34	1991	SPRING	14	41.25	3.1500	108.00	40.01	10.69	97	3.15	7.35	24.25	85.00	108.00
34	1991	SUMMER	13	36.19	9.0000	130.00	33.94	9.41	94	9.00	11.00	28.50	36.00	130.00
34	1991	WINTER	12	45.25	10.000	125.00	34.34	9.91	76	10.00	19.50	32.25	70.00	125.00
34	1992	FALL	7	22.93	3.0000	61.00	24.83	9.39	108	3.00	3.10	15.00	56.00	61.00
34	1992	SPRING	11	58.52	2.4000	120.00	42.66	12.86	73	2.40	16.00	52.00	98.00	120.00
34	1992	SUMMER	14	29.18	4.5000	99.50	23.36	6.24	80	4.50	15.00	24.50	36.00	99.50
34	1992	WINTER	14	71.79	24.000	150.00	34.67	9.26	48	24.00	42.00	70.00	97.00	150.00
34	1993	FALL	6	28.75	6.2000	75.00	30.65	12.51	107	6.20	6.30	12.50	60.00	75.00
34	1993	SPRING	9	56.77	6.7500	110.00	35.86	11.95	63	6.75	27.70	61.00	88.50	110.00
34	1993	SUMMER	9	39.98	.40000	100.00	37.66	12.55	94	0.40	12.00	21.00	71.00	100.00
34	1993	WINTER	4	46.00	27.000	76.00	21.02	10.51	46	27.00	33.00	40.50	59.00	76.00
34	1994	FALL	4	31.30	1.2000	92.00	41.58	20.79	133	1.20	4.60	16.00	58.00	92.00
34	1994	SPRING	5	57.30	14.500	102.00	37.20	16.64	65	14.50	25.00	62.50	82.50	102.00
34	1994	SUMMER	5	36.44	6.2000	88.50	32.84	14.69	90	6.20	13.50	28.00	46.00	88.50
34	1994	WINTER	4	49.28	1.1000	100.00	47.25	23.62	96	1.10	9.55	48.00	89.00	100.00
34	1995	FALL	3	17.77	7.3000	25.00	9.28	5.36	52	7.30	7.30	21.00	25.00	25.00
34	1995	SPRING	4	74.65	18.000	130.00	51.57	25.79	69	18.00	32.05	75.30	117.25	130.00
34	1995	SUMMER	4	54.38	22.500	93.00	35.50	17.75	65	22.50	24.25	51.00	84.50	93.00
34	1995	WINTER	2	57.00	25.000	89.00	45.25	32.00	79	25.00	25.00	57.00	89.00	89.00
34	1996	FALL	2	58.38	41.250	75.50	24.22	17.13	41	41.25	41.25	58.38	75.50	75.50
34	1996	SPRING	2	64.75	30.500	99.00	48.44	34.25	75	30.50	30.50	64.75	99.00	99.00
34	1996	SUMMER	2	54.75	22.500	87.00	45.61	32.25	83	22.50	22.50	54.75	87.00	87.00
34	1997	WINTER	2	52.00	29.000	75.00	32.53	23.00	63	29.00	29.00	52.00	75.00	75.00
73	1990	FALL	38	35.91	2.9000	150.00	28.67	4.65	80	4.60	14.50	26.75	55.00	78.00
73	1990	SPRING	35	60.77	6.8000	150.00	42.47	7.18	70	18.00	25.00	46.00	100.00	140.00
73	1990	SUMMER	20	36.47	9.3500	93.00	21.89	4.90	60	9.43	22.75	33.50	41.00	83.50
73	1990	WINTER	47	68.23	3.5000	180.00	50.83	7.41	75	5.70	24.50	55.00	97.50	170.00

