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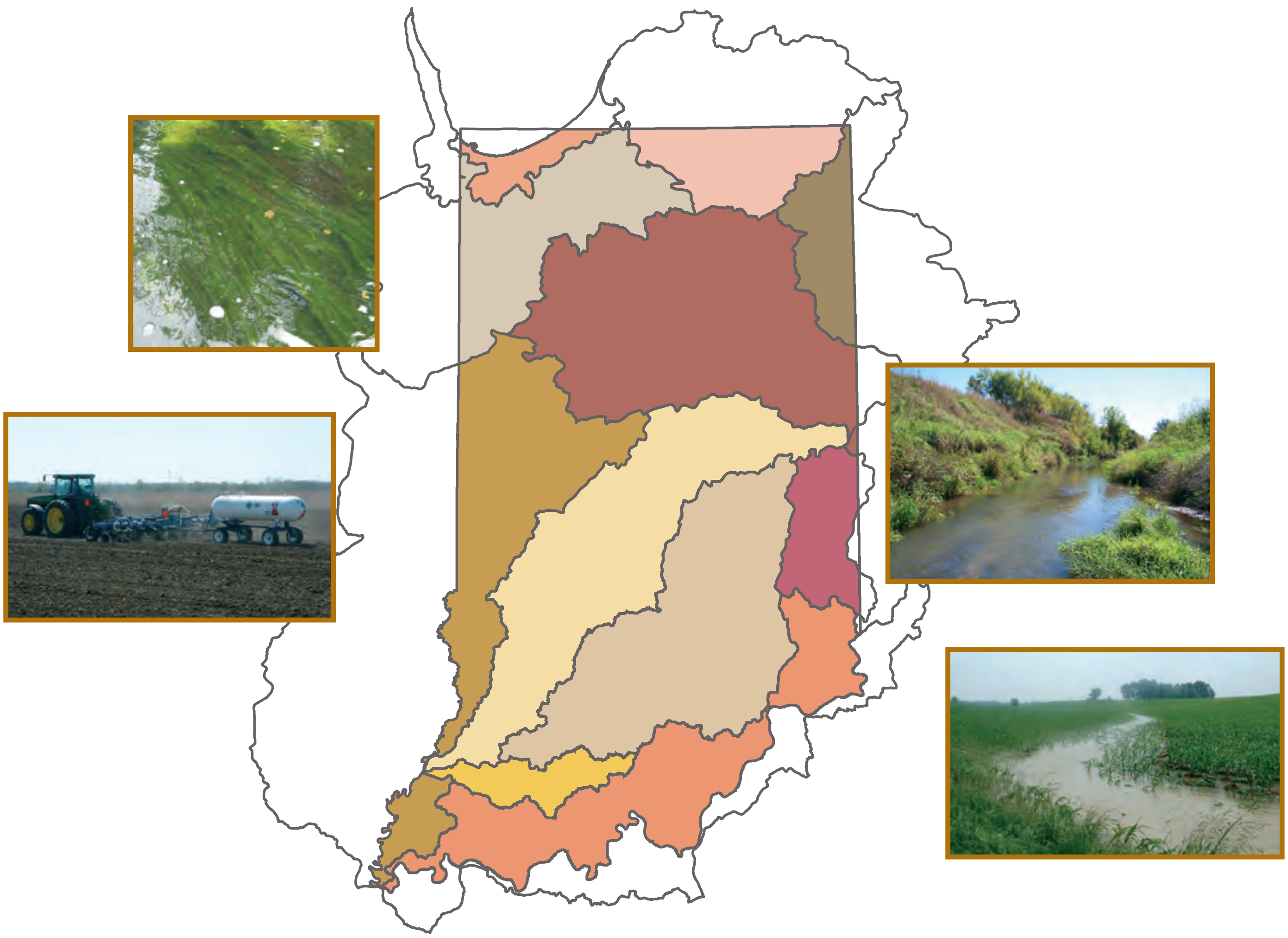
Occurrence and Distribution of Algal Biomass and Its Relation to Nutrients and Selected Basin Characteristics in Indiana Streams, 2001–2005



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By B. Scott Lowe, Donald R. Leer, Jeffrey W. Frey, and Brian J. Caskey

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U.S. Geological Survey

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Front cover photographs

Upper left: An algal mass in water, unknown location in Indiana.
Photograph from USGS Indiana Water Science Center files.

Upper right: Cobb Ditch near Kouts, Ind.
Photograph by B. Scott Lowe, USGS, taken on September 21, 2004.

Lower left: A tractor applying fertilizer to a farm field in the Leary Weber Ditch watershed.
Photograph by John T. Wilson, USGS, taken on April 23, 2003.

Lower right: Water flowing through a farm field in the Sugar Creek watershed.
Photograph by John T. Wilson, USGS, taken on June 17, 2003.

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Conversion Factors

Multiply	By	To obtain
	Length	
centimeter (cm)	0.3937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
	Area	
square centimeter (cm^2)	0.001076	square foot (ft^2)
square meter (m^2)	10.76	square foot (ft^2)
square kilometer (km^2)	0.3861	square mile (mi^2)
	Volume	
liter (L)	0.2642	gallon (gal)
cubic meter (m^3)	264.2	gallon (gal)
cubic meter (m^3)	35.31	cubic foot (ft^3)
	Flow rate	
meter per second (m/s)	3.281	foot per second (ft/s)
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)
	Mass	
gram (g)	0.03527	ounce, avoirdupois (oz)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

°F=(1.8×°C)+32

Horizontal coordinate information used in the map is referenced to the North American Datum of 1927 (NAD 27). Sampling-site coordinate information used a Global Positioning System (GPS) referenced to North American Datum of 1983 (NAD 83), which then was converted to NAD27.

Concentrations of chemical and algal-biomass constituents in water are given either in milligrams per liter (mg/L) or micrograms per liter (µg/L). Concentrations of periphyton algal biomass are given in milligrams per square meter (mg/m^2), or grams per square meter (g/m^2).

Abbreviations

Abbreviations and acronyms used in this report:

CWA	Clean Water Act
USEPA	U.S. Environmental Protection Agency
IDEM	Indiana Department of Environmental Management
WMP	Watershed Monitoring Program
USGS	U.S. Geological Survey
NAWQA	National Water-Quality Assessment Program
NWQL	National Water Quality Laboratory
NLCD	National Land Cover Dataset
IN	Indiana, in a streamflow-gaging station name
N	nitrogen
P	phosphorus
TN	total nitrogen
TP	total phosphorus
CHLa	chlorophyll *a*
TKN	total Kjeldahl nitrogen
AFDM	ash-free dry mass
r_s	Spearman's rho statistic

Occurrence and Distribution of Algal Biomass and Its Relation to Nutrients and Selected Basin Characteristics in Indiana Streams, 2001–2005

By B. Scott Lowe, Donald R. Leer, Jeffrey W. Frey, and Brian J. Caskey

Abstract

Algal biomass and nutrient data were gathered at 322 randomly selected sites on 261 streams in the West Fork White River, Whitewater River, East Fork White River, Upper Wabash River, Kankakee River, Lower Wabash River, Tributaries to the Great Lakes, and Tributaries to the Ohio River Basins in Indiana from May through October for years 2001 through 2005. Basin characteristics (land use and drainage area), substrate, turbidity, and nutrient concentrations were determined for the basin and sampling sites. The relations of the seasonal algal biomass parameters periphyton chlorophyll *a* (CHLa), ash-free dry mass (AFDM), seston CHLa, and particulate organic carbon (POC) to concentrations of the seasonal nutrients nitrate, total Kjeldahl nitrogen (TKN), total nitrogen (TN), and total phosphorus (TP) were determined using Spearman's rho. The effects of streamflow were determined using data collected at U.S. Geological Survey (USGS) streamflow-gaging stations spatially located throughout the study basins.

Throughout the 5-year study, the magnitude and frequency of stream discharge varied monthly and annually and greatly influenced algal biomass concentrations through scour and algal drift. Algal biomass median concentrations in Indiana streams consisted of periphyton CHLa, 41.2 milligrams per square meter (mg/m^2); AFDM, 52.1 grams per square meter (g/m^2); seston CHLa, 2.44 micrograms per liter (µg/L); and POC, 0.75 milligrams per liter (mg/L). Approximately 32 percent of the periphyton CHLa and 6 percent of the seston CHLa samples would be considered eutrophic (nutrient enriched).

To ascertain seasonal variability, samples were collected in the spring (May), summer (June through August), and fall (September through October). The highest median concentration of periphyton CHLa was in the spring, 63.2 mg/m^2, while the highest median concentrations of AFDM, seston CHLa, and POC were in the summer 55.4 g/m^2, 2.96 µg/L, and 0.81 mg/L respectively. There were no significant differences among seasons for periphyton CHLa and AFDM; there were significant differences among seasons for seston CHLa and POC.

There were no significant relations with nutrients and periphyton or seston CHLa parameters. The only significant positive relations were observed between summer POC and summer TP as well as summer POC and summer TKN. Positive relations also related spring POC and spring TP. These significant relations with TP are most likely related to phosphorus associated within seston algal cells and attached to sediment.

Drainage area and land use were analyzed to understand the effect of site location on algal growth. Study basins varied in size (headwater streams, 0–51 km^2; wadable streams, 52–2,590 km^2; and boatable streams, 2,591–38,900 km^2) and were dominated by agricultural land use. Basin characteristics (land use, drainage area) as well as substrate type, turbidity, and nutrients, affected the concentration of algal biomass parameters. Of the eight basins in which samples were collected during the 5-year study, the Whitewater River Basin (2002) had the highest median concentration of periphyton CHLa (63.1 mg/m^2), the Tributaries to the Great Lakes (2005) exhibited the highest median concentration for AFDM (160 g/m^2), the East Fork White River Basin (2002) had nearly twice the median concentration (4.01 µg/L) of seston CHLa as the other basins, and the West Fork White River Basin (2001) exhibited the highest median concentration of POC (1.10 mg/L). Of the eight major basins sampled, 15–45 percent of the periphyton CHLa and up to 20 percent of the seston CHLa samples were eutrophic. Samples collected at headwater and wadable streams were the most eutrophic for periphyton CHLa (31–36 percent) and 28 percent of samples collected at boatable streams were eutrophic for seston CHLa.

As basin size increased, seston CHLa and POC concentrations increased while periphyton CHLa and AFDM concentrations decreased. The median turbidity values ranged from 6.95 NTU for headwater streams to 8.27 NTU for wadable streams, and 17.0 NTU for boatable streams. In addition, the types and availability of periphytic substrates (epilithic, epipsammic, or epidendric) were an important factor when comparing periphyton CHLa and AFDM concentrations in the study due to the periphytic substrates individual susceptibility to bed movement and scouring. Periphyton CHLa median concentrations ranged from 53.8 mg/m^2 for epilithic substrates,

to 41.8 mg/m^2 for epipsammic substrates, and 17.2 mg/m^2 for epidendric substrates. Higher AFDM concentrations were collected from epipsammic substrates during years of low stream discharge velocity, which enhanced the settling of organic matter on epipsammic substrates. AFDM median concentrations ranged from 141 g/m^2 for epipsammic to 28.8 g/m^2 for epilithic and 22.9 g/m^2 for epidendric substrates.

The seasonal values for nutrients (nitrate, TKN, TN, and TP) and algal biomass (periphyton CHLa, AFDM, seston CHLa, and POC) were compared to published U. S. Environmental Protection Agency (USEPA) values for their respective ecoregions. Algal biomass values either were greater than the 25th percentile published USEPA values or extended the range of data in Aggregate Nutrient Ecoregions VI, VII, IX and USEPA Level III Ecoregions 54, 55, 56, 71, and 72. If the values for the 25th percentile proposed by the USEPA were adopted as nutrient water-quality criteria, then about 71 percent of the nutrient samples and 57 percent of the CHLa samples within the eight study basins would be considered nutrient enriched.

Introduction

Although nutrients are essential to the health and diversity of surface waters, excessive inputs of nutrients into streams have potential human-health, economic, and ecological consequences. Excess amounts of nutrients—nitrogen (N) and phosphorus (P), in particular—have been shown to cause eutrophication in aquatic ecosystems, and this sometimes has been linked to fish kills, shifts in species composition, disagreeable taste and odor in drinking-water, and blooms of harmful algae in freshwater and estuaries (Munn and Hamilton, 2003; U.S. Environmental Protection Agency, 2000a, b, c).

The Clean Water Act (CWA) as amended in 1976 established a national goal of achieving water quality that provides for the protection and propagation of aquatic organisms, wildlife, and recreation in and on the water. In 1996, the U.S. Environmental Protection Agency's (USEPA) National Water Quality Inventory identified excess amounts of nutrients as the second leading cause of impairment in rivers and streams across the United States (the leading cause was siltation) (U.S. Environmental Protection Agency, 1997a). The excess amounts of nutrients that have been documented in many rivers and streams have resulted in streams that do not meet the goal of the CWA in Indiana and the nation.

The USEPA drinking-water criteria (maximum contaminant levels) are 10 mg/L for nitrate as N and 1 mg/L nitrite as N (U.S. Environmental Protection Agency, 2005). In addition, aquatic-life criteria established to protect aquatic organisms have been set for ammonia as N (the ammonia as N aquatic-life criteria varies with pH, temperature, and life-stage) (U.S. Environmental Protection Agency, 2005). These criteria do not address the effects of increased nutrients in rivers and streams on biological communities. Typically, nutrient concentrations must be extremely high to be toxic to biological communities; such concentrations rarely are found in the environment (Ohio Environmental Protection Agency, 1999). Exceptions are concentrations of ammonia associated with accidental discharges from wastewater-treatment facilities, combined-sewer overflows, or concentrated-animal feeding operations (Ohio Environmental Protection Agency, 1999).