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
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Turbidity_FTU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1991	FALL	29	26.62	2.5000	77.50	14.75	2.74	55	5.00	17.50	25.00	36.00	42.00
73	1991	SPRING	32	62.47	2.9000	180.00	39.14	6.92	63	5.30	37.75	65.00	77.00	130.00
73	1991	SUMMER	32	33.56	3.1000	130.00	27.14	4.80	81	4.50	16.00	23.50	47.50	79.50
73	1991	WINTER	40	71.74	3.1000	164.00	42.79	6.77	60	4.83	27.00	80.00	100.00	138.75
73	1992	FALL	38	25.69	3.9000	93.00	19.17	3.11	75	4.10	13.00	21.00	36.00	61.00
73	1992	SPRING	33	56.12	5.8000	150.00	32.25	5.61	57	12.00	34.00	60.00	70.00	106.50
73	1992	SUMMER	39	52.91	11.000	140.00	31.77	5.09	60	12.00	27.00	58.00	70.00	120.00
73	1992	WINTER	30	69.03	2.5000	170.00	48.18	8.80	70	2.90	23.00	78.75	97.50	170.00
73	1993	FALL	20	66.43	5.0000	190.00	44.53	9.96	67	16.25	41.50	56.25	65.25	175.00
73	1993	SPRING	28	59.04	9.6000	165.00	33.91	6.41	57	11.15	35.23	56.25	79.75	110.00
73	1993	SUMMER	32	39.85	4.9000	110.00	35.21	6.22	88	5.00	11.58	22.00	76.00	98.00
73	1993	WINTER	34	66.13	7.5000	190.00	39.33	6.75	59	10.00	37.50	65.00	92.50	140.00
73	1994	FALL	12	15.56	2.5000	77.00	20.31	5.86	131	2.50	5.50	8.38	17.00	77.00
73	1994	SPRING	19	40.69	9.5000	90.00	22.59	5.18	56	9.50	23.00	36.00	50.00	90.00
73	1994	SUMMER	22	37.31	4.0000	150.00	35.20	7.51	94	4.10	16.00	26.58	41.00	94.00
73	1994	WINTER	21	55.23	2.5000	160.00	35.09	7.66	64	16.00	37.00	49.00	68.00	120.00
73	1995	FALL	8	10.91	2.4000	29.00	10.98	3.88	101	2.40	3.65	5.35	18.93	29.00
73	1995	SPRING	14	83.29	17.000	140.00	40.56	10.84	49	17.00	38.50	93.00	120.00	140.00
73	1995	SUMMER	12	41.63	9.0000	110.00	27.81	8.03	67	9.00	20.03	42.25	52.75	110.00
73	1995	WINTER	16	44.49	4.8500	120.00	31.00	7.75	70	4.85	24.00	36.00	54.50	120.00
73	1996	FALL	14	42.21	15.000	96.50	20.80	5.56	49	15.00	26.00	42.50	51.00	96.50
73	1996	SPRING	12	40.88	5.1000	73.50	22.77	6.57	56	5.10	25.00	42.50	62.75	73.50
73	1996	SUMMER	13	29.03	1.7000	60.00	16.68	4.63	57	1.70	16.00	31.00	40.00	60.00
73	1996	WINTER	11	63.09	17.000	130.00	38.98	11.75	62	17.00	18.00	60.00	84.00	130.00
73	1997	SPRING	3	42.83	23.500	55.00	16.93	9.77	40	23.50	23.50	50.00	55.00	55.00
73	1997	WINTER	6	119.50	7.5000	180.00	72.10	29.44	60	7.50	79.50	135.00	180.00	180.00

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1993 to 1997
Turbidity_JCU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1993	WINTER	3	9.27	7.8000	10.00	1.27	0.73	14	7.80	7.80	10.00	10.00	10.00
73	1996	FALL	1	18.00	18.000	18.00	.	.	.	18.00	18.00	18.00	18.00	18.00
73	1996	SPRING	1	12.00	12.000	12.00	.	.	.	12.00	12.00	12.00	12.00	12.00
73	1997	SUMMER	1	9.50	9.5000	9.50	.	.	.	9.50	9.50	9.50	9.50	9.50