Many streams within the United States have been placed by the USEPA on the CWA Section 303(d) list of impaired water bodies because of excess nutrients. In 2000, the USEPA proposed nutrient water-quality criteria for the causal nutrients total nitrogen (TN) and total phosphorus (TP) and for the response parameters periphyton CHLa, seston CHLa, and turbidity. However, little or no CHLa data existed for Nutrient Ecoregions VI, VII, and IX in Indiana and no criteria were proposed for periphyton CHLa (U.S. Environmental Protection Agency, 2000a, b, c). Criteria also have been proposed for nitrate and total Kjeldahl nitrogen (TKN) which constitute TN. These proposed nutrient water-quality criteria are based on USEPA Aggregate Nutrient Ecoregions, areas that have similar topography, soils, geology, land use, and biogeography (U.S. Environmental Protection Agency, 2000a, b, c). The USEPA reviewed selected data and set the proposed nutrient water-quality criteria for nitrate, TKN, TN, TP, CHLa (periphyton and seston), and turbidity at the 25th-percentile value of all data in each nutrient ecoregion for each parameter.

The USEPA mandated that by 2004 states either accept the proposed nutrient water-quality criteria or provide their own set of nutrient water-quality criteria that are more appropriate to the waters within each state (U.S. Environmental Protection Agency, 2000a, b, c). An extension was given to Indiana and other states that adopted plans describing the data needs and the process to develop nutrient water-quality criteria. Beginning in 2001, the Indiana Department of Environmental Management (IDEM) and the U.S. Geological Survey (USGS) cooperated on several studies, assisting the State of Indiana in developing nutrient water-quality criteria as mandated by the USEPA. The data and interpretations presented in this report should be representative of similar ecoregions in Illinois and Ohio. Similar algal biomass studies in east-central Illinois found no significant correlation between CHLa and nutrients, rather hydrology and light availability controlled algal abundance in agricultural streams (Morgan and others, 2006).

Purpose and Scope

This report discusses the occurrence and distribution of algal biomass and its relation to nutrients and selected basin characteristics in Indiana streams. Data were collected at 322 randomly selected sites on 261 streams within 8 river basins (the West Fork White River, Whitewater River, East Fork White River, Upper Wabash River, Kankakee River, Lower Wabash River, Great Lakes Tributaries, and Ohio River Tributaries) from 2001 through 2005 (fig. 1). The effectiveness of the fluorometric analysis for the algal biomass samples is discussed through quality assurance data analysis. Relations of seasonal algal biomass to seasonal nutrients are presented. A discussion of the basin characteristics of the 322 sites describes how land use, drainage area, streamflow, substrate type, and turbidity affect algal biomass growth. This report also compares values for the nutrients nitrate plus nitrite as N, TKN as N, TN as N, and TP as P and algal biomass values for periphyton CHLa, AFDM, seston CHLa, POC collected by IDEM and USGS to values published by the USEPA for Aggregate Nutrient Ecoregions VI—Corn Belt and Northern Great Plains; VII—Mostly Glaciated Dairy Region; IX—Southeastern Temperate Forested Plains and Hills and for Level III Ecoregions 54—Central Corn Belt Plains; 55—Eastern Corn Belt Plains; 56—Southern Michigan / Northern Indiana Drift Plains; 71—Interior Plateau; and 72—Interior River Lowland. Aggregate Nutrient Ecoregions consist of one or more Level III Ecoregions (U.S. Environmental Protection Agency, 2000a, b, c).

Data in this report were collected as part of a cooperative effort between IDEM and the USGS in which similar studies were completed as part of the IDEM probabilistic Watershed Monitoring Program (WMP) (Indiana Department of Environmental Management, 2001) in the West Fork White River Basin (2001), Whitewater River and East Fork White River Basins (2002), Upper Wabash (2003), Lower Wabash River and Kankakee River Basins (2004), and Great Lakes and Ohio River Basins (2005). The only major river basin that was not sampled for algal biomass was the Patoka River Basin in 2001. In these yearly WMP studies, IDEM collected habitat and biological community data, water quality samples, and nutrient samples from 2001 through 2003. To augment the IDEM WMP studies, the USGS collected algal biomass during all years and also collected water quality and nutrient samples in 2004 and 2005. The long-term goal of these studies is to provide data and analysis to aid IDEM in the development of nutrient water-quality criteria. An objective of this report was to develop a preliminary understanding of the occurrence and distribution of algal biomass in Indiana streams and to better understand how algal biomass is related to nutrients, water quality, and environmental characteristics within the eight study basins. An additional purpose of this report was to compile a list of the most statistically significant relations between algal biomass and nutrients that may be helpful in future investigations.

Two approaches were used for the preliminary analysis of the data. The first approach included a regression analysis of the algal biomass and nutrient data. The purpose of this analysis was to investigate potential relations and identify the strongest relations that could influence the occurrence and distribution of algal biomass and thus warrant further investigation. The second approach compared the algal biomass (CHLa and AFDM for periphyton, and CHLa and POC for seston) and nutrient values collected to USEPA published values.

In the text, the Aggregate Nutrient Ecoregions are referred to as Ecoregion VI, VII, or IX; Level III Ecoregions are referred to as Ecoregion 54, 55, 56, 71, or 72. The nutrients are described as concentrations of nitrate, TKN, TN, and TP. In this report, periphyton CHLa, AFDM, seston CHLa, and POC are considered measures of algal biomass.

Description of Study Area

The 2001–2005 Algal Biomass Study covered every major river basin within Indiana, except the Patoka River Basin (fig. 1). With approximately 6.1 million citizens (U.S. Census Bureau, 2000), the state of Indiana comprises 94,617 km^2 (Clark, 1980). The climate within Indiana is characterized as humid continental with well defined winter and summer seasons. Temperature and precipitation amounts vary between northern and southern Indiana. The mean monthly temperature in northern Indiana ranged from -5.17^{o}C in winter to 22.8^{o}C in summer. In southern Indiana, temperatures ranged from -1.29^{o}C in winter to 24.5^{o}C in summer (Purdue Applied Meteorology Group, 2007). The mean annual precipitation in Indiana ranges from 94.5 cm in the north to 119 cm in the south (Purdue Applied Meteorology Group, 2007).

Comparison of Major River Basin Characteristics

Basin characteristics were determined for each of the sampling sites in the 5-year study. Typical of Midwestern states, the landscape in the study basins is relatively flat and used mainly for the production of agricultural row crops, primarily corn and soybeans. Many agricultural fields use subterranean tiles to improve drainage. Many agriculturally influenced streams in the study area can be characterized as having low relief and velocities. All of the major river basins in which samples were collected during the study were predominantly agricultural; agricultural land comprised 77 percent of all major river basins in the 2001–2005 study area. Within the study area, 16 percent of the land use was classified as forest and 4 percent was classified as urban. Other uses such as mining, wetlands, or miscellaneous uses constituted 3 percent of the study area.

The percentage of land use by classification varied among each basin in the study area. The Upper Wabash River Basin was mostly agricultural (92 percent) while the West Fork White River Basin, Whitewater River Basin, Kankakee River Basin, Lower Wabash River Basin, and Great Lakes Tributaries averaged 82 percent agricultural. The East Fork White River Basin (71 percent) and the Ohio River Tributaries (52 percent) were less agricultural, and each of these basins had a higher percentage of forested areas. Urbanization, due to population growth, was most apparent within the West Fork White River Basin, where 8 percent of the land use was urban and that included the larger cities of Indianapolis, Muncie, and Anderson. Other land-use influences within the Kankakee River Basin and Great Lakes Tributaries were largely attributed to natural marshes and wetlands that are typical of the lowland, poorly drained areas of northern Indiana.

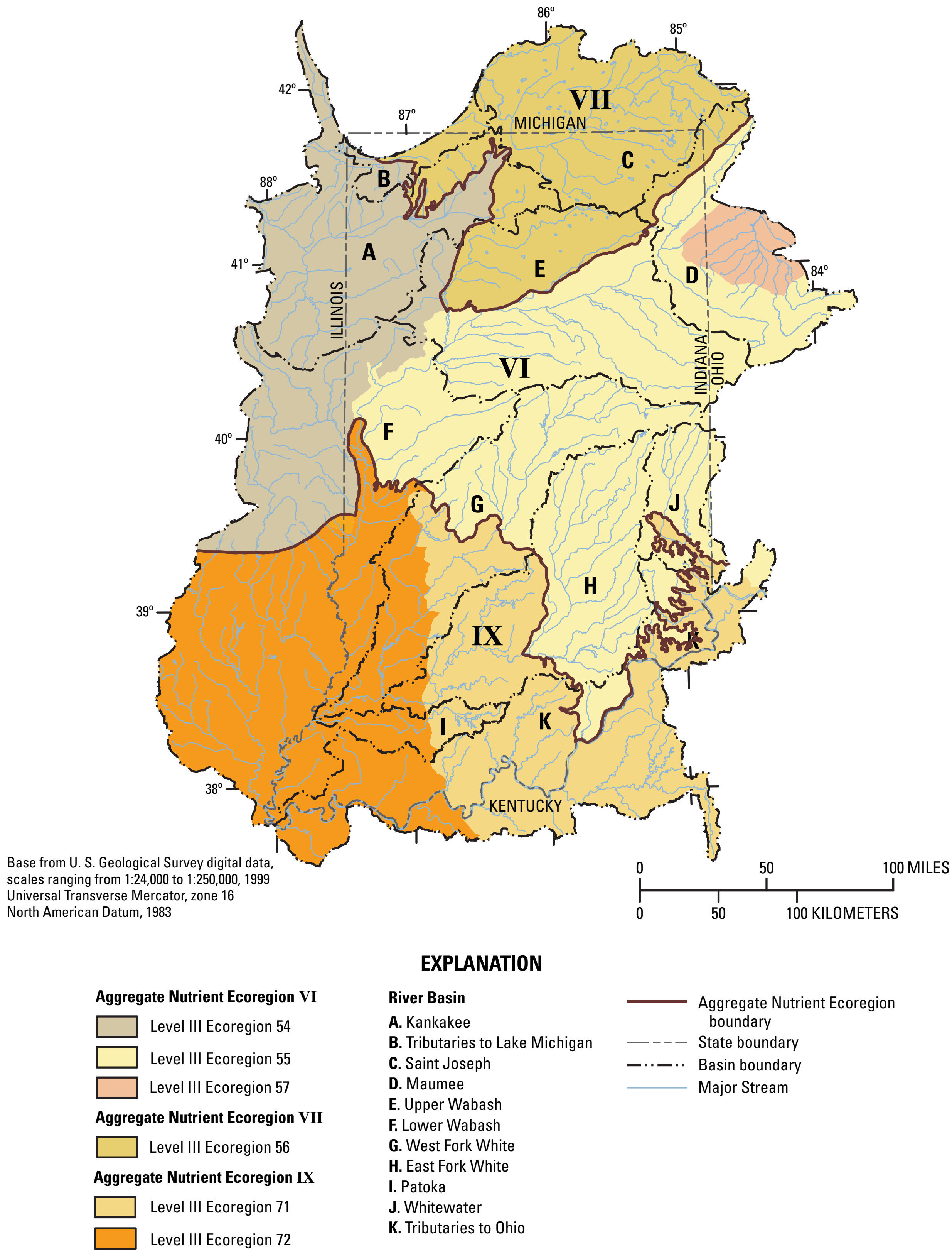

Figure 1. Major river basins and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions.

West Fork White River Basin

Samples were collected in 2001from the West Fork White River Basin (fig. 2, Appendixes 1 and 2), which drains 12,414 km^2 (Hoggatt, 1975) of central and southern Indiana at the USGS streamflow-gaging station and is joined by the East Fork White River at Petersburg, Ind., before flowing into the Wabash River. The basin consists of USEPA Ecoregions VI and IX and Ecoregions 55, 71, and 72. The mean monthly temperature ranges from -2.78^o C in winter to 23.9^{o}C in summer (Schnoebelen and others, 1999). The mean annual precipitation ranges from 96.5 cm in the northern part of the basin to 112 cm in the southern part of the basin. (Schnoebelen and others, 1999).

The dominant land use is agriculture (71 percent), primarily corn and soybeans. Nineteen percent of the basin is forested (Baker and Frey, 1997). The largest urban areas are Indianapolis (population of 791,926), Muncie (population of 67,430), and Anderson (population of 59,730) (U.S. Census Bureau, 2000).

Whitewater River Basin

During the 2002 study, two basins were sampled: the Whitewater River Basin and East Fork White River Basin. The locations of sampling sites within both basins are depicted in figure 3.

The Whitewater River Basin (fig 3, Appendixes 3 and 4) drains more than 3,170 km^2 of southeastern Indiana and southwestern Ohio before draining into the Ohio River (Caskey and others, 2007).The basin consists of USEPA Ecoregions VI and IX and Ecoregions 55 and 71.The mean monthly temperature ranges from -3.3^{o}C in winter to 22.8^{o}C in summer (Indiana Department of Natural Resources, 1988).Mean monthly precipitation ranges from 96.5 to 102 cm (Indiana Department of Natural Resources, 1988). The dominant land use is row-crop agriculture (93 percent), consisting primarily of corn and soybeans (Debrewer and others, 2000). Approximately 4 percent of the basin is forest and 3 percent is urban. The largest urban area is Richmond, which has a population of 39,124 (U.S. Census Bureau, 2000).