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Turbidity_NTU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1990	FALL	11	19.77	5.0000	44.00	13.89	4.19	70	5.00	5.80	18.00	32.00	44.00
34	1990	SPRING	11	74.41	12.000	119.00	38.14	11.50	51	12.00	32.00	80.00	107.00	119.00
34	1990	SUMMER	14	38.52	6.5000	96.00	32.44	8.67	84	6.50	14.00	24.50	56.00	96.00
34	1990	WINTER	11	64.95	18.000	110.00	27.98	8.44	43	18.00	31.50	70.00	80.00	110.00
34	1991	FALL	1	32.00	32.000	32.00	.	.	.	32.00	32.00	32.00	32.00	32.00
34	1991	SPRING	13	78.85	9.8000	175.00	50.82	14.10	64	9.80	56.00	63.00	82.50	175.00
34	1991	SUMMER	13	37.85	16.500	76.00	20.21	5.61	53	16.50	25.50	31.00	38.00	76.00
34	1992	FALL	4	23.13	6.0000	64.00	27.53	13.77	119	6.00	6.75	11.25	39.50	64.00
34	1992	SPRING	13	89.85	14.000	175.00	54.32	15.07	60	14.00	40.00	76.50	124.50	175.00
34	1992	SUMMER	13	37.39	7.0500	100.00	25.76	7.15	69	7.05	26.00	30.00	39.00	100.00
34	1992	WINTER	13	73.90	14.000	170.00	48.13	13.35	65	14.00	32.50	64.00	103.00	170.00
34	1993	FALL	13	25.52	5.2000	50.00	15.63	4.34	61	5.20	11.00	22.75	37.00	50.00
34	1993	SPRING	12	76.48	9.3000	168.00	50.31	14.52	66	9.30	44.00	67.50	98.75	168.00
34	1993	SUMMER	13	31.08	11.000	80.00	21.22	5.89	68	11.00	16.50	20.00	38.00	80.00
34	1993	WINTER	13	68.04	10.000	140.00	36.59	10.15	54	10.00	60.00	68.00	78.00	140.00
34	1994	FALL	13	24.94	5.0000	55.00	14.84	4.11	59	5.00	17.00	25.50	30.00	55.00
34	1994	SPRING	12	95.04	22.000	190.00	50.56	14.59	53	22.00	48.75	100.00	125.00	190.00
34	1994	SUMMER	13	52.30	10.000	128.00	33.65	9.33	64	10.00	35.00	50.00	68.00	128.00
34	1994	WINTER	13	74.22	7.9000	129.00	43.56	12.08	59	7.90	38.00	70.00	110.00	129.00
34	1995	FALL	13	27.33	9.3500	60.00	15.86	4.40	58	9.35	16.00	26.00	30.00	60.00
34	1995	SPRING	12	90.29	14.000	170.00	48.37	13.96	54	14.00	57.50	75.00	136.25	170.00
34	1995	SUMMER	13	39.52	9.5000	80.00	22.70	6.30	57	9.50	20.00	45.00	50.00	80.00
34	1995	WINTER	12	69.58	11.000	120.00	42.12	12.16	61	11.00	27.50	82.50	107.50	120.00
34	1996	FALL	13	25.77	4.0000	42.00	13.24	3.67	51	4.00	11.00	29.00	34.00	42.00
34	1996	SPRING	12	63.35	6.7000	160.00	45.12	13.02	71	6.70	27.00	53.50	93.50	160.00
34	1996	SUMMER	13	30.86	6.1500	80.00	19.43	5.39	63	6.15	18.00	28.00	35.00	80.00
34	1996	WINTER	13	65.46	17.000	105.00	30.98	8.59	47	17.00	48.00	75.00	80.00	105.00
34	1997	FALL	13	31.95	7.4000	65.00	18.78	5.21	59	7.40	19.00	27.00	49.50	65.00
34	1997	SPRING	11	79.31	9.4000	136.00	44.68	13.47	56	9.40	25.00	92.50	120.00	136.00
34	1997	SUMMER	13	54.69	13.500	130.00	33.40	9.26	61	13.50	26.00	60.00	70.00	130.00
34	1997	WINTER	12	59.83	21.000	100.00	24.52	7.08	41	21.00	43.50	62.00	75.00	100.00
34	1998	SPRING	10	119.15	14.000	190.00	50.59	16.00	42	14.00	90.00	130.00	160.00	190.00

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1990 to 2000
Turbidity_NTU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
34	1998	WINTER	13	66.35	17.000	153.50	36.50	10.12	55	17.00	39.00	67.00	80.50	153.50
73	1990	FALL	69	24.54	4.0000	170.00	23.39	2.82	95	5.90	10.00	20.00	29.00	59.00
73	1990	SPRING	69	55.18	6.4000	185.00	47.96	5.77	87	12.80	21.00	40.00	64.00	175.00
73	1990	SUMMER	68	34.69	6.8000	121.00	27.53	3.34	79	8.20	15.00	23.50	51.75	102.00
73	1990	WINTER	68	57.80	3.5000	160.00	37.29	4.52	65	7.70	28.50	52.25	80.00	140.00
73	1991	FALL	25	32.93	3.5000	107.00	29.97	5.99	91	4.40	7.80	25.00	44.00	95.00
73	1991	SPRING	81	44.74	5.0000	196.00	39.83	4.43	89	11.50	20.00	31.00	49.25	133.00
73	1991	SUMMER	93	29.26	1.4500	128.00	21.76	2.26	74	7.00	13.00	23.00	41.00	66.00
73	1991	WINTER	20	42.54	4.3000	160.00	33.11	7.40	78	7.15	24.50	33.50	49.50	120.00
73	1992	FALL	39	21.40	3.0000	68.50	15.94	2.55	74	3.60	8.00	15.00	32.00	58.60
73	1992	SPRING	97	40.64	4.1000	167.00	32.80	3.33	81	6.60	18.50	28.60	53.00	124.00
73	1992	SUMMER	95	37.81	3.0000	157.00	32.92	3.38	87	5.80	16.00	24.00	50.00	115.50
73	1992	WINTER	97	42.79	4.9000	180.00	36.02	3.66	84	6.40	19.00	30.00	51.00	126.00
73	1993	FALL	99	26.90	3.0000	100.95	20.35	2.05	76	5.60	13.00	21.00	34.00	77.10
73	1993	SPRING	91	52.40	2.0000	190.00	46.02	4.82	88	10.00	20.00	36.25	65.50	165.00
73	1993	SUMMER	104	32.17	1.9000	138.00	27.00	2.65	84	4.60	13.00	22.50	48.00	82.50
73	1993	WINTER	102	49.20	5.4500	198.00	33.03	3.27	67	12.00	23.00	44.00	66.00	107.00
73	1994	FALL	130	25.88	1.0000	120.00	20.44	1.79	79	5.00	12.00	20.00	34.00	70.00
73	1994	SPRING	94	46.16	3.4000	193.00	39.21	4.04	85	8.30	20.00	30.00	65.00	145.00
73	1994	SUMMER	127	41.85	3.0500	133.00	32.00	2.84	76	7.20	18.00	31.00	55.00	111.00
73	1994	WINTER	97	43.09	3.0500	188.00	35.59	3.61	83	8.00	20.80	33.00	50.00	130.00
73	1995	FALL	132	20.88	2.2000	109.50	18.04	1.57	86	4.10	9.88	16.50	25.00	49.00
73	1995	SPRING	130	46.96	1.0000	160.00	35.96	3.15	77	10.00	20.00	36.50	65.00	120.00
73	1995	SUMMER	133	30.82	1.5000	180.00	29.96	2.60	97	5.50	14.00	21.00	36.00	92.00
73	1995	WINTER	127	45.37	2.8000	188.00	41.31	3.67	91	6.60	17.00	32.50	57.00	160.00
73	1996	FALL	132	27.58	1.7000	170.00	28.59	2.49	104	3.50	8.80	19.75	35.00	78.00
73	1996	SPRING	121	44.47	3.8500	198.00	40.62	3.69	91	7.20	16.50	33.00	60.00	130.00
73	1996	SUMMER	97	29.54	2.3000	175.00	27.87	2.83	94	3.40	11.00	20.00	41.00	83.00
73	1996	WINTER	134	54.47	1.6000	195.00	45.63	3.94	84	7.80	20.00	36.00	80.00	165.00
73	1997	FALL	94	23.81	2.0000	105.00	19.76	2.04	83	5.10	10.00	18.50	29.00	75.00
73	1997	SPRING	100	36.93	1.1000	162.00	32.71	3.27	89	7.13	15.00	25.00	51.50	114.75
73	1997	SUMMER	99	40.51	3.1500	150.00	31.10	3.13	77	5.20	19.00	33.00	54.00	110.00

Aggregate Nutrient Ecoregion: X
Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
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Turbidity_NTU