East Fork White River Basin

The East Fork White River Basin (fig. 3, Appendixes 5 and 6) drains more than 14,880 km^2 of central and southern Indiana (Hoggatt, 1975) and joins the West Fork White River near Petersburg, Ind. The basin consists of USEPA Ecoregions VI and IX and Ecoregions 55, 71, and 72. The mean monthly temperature ranges from -2.80^{o}C in winter to 23.9^{o}C in summer (Schnoebelen and others, 1999). The mean annual precipitation ranges from 96.5 cm in the northern part of the basin to 112 cm in the southern part (Schnoebelen and others, 1999). The dominant land use is row-crop agriculture (69 percent), primarily corn and soybeans (Baker and Frey, 1997). Twenty-five percent of the basin area is forest (Baker and Frey, 1997). The largest urban areas are Columbus (population of 39,059), Greensburg (population of 10,260), and Seymour (population of 18,101) (U.S. Census Bureau, 2000).

Upper Wabash River Basin

Samples were collected in 2003 from the Upper Wabash River Basin (fig. 4, Appendixes 7 and 8), which drains 18,655 km^2 of central Indiana and parts of western Ohio (Hoggatt, 1975) before draining into the Lower Wabash River. The closest streamflow-gaging station is at Lafayette, located 8.2 km downstream from the basin boundary. The basin consists of USEPA Ecoregions VI and VII and Ecoregions 54, 55, and 56. The mean annual temperature ranges from -4.3^{o}C in winter to 22.9^{o}C in summer (Purdue Applied Meteorology Group, 2007). The mean annual precipitation ranges from 94.5 cm to 104 cm (Purdue Applied Meteorology Group, 2007).

The dominant land use of the Upper Wabash Basin is agriculture (92 percent), primarily corn and soybeans. Approximately 5 percent of the basin is forested, approximately 1 percent is urban, and 2 percent is other land uses. The largest urban areas are Kokomo (population of 46,113), Marion (population of 31,320), and Warsaw (population of 12,415) (U.S. Census Bureau, 2000).

Kankakee River Basin

During the 2004 study, two basins were sampled: the Kankakee and Lower Wabash River Basins. The Kankakee River Basin (fig. 5, Appendixes 9 and 10) drains 13,339 km^2 of northwestern Indiana and northeastern Illinois (Steeves and Nebert, 1994). Within Indiana, the Kankakee River Basin drains 4,973 km^2 (Hoggatt, 1975). In this study, although the sample collection sites were located within Indiana, the basin included streams that originate in Illinois and flow into Indiana and streams that flow into the main stem of the Kankakee River near the Indiana-Illinois state line. The basin consists of USEPA Ecoregions VI and VII and Ecoregions 54 and 56. The mean monthly temperature ranges from -5.0^{o}C in winter to 22.8^{o}C in summer (Purdue Applied Meteorology Group, 2007). The mean annual precipitation was 97.7 cm. The dominant land use was agriculture (83 percent), primarily row crops such as corn and soybeans. Approximately 10 percent of the basin is forested, approximately 2 percent of the land use was urban. and the remaining 5 percent consist of other land uses. The largest urban areas are La Porte (population of 21,621), Plymouth (population of 9,840), and Cedar Lake (population of 9,279) (U.S. Census Bureau, 2000).

Lower Wabash River Basin

The Lower Wabash River Basin (fig. 6, Appendixes 11 and 12) drains 34,995 km^2 of central and southern Indiana and eastern Illinois (Hoggatt, 1975) before it flows into the Ohio River. The basin consists of USEPA Ecoregions VI and IX and Ecoregions 54, 55, 71, and 72. The mean monthly temperature ranges from -3.09°C in winter to 23.6°C in summer (Purdue Applied Meteorology Group, 2007). The mean annual precipitation ranges from 94.5 cm in the northern part of basin to 119 cm in the southern part of the basin (Purdue Applied Meteorology Group, 2007). The dominant land use within the Lower Wabash Basin is agriculture (78 percent), primarily corn and soybeans. Approximately 16 percent of the basin area is forested, and approximately 3 percent is both urban and other land uses. The largest urban areas are Terre Haute (population of 59,614) and Lafayette (population of 56,397) (U.S. Census Bureau, 2000).

Tributaries to the Great Lakes Basin

During the 2005 study, the two basins sampled were the tributaries to the Great Lakes and the Ohio River Basins. The tributaries to the Great Lakes Basin (fig. 7, Appendixes 13 and 14) drains 16,622 km^2 of northern Indiana, southwestern Michigan, and northwestern Ohio (Steeves and Nebert, 1994). The basin consists of USEPA Ecoregions VI and VII, and Ecoregions 54, 55, 56, and 57. The mean monthly temperature ranges from -5.17°C in winter to 22.8°C in summer (Purdue Applied Meteorology Group, 2007). The mean annual precipitation ranges from 94.5 cm to 97.5 cm (Purdue Applied Meteorology Group, 2007). The dominant land use within the tributaries to the Great Lakes Basin is agriculture (74 percent), primarily corn and soybeans. Approximately 11 percent of the basin is forest, approximately 5 percent of the land use is urban, and the remaining 7 percent consist of other land uses. The tributaries to the Great Lakes Basin consist of three subbasins: the St. Joseph River, Maumee River, and Lake Michigan River Basins.

St. Joseph River Basin

The St. Joseph River Basin (fig. 7, Appendixes 13 and 14) drains 12,157 km^2 of northern Indiana and southern Michigan (Steeves and Nebert, 1994). Within Indiana, the St. Joseph River Basin drains 9,485 km^2 (Hoggatt, 1975). In this study, although the sample collection sites were within Indiana, the basin included streams that originate in Michigan and flow into Indiana and streams that flow into the main stem of the St. Joseph River near the Michigan-Indiana state line. The mean monthly temperature ranges from -4.86°C to 22.7°C and the mean annual precipitation ranges from 94.5 cm to 97.5 cm (Purdue Applied Meteorology Group, 2007). The dominant land use within the St. Joseph River Basin is row-crop agriculture (74 percent), primarily corn and soybeans. Approximately 15 percent of the basin is forested, 3 percent of the land use is urban, and the remaining 8 percent consists of other land uses. The largest urban areas are South Bend (population of 107,789) and Elkhart (population of 51,874) (U.S. Census Bureau, 2000).

Maumee River Basin

The Maumee River Basin (fig. 7, Appendixes 13 and 14) drains 17,059 km^2 of northeastern Indiana and northwestern Ohio (Steeves and Nebert, 1994). In Indiana, the drainage area of the Maumee River Basin is 5,715 km^2 (Steeves and Nebert, 1994). The mean monthly temperature ranges from -4.89°C to 22.6°C and the mean annual precipitation was 94.5 cm (Purdue Applied Meteorology Group, 2007). The dominant land use within the Maumee River Basin is row-crop agriculture (84 percent), primarily corn and soybeans. Approximately 9 percent of the basin is forested, 4 percent of the land use is urban, and the remaining 3 percent consists of other land-uses. The largest urban area is Fort Wayne (population of 205,727) (U.S. Census Bureau, 2000).

Tributaries to the Lake Michigan Basin

Tributaries to the Lake Michigan Basin, (fig. 7, Appendixes 13 and 14) drain 1,873 km^2 of northwestern Indiana, northeastern Illinois, and southwestern Michigan (Steeves and Nebert, 1994). Within Indiana, the drainage area of the tributaries to the Lake Michigan Basin is 1,422 km^2 (Steeves and others, 1994). The mean monthly temperature ranges from -5.17°C to 22.8°C and the mean annual precipitation is 97.9 cm (Purdue Applied Meteorology Group, 2007). The dominant land use is agriculture (38 percent), primarily row-crop corn and soybeans. Approximately 26 percent of the basin is forested, 21 percent of the land use is urban, and the remaining 15 percent consists of other land uses. The largest urban areas are Gary (population of 102,746), Hammond (population of 83,048), and Michigan City (population of 32,900) (U.S. Census Bureau, 2000).

Tributaries to the Ohio River Basin

Tributaries to the Ohio River Basin (fig. 8, Appendixes 15 and 16) drain 10,988 km^2 of southern Indiana (Steeves and Nebert, 1994). Three major streams flow separately into the Ohio River: the Anderson River, the Blue River, and Indian-Kentuck Creek. The basin consists of USEPA Ecoregions VI and IX and Ecoregions 55, 71, and 72. The mean monthly temperature ranges from -1.29°C in the winter to 24.5°C and the mean annual precipitation ranges from 114 cm in the southwest to 119 cm in the southeast (Purdue Applied Meteorology Group, 2007). The dominant land use is agriculture (57 percent), primarily row-crop corn and soybeans. Approximately 38 percent of the basin is forested, 3 percent of the land use is urban, and the remaining 2 percent consists of other land uses. The largest urban areas are Evansville (population of 121,582), New Albany (population of 37,603), and Jeffersonville (population of 27,362) (U.S. Census Bureau, 2000).

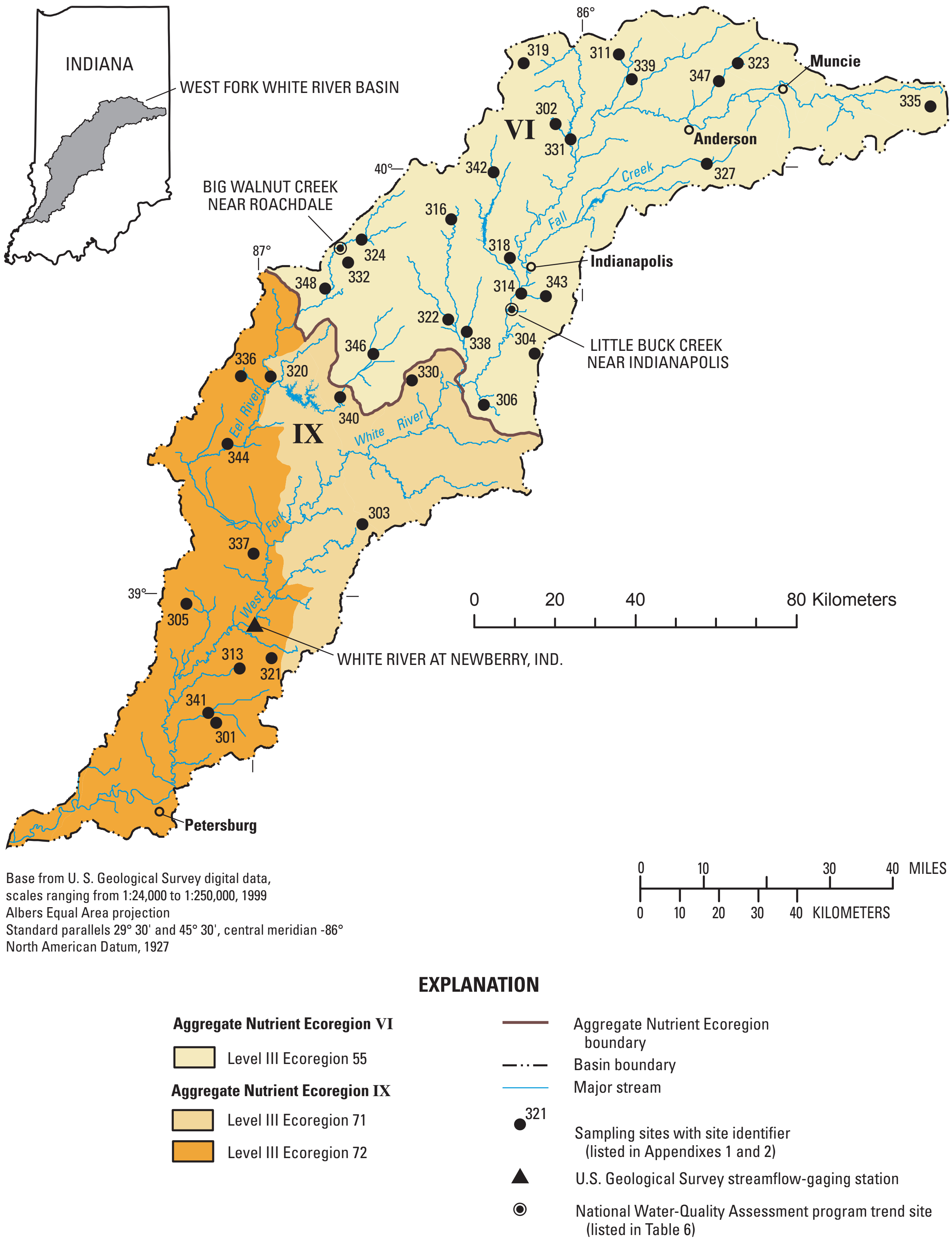

Figure 2. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the West Fork White River Basin, Indiana, 2001.

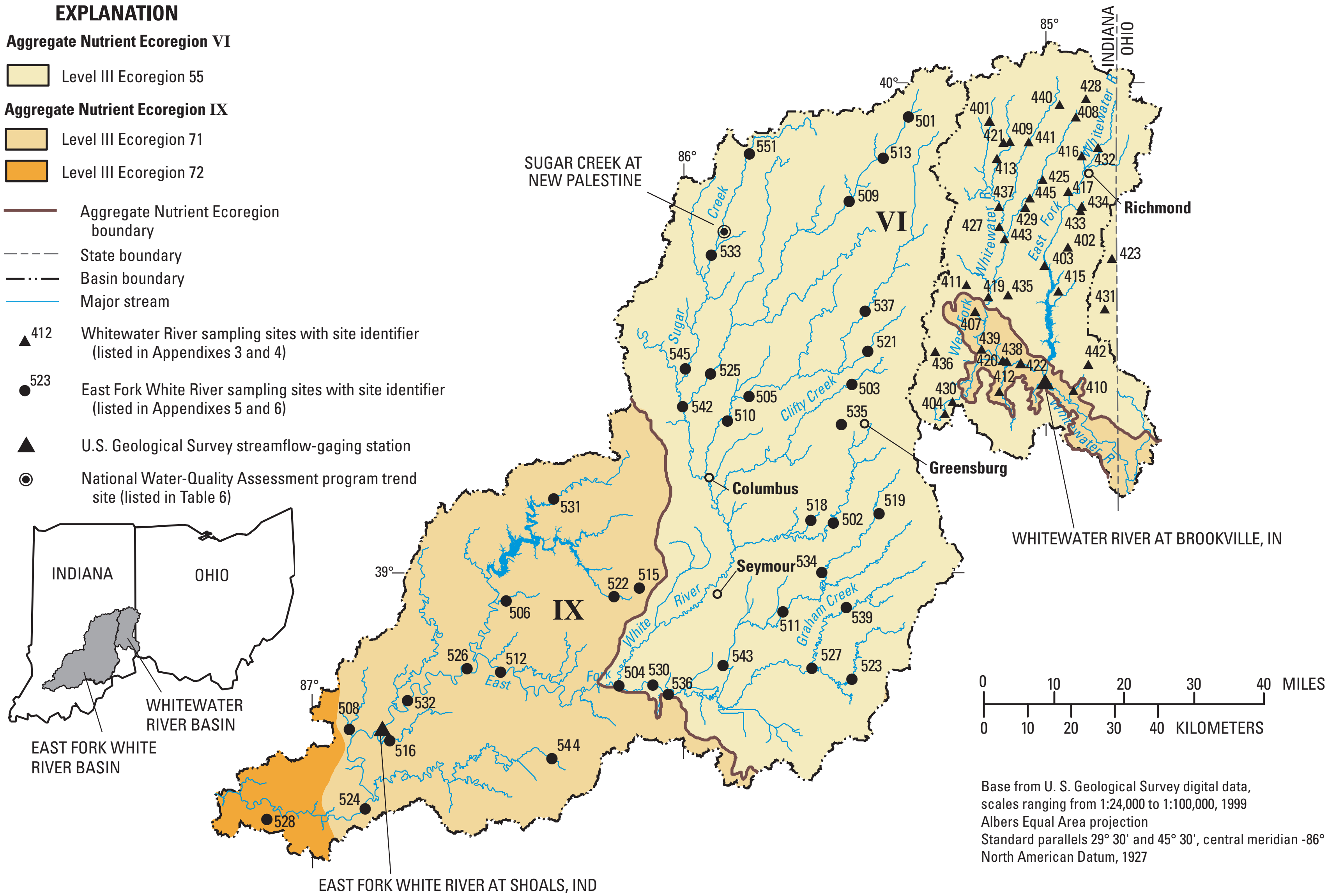

Figure 3. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Whitewater and East Fork White River Basins, Indiana, 2002.

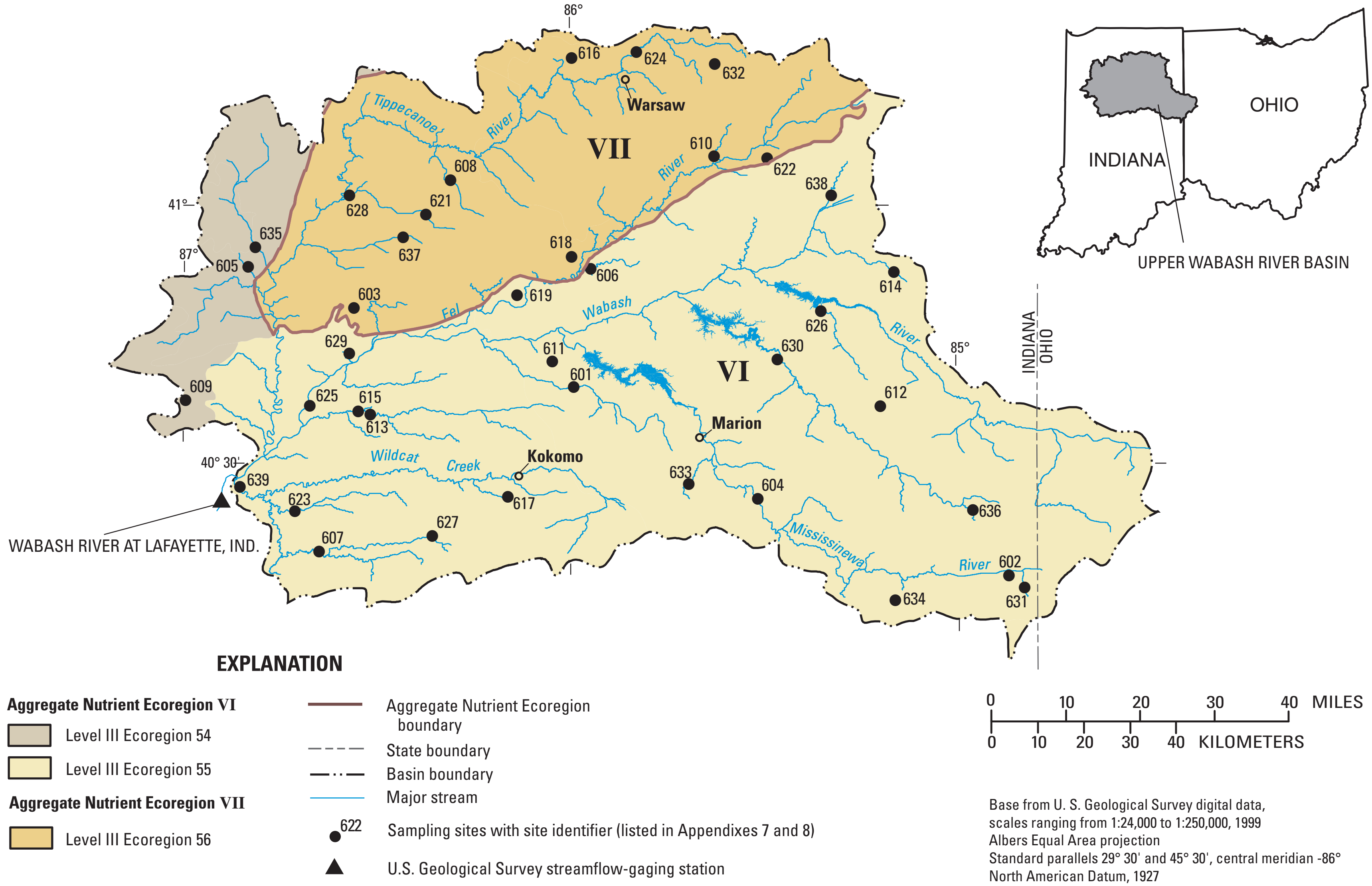

Figure 4. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Upper Wabash River Basin, Indiana, 2003.

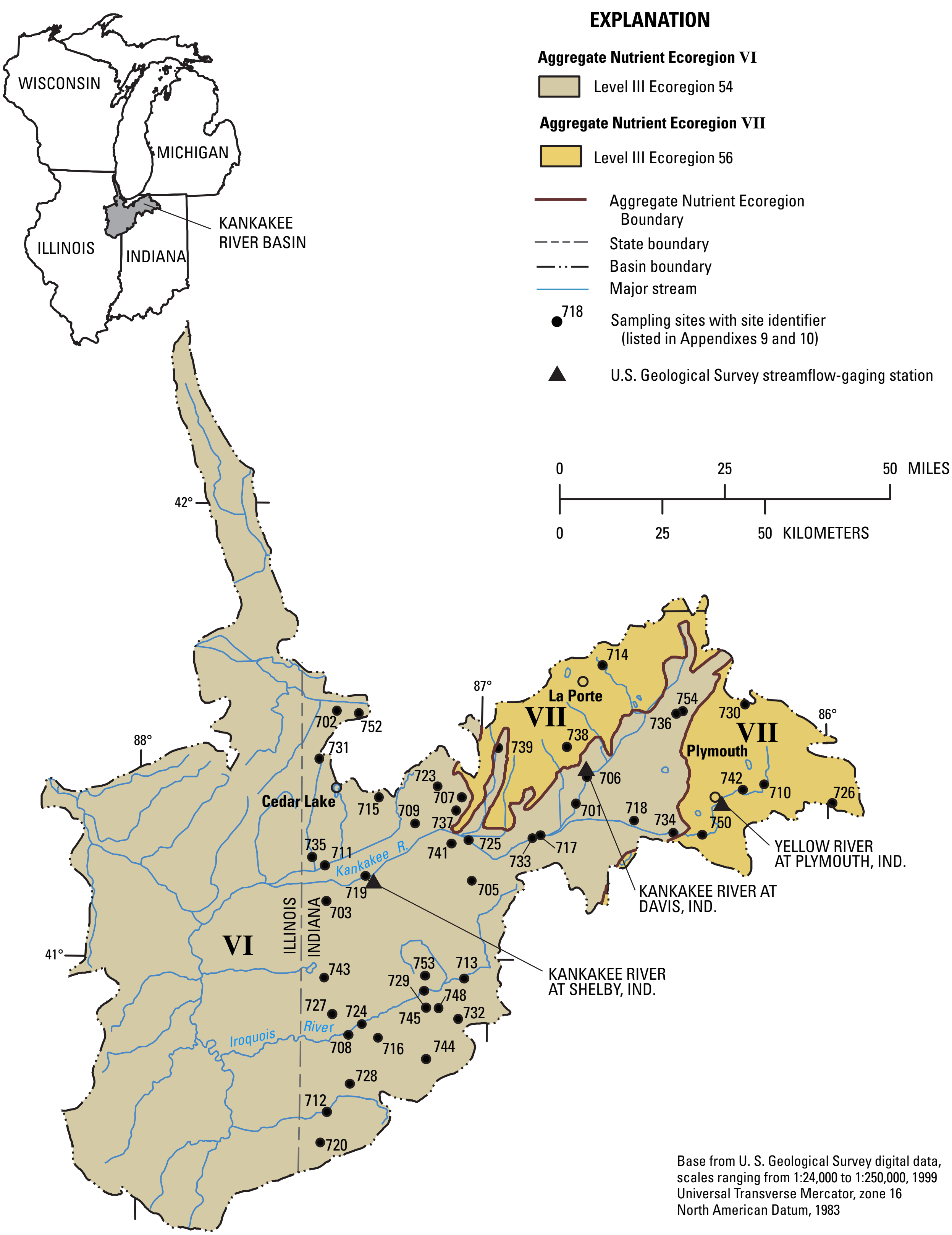

Figure 5. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Kankakee River Basin, Indiana, 2004.

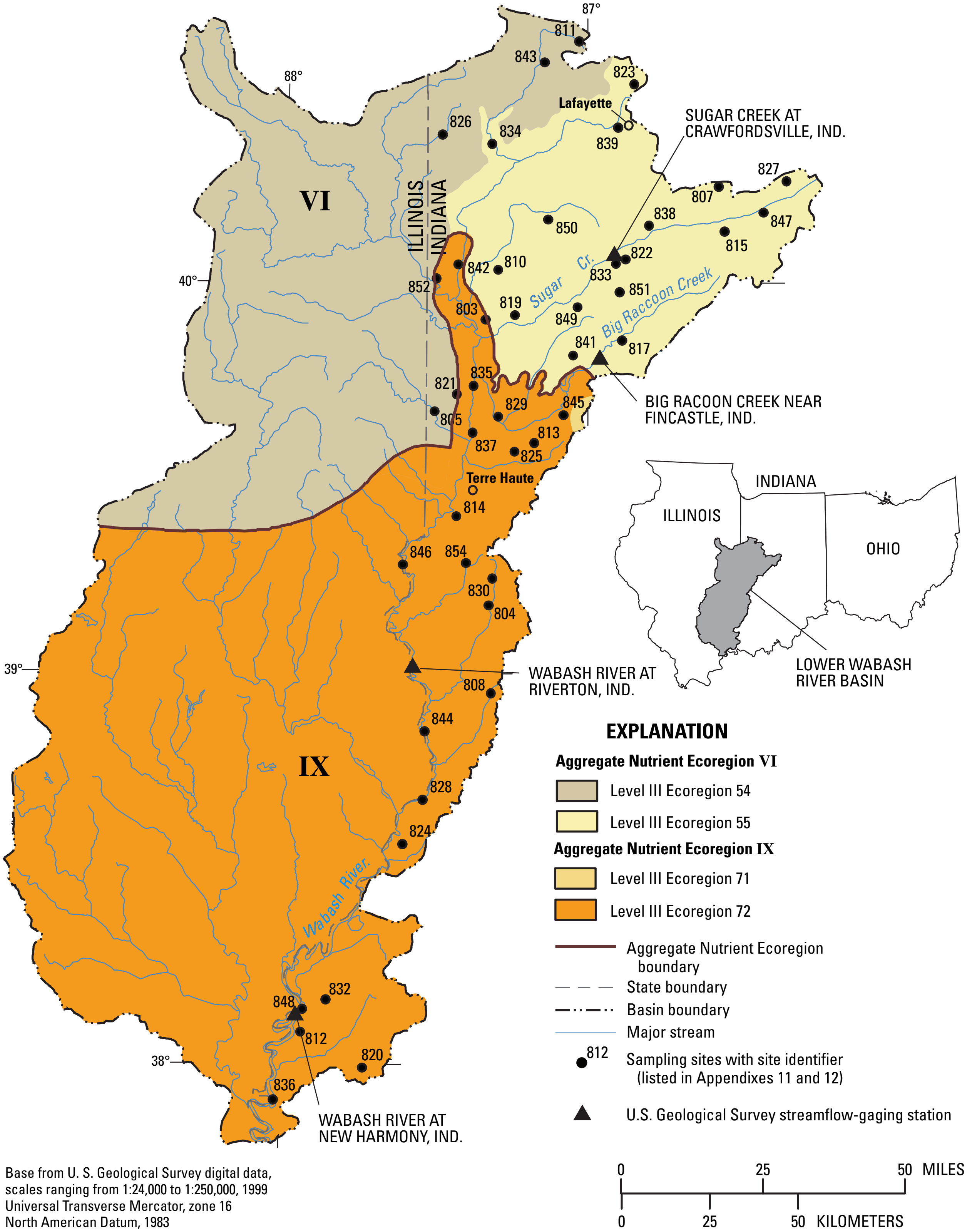

Figure 6. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Lower Wabash River Basin, Indiana, 2004.