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1997	WINTER	93	45.51	3.6000	180.00	42.65	4.42	94	6.50	18.00	30.00	62.00	156.00
73	1998	SPRING	47	63.87	10.000	170.00	39.33	5.74	62	18.00	32.00	50.50	90.00	135.00
73	1998	WINTER	65	65.68	5.3000	198.00	46.40	5.76	71	13.00	31.50	59.00	89.00	166.00
73	1999	FALL	4	1.00	.00000	2.00	1.15	0.58	115	0.00	0.00	1.00	2.00	2.00
73	1999	SUMMER	6	12.00	5.0000	16.00	5.44	2.22	45	5.00	5.00	15.00	16.00	16.00
73	2000	SPRING	3	218.33	15.000	435.00	210.32	121.43	96	15.00	15.00	205.00	435.00	435.00
73	2000	SUMMER	3	41.67	17.000	57.00	21.57	12.45	52	17.00	17.00	51.00	57.00	57.00

Rivers and Streams
Descriptive Statistics by Subecoregion, Year and Season
from 1999 to 2000
pH_S_U

subecoregion	year	season	N	MEAN	MIN	MAX	STDDEV	STDERR	CV	P5	P25	MEDIAN	P75	P95
73	1999	FALL	4	8.50	7.8400	9.15	0.76	0.38	9	7.84	7.84	8.50	9.15	9.15
73	1999	SUMMER	6	8.19	8.0500	8.43	0.19	0.08	2	8.05	8.05	8.08	8.43	8.43
73	2000	SPRING	3	8.32	7.7100	9.06	0.69	0.40	8	7.71	7.71	8.18	9.06	9.06
73	2000	SUMMER	3	7.96	7.7300	8.20	0.24	0.14	3	7.73	7.73	7.95	8.20	8.20

APPENDIX C

Quality Control/Quality Assurance Rules

INDUS CORPORATION
Knowledge-Based Solutions

Continued Support for the Compilation and Analysis of National Nutrient Data

9 Nutrient Ecoregion/Waterbody Type Summary Chapters

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Appendix C—Quality Control/Quality Assurance Rules

CONTENTS

1.0 BACKGROUND

The Nutrient Criteria Program initiated the development of a national Nutrient Criteria Database application that is used to store and analyze nutrient data. The ultimate use of these data is to derive ecoregion specific nutrient criteria. 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 are used to develop national nutrient criteria recommendations.

1.1 Purpose

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

- Lakes and Reservoirs
  - Aggregate Nutrient ecoregions: 3, 4, 5, and 14
- Rivers and Streams
  - Aggregate Nutrient ecoregions: 1, 4, 5, 8, and 10

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 Document: 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
- EPA Region 1
- EPA Region 2 - Lake Champlain Monitoring Project
- EPA Region 2 - NYSDEC Finger Lakes Monitoring Program
- EPA Region 2 - NY Citizens Lake Assessment Program
- EPA Region 2 - Lake Classification and Inventory Survey
- EPA Region 2 - NYCDEP (1990-1998)
- EPA Region 2 - NYCDEP (Storm Event data)
- EPA Region 2 - New Jersey Nutrient Data (Tidal Waters)
- EPA Region 5
- EPA Region 3
- EPA Region 3 - Nitrite Data
- EPA Region 3 - Choptank River files
- EPA Region 4 - Tennessee Valley Authority
- EPA Region 7 - Central Plains Center for BioAssessment (CPCB)
- EPA Region 7 - REMAP
- EPA Region 2 - Delaware River Basin Commission (1990-1998)
- EPA Region 3 - PA Lake Data
- EPA Region 3 - University of Delaware
- EPA Region 10
- University of Auburn
- EPA Region 8 - MT and WY
- EPA Region 9
- Suffolk County
- NYCDEC
- NY Lakes Morphometry
- EPA Region 8 - South Dakota
- EPA Region 8 - Colorado Reservoir
- EPA Region 4
- EPA Region 10 - Lake Data
- EPA Region 7 - Central Plains Center for BioAssessment (CPCB) 2
- EPA Region 8 - North Dakota
- EPA Region 8 - Eagle River
- EPA Region 8 - Utah
- Florida

As part of the conversion process, INDUS performed a number of Quality Assurance/Quality Control (QA/QC) steps to ensure that the data were properly converted into the Nutrient Criteria Database. Sections 2.1 and 2.2 explain 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. However, if there was not enough information provided to determine duplicates such as sampling date, there was no way for INDUS to locate 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.

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. In other cases, the methods are unknown.

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 were 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, the county centroid, or HUC (Hydrological Unit Code) centroid. If a station was lacking latitude and longitude coordinates and 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 were 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/HUC listed in the station table. The county information was assumed to be correct; therefore, the county centroid was used.