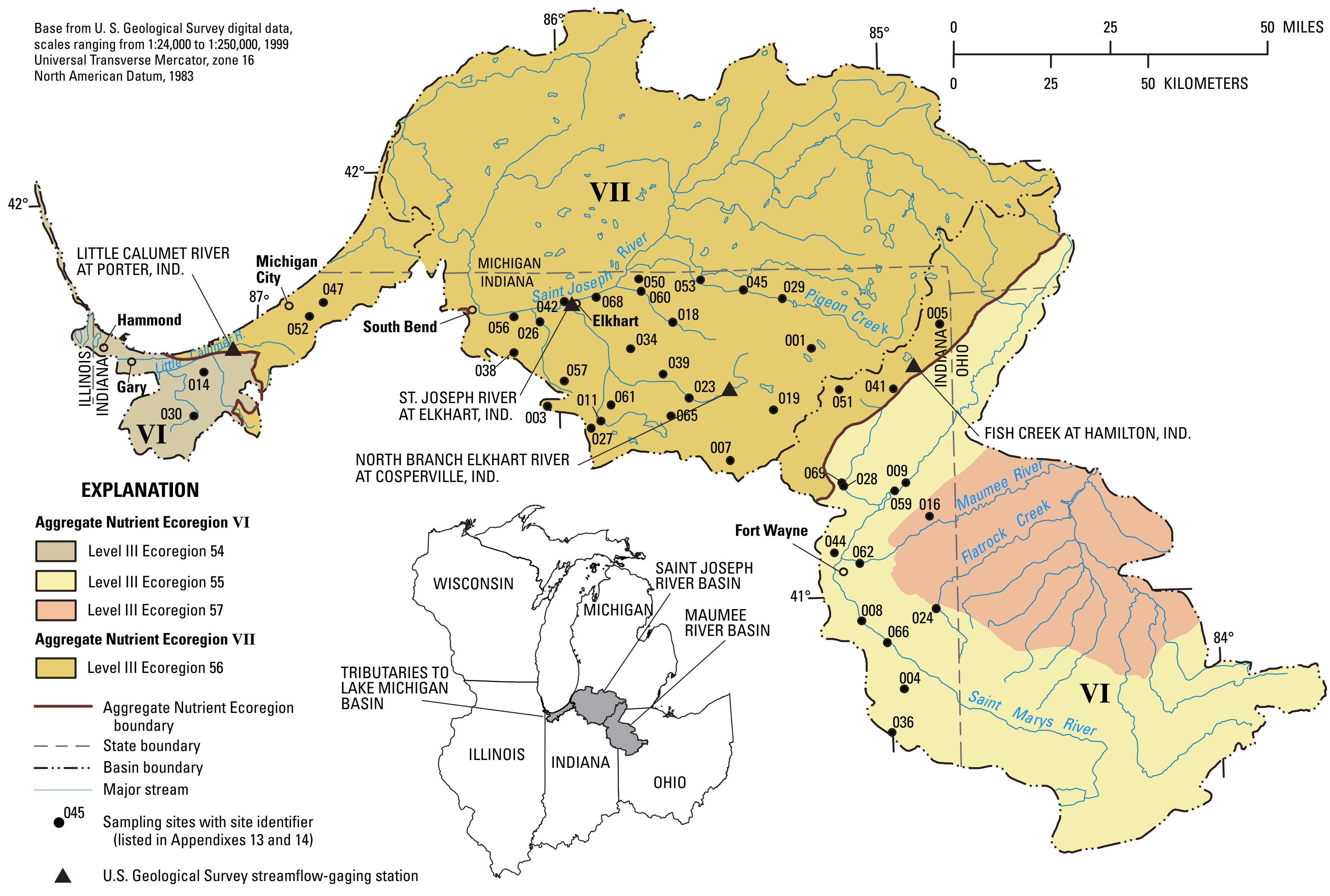

Figure 7. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Saint Joseph, Maumee and Tributaries to Lake Michigan Basins, Indiana, 2005.

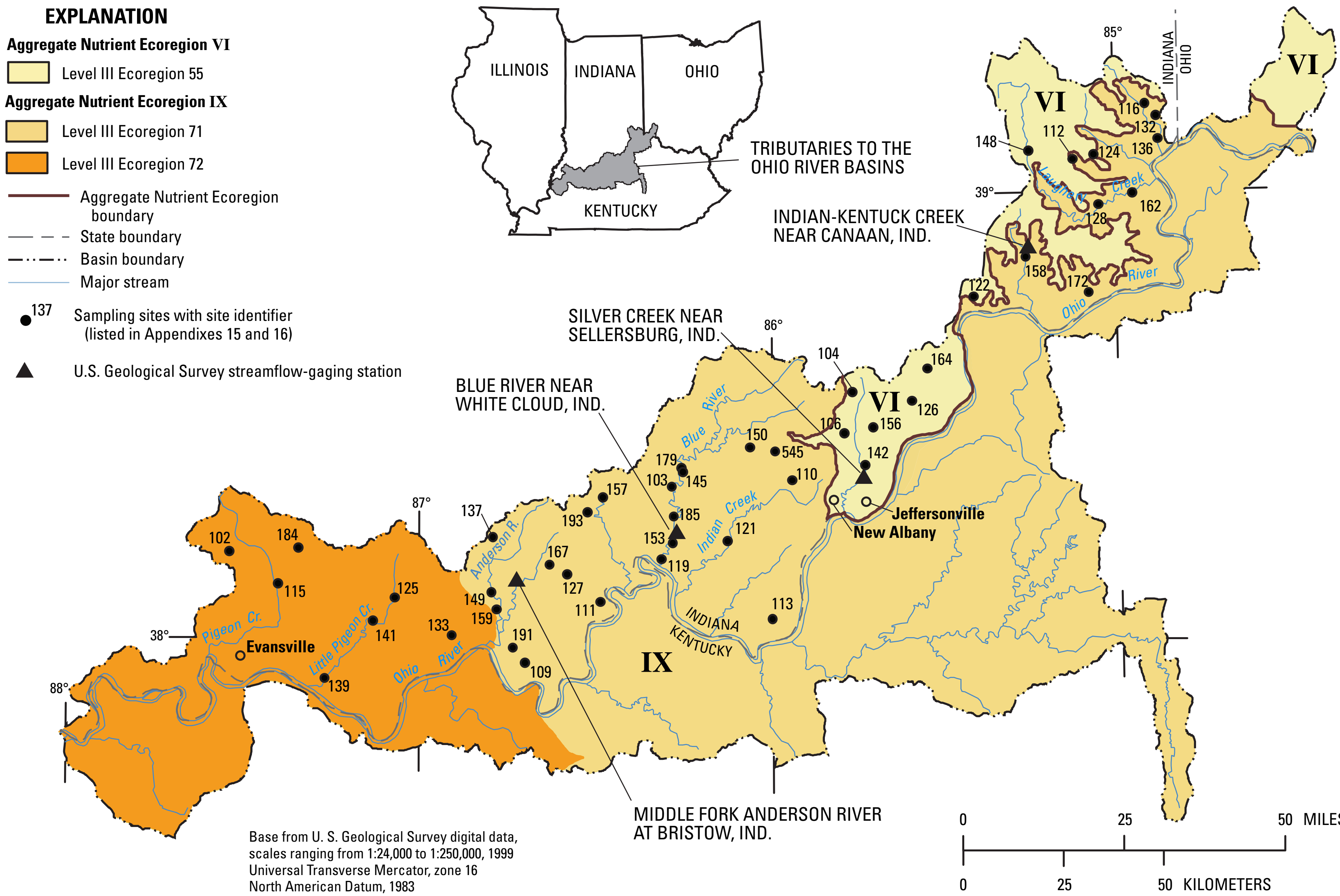

Figure 8. Sampling locations and U.S. Environmental Protection Agency Aggregate Nutrient Ecoregions and Level III Ecoregions of the Tributaries to the Ohio River Basin, Indiana, 2005.

Study Methods

This study used field and analytical methods from the IDEM and the USGS. The following sections describe the site selection and sampling strategies; field and laboratory methods used in collecting, processing, and analyzing algal-biomass, basin-characteristics, nutrients; and data analysis used in this report.

Site Selection and Sampling Strategies

Sampling sites were selected randomly by the USEPA as part of the IDEM probabilistic Watershed Monitoring Program (WMP) (Indiana Department of Environmental Management, 1999, 2001). Each selected sampling site (Appendixes 1–16) represents a specific stream order; therefore, statistically valid extrapolations can be made from the randomly sampled streams to unsampled streams in a particular basin (Indiana Department of Environmental Management, 1999, 2001). The IDEM WMP works on a 5-year rotating basin schedule, focusing on one to two selected basins each year, with a complete assessment of the state at the end of each 5-year cycle. In 2001, the focus was the West Fork White River Basin; 2002, the Whitewater River and East Fork White River Basins; 2003, the Upper Wabash River Basin; 2004, the Kankakee and Lower Wabash River Basins; and 2005, the Great Lakes and Ohio River Basins. The Patoka River Basin was not included in this study because the initial proposal called for method development in the West Fork White River Basin in 2001. After the sampling sites were selected and prior to collection of field data, IDEM personnel completed a visual assessment of the potential sampling sites and determined the area to be sampled at each site. At each site, the latitude and longitude, provided by IDEM, was used as the center point of the sampling reach, so that half of the reach was upstream and half of the reach was downstream of the midpoint.

During periods of stable flow, a total of 322 sites were sampled from May through October 2001–2005 (figs. 1–9, appendix 1). Within each major basin, 34–45 sites were sampled two or three times for algal biomass and nutrients. The samples were collected three times in each basin to measure seasonal changes in algal biomass and nutrients, with the exception of the West Fork White River Basin, which was sampled only two times during 2001. Round 1 samples were collected in May and June, round 2 samples were collected in July and August, and round 3 samples were collected in September and October. In this report, round 1 sampling is referred to as May, round 2 as July, and round 3 as September, to be consistent with USEPA seasons used in the development of proposed nutrient criteria. At each site the algal-biomass and nutrient samples were collected on the same day at about the same time. Sampling at some sites, within different years, was delayed because of high water.

Data Collection and Processing Methods

Samples were collected and processed for four measures of algal-biomass: CHLa and AFDM for periphyton and CHLa and POC for seston. Periphyton algal biomass consists of algae attached to a substrate and seston algal biomass consists of algae floating in the water column. The term “seston” is used instead of “phytoplankton,” because algal community composition was not determined and periphyton scoured from a substrate could be included in the algal biomass assessment of the water-column. The second measurement of algal biomass for seston was POC because AFDM concentrations in the water column, especially during stable low-flow conditions, are typically very low.

Samples were collected and processed according to USGS protocols, with two modifications. The National Water-Quality Assessment (NAWQA) Program algal protocols for periphyton (Moulton and others, 2002; U.S. Geological Survey, variously dated) are a reach-based sampling methodology in which five periphyton subsamples are collected from five different locations within the sampling reach. At each location, the stream depth, velocity, shading, and substrate are recorded. The subsamples are composited and marked as a single sample. At each site during the sampling period, periphyton and AFDM samples were collected from the same substrate type—epilithic (rocks), epidendric (sticks), or epipsammic (sand). If available, epilithic substrates were the priority substrate for periphyton collection in smaller streams with less than 2,590 km^2 drainage area. The primary means of periphyton sampling during 2001 through 2003 was the top-rock scrape, which consisted of scraping the algae from the rock surface and determining the area with a template (Moulton and others, 2002). During 2004 and 2005, epilithic substrate was sampled using a SG-92 modified syringe sampling device, or completing an area scrape using the SG-92 to determine the sampled area. One modification to this study from the NAWQA protocols was that 10 periphyton subsamples were collected from similar substrate as close to the center point of the reach as possible. Then five subsamples that best represented the average algal cover at the sampled reach were randomly selected, and these subsamples were composited into a single sample (Charles and others, 2000). Typically, a 400-milliliter periphyton composite sample was collected, volume recorded, and homogenized. A second modification to this study from the NAWQA protocols was that stream velocity at the point of sample collection was not calculated. Neither stream velocity nor light availability were incorporated into this study. Water-quality field measurements for each sample included water temperature, pH, specific conductance, turbidity, and dissolved oxygen.

Seston and POC samples were collected in the center of the sampling reach along a line that extended from the left edge to the right edge of the stream bank (transect). The wetted channel width and water depths (one-quarter, one-half, and three-quarters points) along the transect were recorded. The seston and POC samples were collected with a 3-L bottle and a 0.476-cm nozzle; either a grab sample or a multiple vertical method was used (Shelton, 1994). Seston and POC subsample volumes were determined by examining the color density of the filter following USGS National Water Quality Laboratory (NWQL) guidelines for particulate carbon sampling and analysis (U.S. Geological Survey, written commun., 2000).

The volume of each algal-biomass sample was measured and recorded. Each sample was homogenized and filtered onto glass-fiber filters in the field by USGS personnel. All filters collected by the USGS were placed on dry ice and transported to the USGS Indiana Algal Biomass Laboratory for analysis. The CHLa and AFDM filters were analyzed at the USGS Indiana Algal Biomass Laboratory; the POC filters were analyzed at the USGS NWQL in Lakewood, Colo.

Concentrations of CHLa were determined, following USEPA method 445, with a Turner Designs TD-700 fluorometer outfitted for CHLa analysis (Arar and Collins, 1997). There were two exceptions to method 445: filters were ground in Nalgene centrifuge tubes rather than glass to counter the problem of tube breakage, and samples were centrifuged at a slower rate of 1,500 to 2,000 revolutions per minute (approximately 320 to 569 g) for 15 minutes (Freeman, 1968). At the modified centrifuge rate, the filter residue and acetone solution separated well. If samples did not separate well, they were placed in the centrifuge a second time or care was taken not to decant the filter residue. All samples were allowed to steep for 2 hours thirty minutes at 4ºC. Samples were agitated prior to, during, and following the steeping period to ensure filter residue remained in the acetone slurry. Concentrations of AFDM were determined, following USGS method B-3520-85 (Britton and Greeson, 1988) with two exceptions: the samples were filtered in the field, and the filters were not baked and weighed in the crucibles before use.

Quality-assurance methods for algal biomass samples included triplicate filters from the same sample to measure variability and a blank filter collected at each sampling reach to evaluate equipment decontamination procedures and possible sample processing contamination (Bowren and Ghiasuddin, 1999). In addition, a fifth filter was collected at each site and 10 to 15 percent of these filters were analyzed for CHLa at the NWQL to measure inter-laboratory variability.

Nutrient samples for ammonia, nitrate, TKN, TN, and TP were collected by IDEM and USGS personnel following approved IDEM methods (Beckman, 2000). Nutrient quality-assurance methods followed approved IDEM methods (Bowren and Ghiasuddin, 1999). The nutrient samples were preserved, placed on wet ice, and taken to an independent laboratory (Test America, Indianapolis; Heritage Environmental, Indianapolis; or Underwriters Laboratories, South Bend) for analysis.

Data Analysis

Two approaches were used for the analysis of data collected for this study. The first approach consisted of regression analyses of the algal biomass, nutrient, and environmental data. The second approach was a comparison of seasonal differences of the CHLa and nutrient values collected by IDEM and USGS personnel to the USEPA seasonal published values. These approaches provided an exploratory analysis to identify which biological and environmental parameters were significantly related to algal biomass. This allows researchers to determine the relations of interest to use as a starting point in future studies.

The regression approach related the seasonal periphyton and seston concentrations to four nutrient parameters. All data were normalized to a z-score, allowing for comparison of parameters that were recorded in different units. Additionally, the nonparametric Kruskal-Wallis test compared the median algal biomass (periphyton and seston CHLa, AFDM, and POC) values among the spring, summer, and fall seasons. The central tendency and variability of the data are shown graphically in boxplots made in S+ (Insightful Corporation, 2001).

Basin Characteristics

Basin characteristics used in the analysis were drainage area and land use, which was expressed as a percentage of agriculture, forest, urban, and other; the basin characteristics were determined by the USGS for this study. Drainage area was determined from the basin boundaries by use of a Geographic Information System (GIS). Drainage area was used to categorize streams as either headwater streams (0–51 km^2), wadable streams (52–2,590 km^2), or boatable streams (2,591–38,900 km^2). Basin boundaries for each site were generated following the method outlined by Ries, III, and others (2004). This method combines the National Elevation Dataset, Digital Elevation Model data, and the National Hydrography Dataset, which is a comprehensive set of digital surface-water features. The basin boundaries formed a polygon that was used to extract land-use information from the National Land Cover Dataset (NLCD) (U.S. Geological Survey, 2000). Each sampling site was assessed to determine in which Aggregate Nutrient Ecoregion (U.S. Environmental Protection Agency, 2000a, b, c) and Level III Ecoregion (U.S. Environmental Protection Agency, 1998) it was located.

Nutrient Analysis

The nutrients analyzed for this study were dissolved ammonia as N, dissolved nitrite plus nitrate as N, total Kjeldahl nitrogen as N, total nitrogen as N, and total phosphorus as P. Ammonia was not included in the analysis because most of the ammonia concentrations (90 percent) were less than the reporting level. Because concentrations of nitrate typically are two orders of magnitude greater than nitrite and because nitrite usually does not exceed 0.5 mg/L in surface water (National Research Council, 1978), concentrations of nitrite plus nitrate are referred to as nitrate in this report. Concentrations of TN were calculated as the sum of nitrate and TKN. For concentrations of nitrate and TP less than the reporting level, one-half of the reporting level was used in the analysis. The IDEM/USGS data were classified by season following the USEPA classifications; for aggregate nutrient ecoregions VI and VII, spring was April through May, summer was June through August, fall was September through October; and for aggregate nutrient ecoregion IX, spring was March through May, summer was June through August, and fall was September through November. The seasonal nutrient and the seasonal algal-biomass data were then related using Spearman's rho to determine the most significant seasonal relations.

Statistical Analysis

A seasonal analysis using Statistical Analysis System (SAS) (SAS Institute Inc, 1999) was completed to relate the algal biomass data (periphyton CHLa, AFDM, seston CHLa, POC) to the nutrient data (nitrate, TKN, TN, and TP). Spearman's rank order (rho) correlations are the preferred method when determining relations among environmental data because (1) the initial sample size was greater than 20 for most variables and (2) environmental data typically are not normally distributed (Helsel and Hirsch, 1992). Although the data from this study were normalized prior to analysis, all variables were not normally distributed, thus a non-parametric statistic was required. The purpose of this analysis was to investigate all potential relations and identify those relations that were the strongest and that might warrant further investigation. The environmental parameters with the strongest relations could help in the development of nutrient criteria. In this report, for a relation to be considered statistically significant, the Spearman's rho statistic (r_S) was required to be greater than the absolute value of 0.45 and have at least a 5 percent significance level ($\alpha = 0.05$) based on the sample size. Although an r_S of 0.45 is considered significant, it has a possibility of introducing a Type I error in which the relation is declared present when the relation is not present (Helsel and Hirsch, 1992).

Several procedures—such as the Bonferroni correction—are available for adjusting the significance level when performing a large number (or "family") of tests simultaneously (Van Sickle, 2003). This adjustment reduces the chances of a Type I error at a specific alpha level. Although useful in reducing Type I error, this technique increases the chance of producing a Type II error, in which no relation declared when a relation is present. No corrections were applied for this analysis because the goal of this study was to investigate the largest number of potential relations.

Comparison with U.S. Environmental Protection Agency Data

The USEPA proposed criteria in 2000 for nitrate, TKN, TN, TP, CHLa (periphyton and seston), and turbidity at the 25th percentile of all data for each variable for each Aggregate Nutrient and Level III Ecoregion. However, little data from Indiana was included in determining the proposed criteria. Consequently, part of the study objective was to determine how the data collected by IDEM and USGS for CHLa and nutrients compared to USEPA published values (U.S. Environmental Protection Agency, 2000a, b). For the USEPA method, the median value for each variable for each stream was calculated. Percentiles were then determined for each of the three seasons, spring, summer, and fall in each ecoregion. The 25th percentile of the combined three seasons was used as the proposed criteria. For this study, median nutrient (nitrate, TKN, TN, and TP) and CHLa values were calculated for all streams sampled within the same Aggregate Nutrient and Level III Ecoregions. However, summary statistics, based on seasonality, were not calculated because IDEM and USGS did not collect winter samples. In addition, although Round 1 samples were collected in May and June. spring samples were limited because USEPA considers June as part of summer. In this report, to follow the USEPA season designation, May sampling will be referred to as spring, July and August as summer, and September and October as fall. Descriptive statistics—minimum and maximum ranges and 10th, 25th, 50th, 75th, and 90th percentiles—were calculated for all the streams within a specific ecoregion. For CHLa (periphyton and seston), a mean of the three filters collected at each site was calculated and then the medians for each stream sampled within each ecoregion were used to calculate the descriptive statistics. The descriptive statistics then were compared to published USEPA values for Ecoregions VI, VII, IX, 54, 55, 56, 71, and 72 (U.S. Environmental Protection Agency, 2000a, b).

Quality Assurance Methods

At each sampling site, five filters were collected for periphyton and seston CHLa—four environmental samples and one field blank. Field blanks were used to evaluate equipment cleaning procedures and possible contamination resulting from processing the samples. Three of the environmental samples were measured in the USGS Indiana Algal Biomass Laboratory to evaluate sampling variability. Approximately 11 percent of the environmental samples were sent to the NWQL for evaluation of inter-laboratory variability. In addition, duplicate samples were collected at each site for determination of AFDM. Approximately 11 percent of these duplicates were sent to the NWQL for evaluation of interlaboratory variability.

Field Blanks

A total of 839 periphyton field blanks and 833 seston field blanks had measurable concentrations greater than or equal to zero. One periphyton blank and five seston field blanks were removed from the database due to gross contamination or mislabeling. Figure 9 displays the comparison between the median concentration determined for the periphyton field blanks and the median concentration determined for the environmental periphyton samples. The median concentration for the periphyton field blanks was 0.03 mg/m^2 compared to the median concentration of environmental periphyton samples of 41.2 mg/m^2 (fig. 9). The median concentration for the seston field blanks was 0.01 µg/L while the median concentration for the environmental seston samples was 2.44 µg/L (fig. 9). No significant contamination from cleaning the equipment or processing the samples was observed for periphyton or seston.

Environmental Samples

Sampling variability was evaluated by computing the relative standard deviation (RSD) of the three filters collected at each site for periphyton CHLa and seston CHLa. During the 5-year study the median RSD for periphyton CHLa, AFDM, and seston CHLa decreased, reflecting improved sampling, processing, and analytical techniques (fig. 10). The median RSD for environmental periphyton samples decreased from 27.3 in 2001 to 10.1 in 2005. The median RSD for AFDM decreased from 17.3 in 2001 to 7.23 in 2005. The median RSD for environmental seston samples decreased from 15.6 in 2001 to 8.62 in 2005 (fig. 10).

Comparison between Laboratories

Eleven percent of the periphyton CHLa, AFDM, and seston CHLa filters collected were analyzed by the USGS NWQL to evaluate variability between the Indiana Biomass Laboratory and the USGS NWQL (figs. 11–12). There were 90 paired

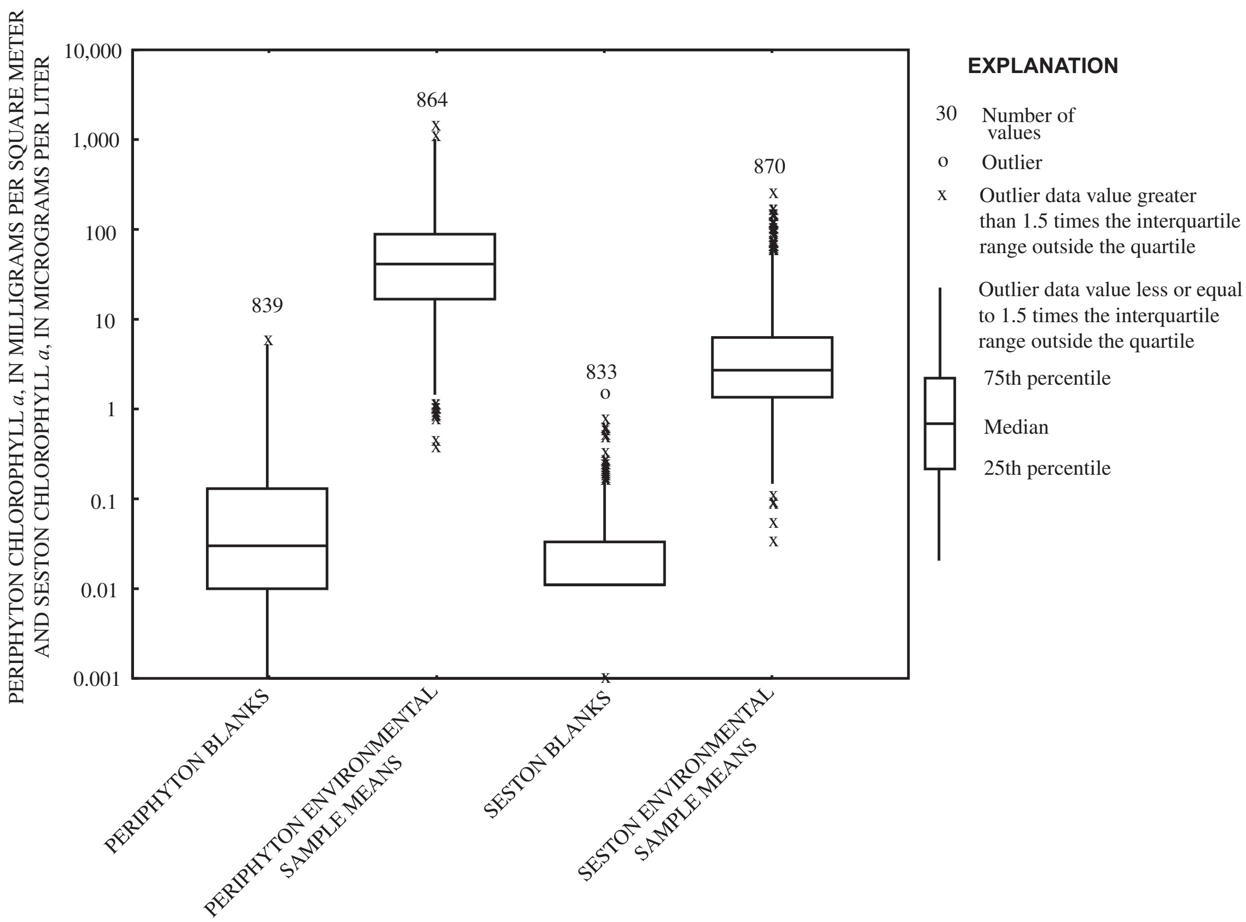

Figure 9. Median concentrations of periphyton and seston chlorophyll *a* for field blank and environmental samples, Indiana, 2001–2005.