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

- The latitude and longitude coordinates and county were missing, but the HUC information was available.

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, state, county, 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, state, county, 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 to 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 waterbody 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 waterbody 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 aggregate nutrient ecoregion for all seasons 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. 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.

4.0 TIME PERIOD

Data collected from January 1990 to December 2000 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, 3, 4, 5, 9, 10, 11, 12, 13, and 14
  - 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, data for the following parameters were grouped together and reported under 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 3

Data Sources:

Legacy STORET
EPA Region 10
EPA Region 8 - Colorado Reservoir

Parameters:

Chlorophyll A, Fluorometric, corrected (ug/L)
Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Chlorophyll A, Trichromatic, uncorrected (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
SECCHI (m)
pH

Level III ecoregions:

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

5.1.2 Aggregate Nutrient Ecoregion 4

Data Sources:

Legacy STORET
EPA Region 8 - MT and WY
EPA Region 8 - South Dakota
EPA Region 8 - North Dakota

Parameters:

Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Chlorophyll A, Trichromatic, uncorrected (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (% Saturated)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)

Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
SECCHI (m)
pH

Level III ecoregions:

26, 28, 30, 31, 43, 44

5.1.3 Aggregate Nutrient Ecoregion 5

Data sources:

Legacy STORET
EPA Region 8 - MT and WY
EPA Region 8 - South Dakota
EPA Region 8 - North Dakota

Parameters:

Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Chlorophyll A, Trichromatic, uncorrected (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (% Saturated)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
SECCHI (m)
pH

Level III ecoregions:

25, 27, 32, 42

5.1.4 Aggregate Nutrient Ecoregion 14

Data sources:

Legacy STORET
Region 2 - NY Citizens Lake Assessment Program
Region 2 - NYCDEP (1990-1998)
EPA Region 1

Parameters:

CHLB (ug/L)
CHLC (ug/L)
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)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
SECCHI (m)
pH

Level III ecoregions:

59, 63, 84

5.2 Rivers and Streams

5.2.1 Aggregate Nutrient Ecoregion 1

Data sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 10

Parameters:

Chlorophyll A, Fluorometric, corrected (ug/L)
Chlorophyll A, Periphyton, spectrophotometric, uncorrected (mg/sqm)
Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Chlorophyll A, Trichromatic, uncorrected (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
Phosphorus, orthophosphate, total, as P(ug/L)
Turbidity (FTU)

Turbidity (NTU)
Turbidity (JCU)
pH

Level III ecoregions:

3, 7

5.2.2 Aggregate Nutrient Ecoregion 4

Data sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 7 - Central Plains Center for BioAssessment (CPCB)
EPA Region 7 - Central Plains Center for BioAssessment (CPCB) 2
EPA Region 7 - REMAP
EPA Region 8 - MT and WY
EPA Region 8 - South Dakota
EPA Region 8 - North Dakota

Parameters:

Chlorophyll A, Fluorometric, corrected (ug/L)
Chlorophyll A, Pheophytin, corrected (ug/L)
Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (% Saturated)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Organic_P (ug/L)
Phosphorus, Total (TP) (ug/L)
Phosphorus, orthophosphate, total, as P(ug/L)
Turbidity (FTU)
Turbidity (NTU)
Turbidity (JCU)
pH

Level III ecoregions:

26, 28, 30, 31, 43, 44

5.2.3 Aggregate Nutrient Ecoregion 5

Data sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 7 - Central Plains Center for BioAssessment (CPCB)
EPA Region 7 - Central Plains Center for BioAssessment (CPCB) 2
EPA Region 7 - REMAP
EPA Region 8 - MT and WY
EPA Region 8 - South Dakota
EPA Region 8 - North Dakota

Parameters:

Chlorophyll A, Fluorometric, corrected (ug/L)
Chlorophyll A, Pheophytin, corrected (ug/L)
Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (% Saturated)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Organic_P (ug/L)
Phosphorus, Total (TP) (ug/L)
Phosphorus, orthophosphate, total, as P (ug/L)
Turbidity (FTU)
Turbidity (NTU)
Turbidity (JCU)
pH

Level III ecoregions:

25, 27, 32, 42

5.2.4 Aggregate Nutrient Ecoregion 8

Data sources:

Legacy STORET
NASQAN
NAWQA
EPA Region 2 - NYCDEP (1990-1998)
EPA Region 1

EPA Region 3
EPA Region 5

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)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (% Saturated)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)
Nitrogen, Total Kjeldhal (TKN) (mg/L)
Phosphorus, Total (TP) (ug/L)
Phosphorus, orthophosphate, total, as P (ug/L)
Turbidity (FTU)
Turbidity (NTU)
pH

Level III ecoregions:

49, 50, 58, 62, 82

5.2.5 Aggregate Nutrient Ecoregion 10

Data sources:

Legacy STORET
NASQAN
EPA Region 7 - Central Plains Center for BioAssessment (CPCB)
EPA Region 7 - Central Plains Center for BioAssessment (CPCB) 2
EPA Region 7 - REMAP

Parameters:
Chlorophyll A, Fluorometric, corrected (ug/L)
Chlorophyll A, Pheophytin, corrected (ug/L)
Chlorophyll A, Phytoplankton, chromotographic- fluorometric (ug/L)
Chlorophyll A, Phytoplankton, spectrophotometric Acid (ug/L)
Chlorophyll A, Trichromatic, uncorrected (ug/L)
Chlorophyll B, Phytoplankton, chromotographic- fluorometric (ug/L)
Dissolved Inorganic Phosphorus (DIP) (ug/L)
Dissolved Oxygen (DO) (mg/L)
Nitrite and Nitrate, (NO2+NO3) (mg/L)
Nitrogen, Total (TN) (mg/L)

Nitrogen, Total Kjeldhal (TKN) (mg/L)
Organic_P (ug/L)
Phosphorus, Total (TP) (ug/L)
Phosphorus, orthophosphate, total, as P(ug/L)
Turbidity (FTU)
Turbidity (NTU)
Turbidity (JCU)
pH

Level III ecoregions:

34, 73

APPENDIX A. Process Used to QA/QC 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

TABLE 2: STORET REMARK CODE RULES	
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

The flag_id tracks the type of changes that were made to the data. There are a total of eight flags that are used to describe the changes made to the data. The flags are defined as follows:

1—The latitude and longitude coordinates match the county that was provided. If the HUC was null, it was updated based on the latitude and longitude coordinates. The ecoregions were determined by using the latitude and longitude coordinates.

2—The county and HUC are available, but the latitude and/or longitude coordinates are missing. Therefore, the centroid of the intersection of the county and HUC was used to determine the ecoregions and the latitude and longitude coordinates. If the HUC and county did not intersect, the county centroid was used to determine the ecoregions and the latitude and longitude coordinates.

3—The county is available, but the HUC and the latitude and/or longitude coordinates are missing. Therefore, the county centroid was used to determine the ecoregions, HUC, and the latitude and longitude coordinates.

4—The HUC is available, but the county is not and the latitude and/or longitude coordinates are missing. Therefore, the HUC centroid was used to determine the ecoregions, county, and the latitude and longitude coordinates.

5—The county is missing, but the latitude and longitude coordinates are available. Note: A county is considered missing if it is invalid. In other words, if the county entered did not exist in the state, it was considered null. Therefore, the latitude and longitude coordinates were used to determine the ecoregions, county, and HUC (if it was missing).

6—The latitude and longitude coordinates did not match the county that was provided, but they did match the HUC. Therefore, the county centroid was used to determine ecoregion values.

7—The latitude and longitude coordinates did not match the county or the HUC that was provided (including null HUCs). Therefore, the county centroid was used to determine ecoregion values.

8—The latitude and longitude coordinates were missing, but the ecoregions were provided by the state.
The ecoregions provided by the states were used as the ecoregion values.

APPENDIX C. Glossary

Coefficient of Variation - A measure of variability. The standard deviation divided by the mean multiplied by 100.

Maximum - The highest value.

Mean – A measure of central tendency. The arithmetic average.

Median – A measure of central tendency. The value which cuts the distribution in half, such that half of the values are above the median, and half of the values are below the median. Also called the 50th percentile or middle value.

Minimum - The lowest value.

Standard Deviation – A measure of variability. 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 - A measure of variability. The standard deviation divided by the square root of the sample size.

5^{th} % - the 5^{th} percentile

25^{th} % - the 25^{th} percentile, the first quartile.

75^{th} % - the 75^{th} percentile, the third quartile.

95^{th} % - the 95^{th} percentile