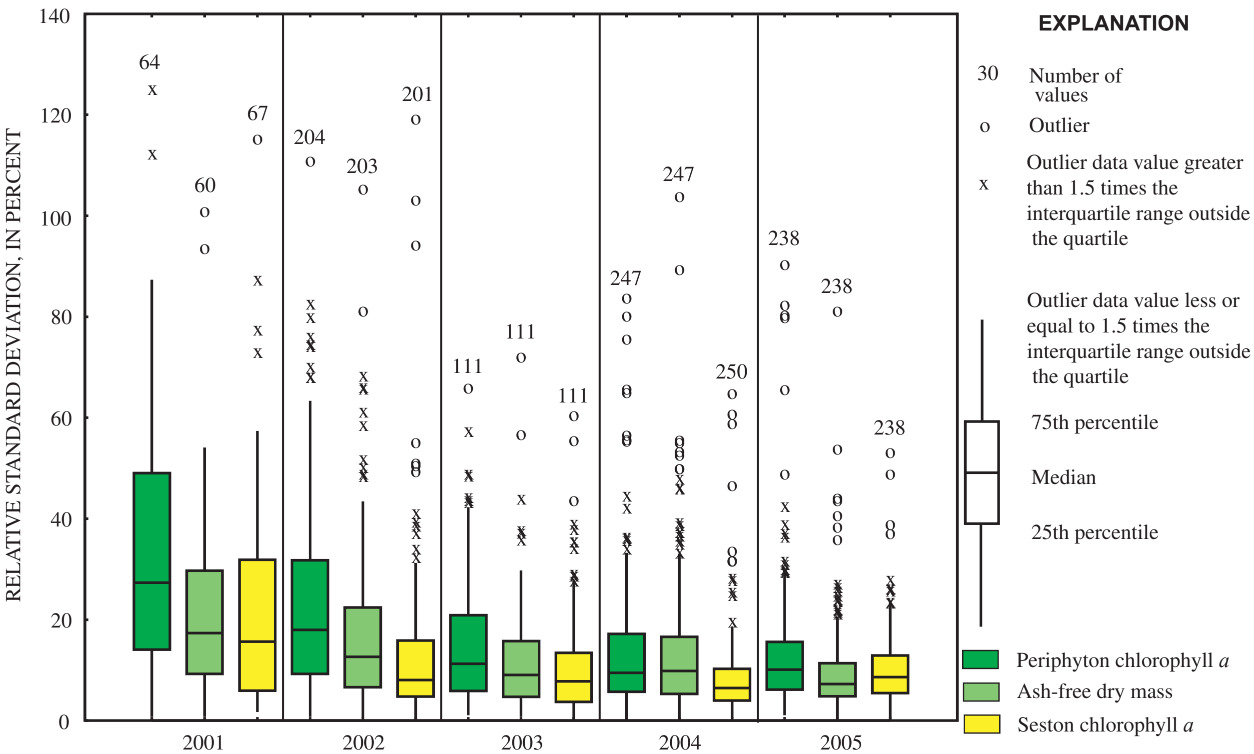

Figure 10. Relative standard deviation by year for algal biomass data, Indiana, 2001–2005.

filters for periphyton, 89 paired filters for AFDM, and 89 paired filters for seston. A Wilcoxon Rank Sum test (Helsel and Hirsch, 1992, p. 109) was used to evaluate whether the median difference between the groups of paired samples was zero. No statistically significant differences were determined between the two laboratories for periphyton CHLa (p=0.977), AFDM (p=0.736), or seston CHLa (p=0.715).

Occurrence and Distribution of Algal Biomass in Indiana Streams

The USEPA proposed nutrient criteria for Aggregate Nutrient and Level III Ecoregions because the agency recognized that nutrients vary regionally. Several states, including Indiana, have expressed interest in establishing statewide nutrient criteria to facilitate implementation and compliance. The USEPA Total Maximum Daily Load program use criteria based on watersheds. For this report, the occurrence and distribution of algal biomass (periphyton and seston CHLa, AFDM, and POC) concentrations were evaluated for Indiana (fig. 13 and by site in Appendix 17) as well as for major river basins (fig. 14 and table 1), ecoregions (fig. 15 and table 2), and seasonal (fig. 16 and table 3) categories, which could be used by IDEM in the development of nutrient criteria for Indiana.

Data sets for sampling dates, laboratory-analysis dates, and algal-biomass (periphyton CHLa, AFDM, seston CHLa, and POC) are available at: *http://in.water.usgs.gov/NAWQAWHMI/neet.php*. To assess the trophic levels of the algal biomass in streams, CHLa concentrations were compared to boundaries determined by Dodds and others (1998), who categorized streams as unproductive below the oligotrophic/mesotrophic boundary for periphyton CHLa concentrations of 20 mg/m^2 and seston CHLa of 10 µg/L. Streams were categorized as nutrient enriched at the mesotrophic/eutrophic boundary of 70 mg/m^2 for periphyton CHLa and 30 µg/L for seston CHLa.

The IDEM probabilistic WMP is designed to monitor major river basins. One to two basins are sampled every year and the entire state sampled within 5 years. Samples collected within the same year, regardless if it is “wet” or “dry”, tend to have less variability associated with differences in streamflow when compare to samples collected across years. The major basins include the West Fork White River Basin (2001), Whitewater River and East Fork White River Basins (2002), Upper Wabash (2003), Lower Wabash River and Kankakee River Basins (2004), and Great Lakes and Ohio River Basins (2005).

Algal biomass samples for this study were collected in three Aggregate Nutrient Ecoregions. Ecoregion VI consists of subset Ecoregions 54, 55, and 57; Ecoregion VII, consists of Ecoregion 56; Ecoregion IX consists of Ecoregions 71, and

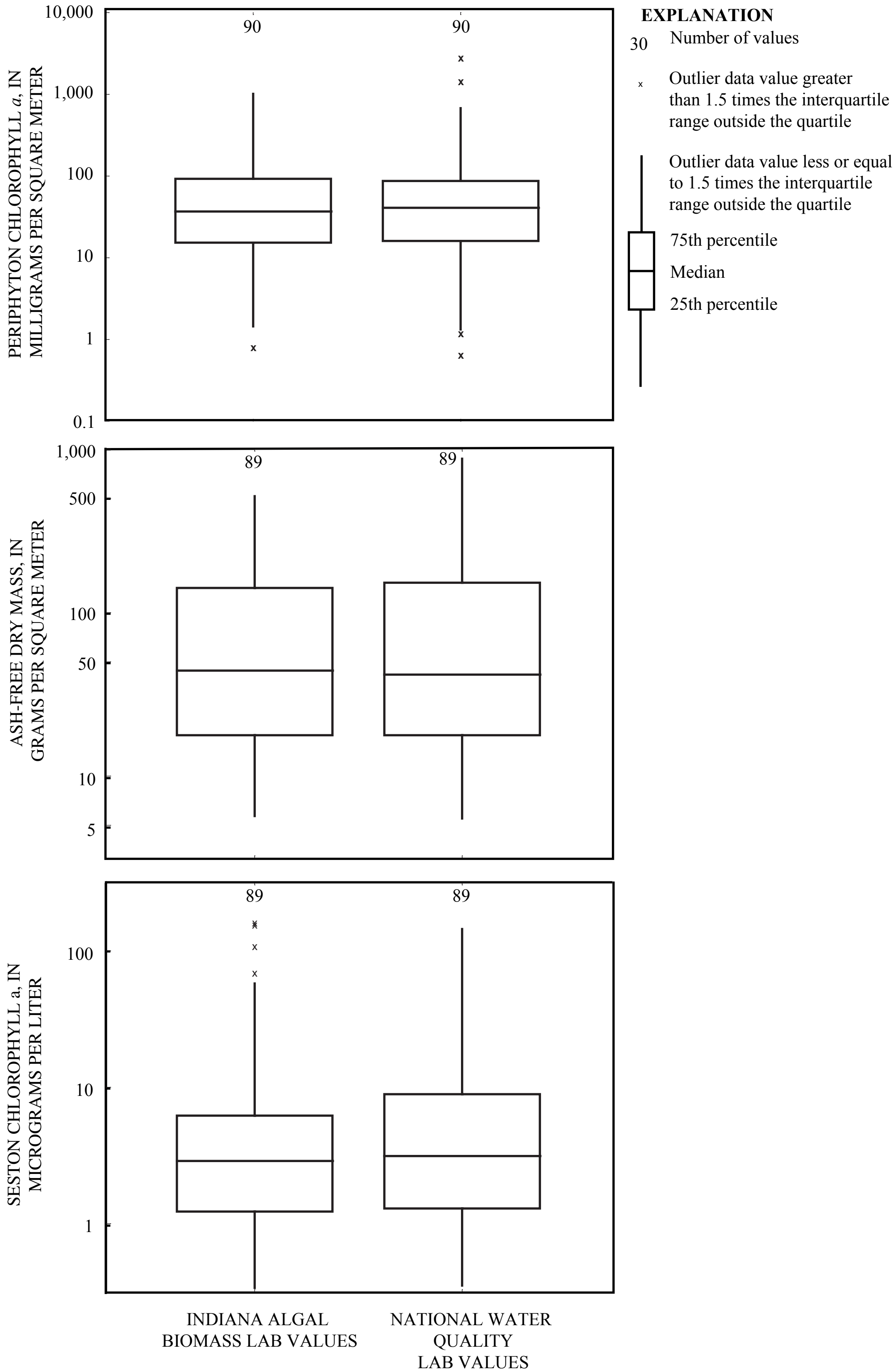

Figure 11. Comparison of seston and periphyton chlorophyll *a* and ash-free dry mass values from the Indiana Algal Biomass Laboratory and National Water Quality Laboratory.

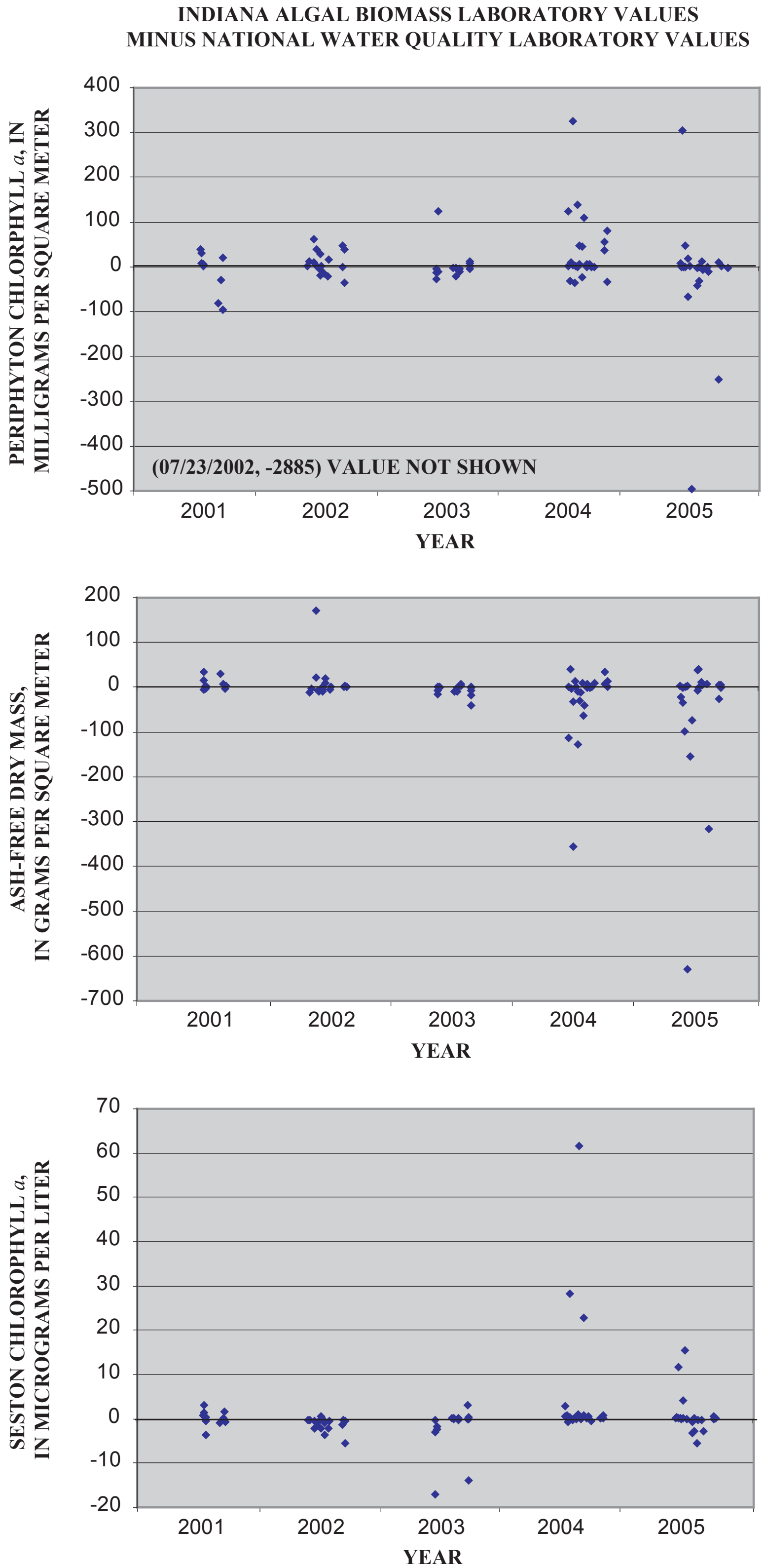

Figure 12. Differences between seston and periphyton chlorophyll *a* and ash-free dry mass values by year, reported by the Indiana Algal Biomass Laboratory and National Water Quality Laboratory.

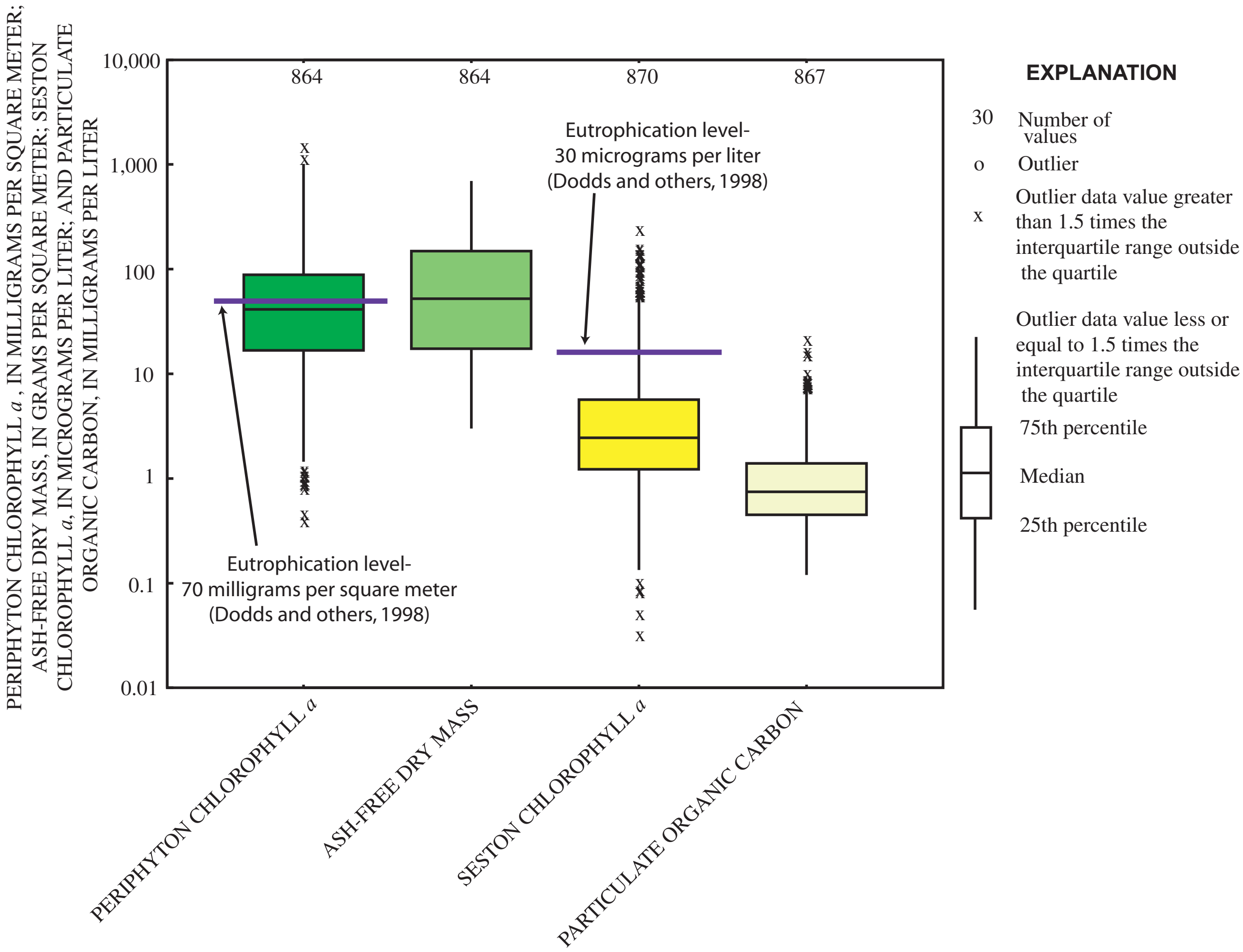

Figure 13. Algal biomass concentrations in Indiana, 2001–2005.

72. Level III Ecoregion 57 contained only one sampling site and was not included in the analysis for Level III Ecoregions. The USEPA set nutrient criteria for periphyton and seston CHLa based on limited available datasets. The periphyton CHLa data from this study provides the first periphyton CHLa data and augments the limited seston CHLa data for Ecoregions VI, VII, and IX.

The IDEM probabilistic WMP measures seasonal variability by collecting samples three times during the growing season, and targeted collection periods start in May, July, and September. Collection periods varied with each year. In this study, samples were grouped according to USEPA seasonal classification: spring (May), summer (June through August), and fall (September through October). Algal biomass data are grouped by season in figure 16 and table 3. Minimal algal biomass variability occurred due to seasonal influence.

Periphyton Chlorophyll *a*

Statewide, concentrations of periphyton CHLa ranged from 0.41 to 1,550 mg/m^2 with a median of 41.2 mg/m^2 (fig. 13 and by site in Appendix 17). The large range of periphyton CHLa concentrations could be attributed to basin characteristics and factors including land use, patterns of streamflow, substrate type, stream gradient, algal species, and light availability. The Whitewater River Basin, sampled in 2002, had the highest periphyton CHLa median concentration of 63.1 mg/m^2. The lowest median concentration of periphyton CHLa, 16.7 mg/m^2, was in the West Fork White River Basin, sampled in 2001. (fig. 14 and table 1). Median concentrations ranged from 49.9 mg/m^2 in Ecoregion VI and 41.2 mg/m^2 in Ecoregion VII to 27.3 mg/m^2 in Ecoregion IX (fig. 15 and table 2). Seasonal median concentrations of periphyton CHLa were highest in the spring, 63.2 mg/m^2, and decreased through the growing season to 37.3 mg /m^2 in the fall (fig. 16 and table 3). However, an analysis of variance on the ranks using a Kruskal-Wallis test indicated no significant differences among seasons (p=0.103).

Periphyton Chlorophyll *a* Trophic Level

Statewide, about 32 percent of the periphyton CHLa samples would be considered eutrophic according to trophic-boundary values for periphyton CHLa from Dodds and others

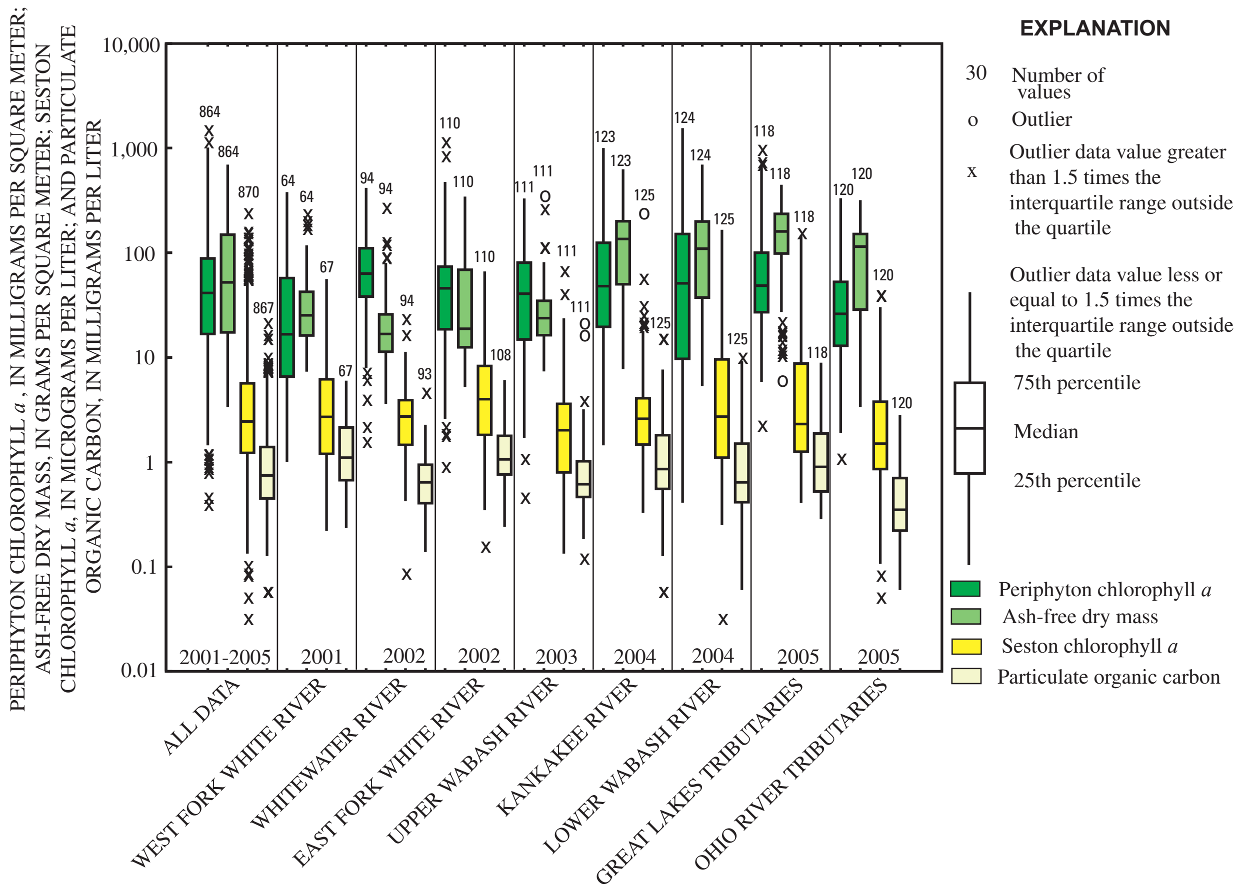

Figure 14. Algal biomass concentrations by individual basins in Indiana, 2001–2005.

(1998). By major river basins, the percentage of samples considered eutrophic ranged from 15 percent in the Tributaries to the Ohio River in 2005 to 45 percent in the Whitewater River Basin in 2002 (table 1). In the Aggregate Nutrient Ecoregions, approximately 37 percent of samples collected in Ecoregion VI, 34 percent of samples collected in Ecoregion VII and 21 percent of the samples collected in Ecoregion IX would be considered eutrophic (table 2). Seasonally, about 45 percent of the samples collected in the spring, 31 percent of the samples in summer, and 31 percent of the samples collected in the fall were considered eutrophic (table 3).

Ash-Free Dry Mass

Statewide, concentrations of AFDM ranged from 3.37 to 697 g/m2 with a median of 52.1 g/m^2 (fig. 13 and by site in Appendix 17). The highest median concentrations of AFDM were in the Great Lakes Tributaries (160 g/m^2), Kankakee River Basin (135 g/m^2), Ohio River Tributaries (115 g/m^2), and the Lower Wabash River Basin (109 g/m2) during years of low to moderate hydrologic discharge through the sampling season. The lowest median concentration of AFDM, 16.8 g/m^2, was in the Whitewater River Basin, sampled in 2002 (fig. 14 and table 1). The AFDM concentrations in Ecoregion VI ranged from 3.60 to 697 g/m^2 with a median of 29.6 g/m^2 (fig. 15 and table 2). The AFDM concentrations in Ecoregion VII ranged from 6.30 to 446 g/m^2 with a median of 145 g/m^2. The AFDM concentrations in Ecoregion IX ranged from 3.37 to 318 g/m^2 with a median of 70.5 g/m^2. Seasonal median concentrations of AFDM ranged from 44.8 g/m^2 in the spring to 55.4 g/m^2 in the summer, and 47.0 g/m^2 in the fall (fig. 16 and table 3). However, the Kruskal-Wallis test indicated no significant differences among seasons (p=0.952). Hydrologic scour and substrate type appeared to greatly influence AFDM concentrations.

Seston Chlorophyll *a*

Statewide, concentrations of seston CHLa ranged from 0.03 to 251 µg/L with a median of 2.44 µg/L. The East Fork White River Basin, sampled in 2002, had the highest seston CHLa median concentration of 4.01 µg/L. The lowest median concentration of seston CHLa (1.50 µg/L) was in the Ohio River Tributaries, sampled in 2005. Seston CHLa median concentrations were relatively consistent throughout the Aggregate Nutrient Ecoregions and ranged from 2.69 µg/L in Ecoregion VI and 2.29 µg/L in Ecoregion IX to 2.06 µg/L in Ecoregion VII (fig. 15 and table 2). Seasonal median

Table 1. Algal biomass concentrations by individual basin in Indiana, 2001–2005.

[mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter]

	2001–2005	2001	2002		2003	2004		2005	
Statistic	All data	West Fork White River	Whitewater River	East Fork White River	Upper Wabash River	Kankakee River	Lower Wabash River	Tributaries to Great Lakes	Tributaries to Ohio River
Periphyton chlorophyll *a* (mg/m²)									
Number of samples	864	64	94	110	111	123	124	118	120
Minimum	.41	1	1.62	.943	.48	1.45	.41	2.34	1.13
Median	41.2	16.7	63.1	45.8	40.5	47.9	51.2	48.5	26.1
Maximum	1550	379	417	1190	331	1000	1550	1010	332
Percent of samples above eutrophic level[1]	32	19	45	29	30	37	42	37	15
Ash-free dry mass (g/m²)									
Number of samples	864	64	94	110	111	123	124	118	120
Minimum	3.37	7.3	3.6	5.2	7.33	7.7	5.33	6.3	3.37
Median	52.1	25.3	16.8	18.8	23.7	135	109	160	115
Maximum	697	245	283	345	366	627	697	446	318
Seston chlorophyll *a* (µg/L)									
Number of samples	870	67	94	110	111	125	125	118	120
Minimum	.03	.22	.09	.16	.13	.33	.03	.41	.05
Median	2.44	2.7	2.73	4.01	2.02	2.59	2.71	2.31	1.5
Maximum	251	56.1	24.4	66.1	69.8	251	166	161	41.2
Percent of samples above eutrophic level[2]	6	1	0	6	2	2	20	9	2
Particulate organic carbon (mg/L)									
Number of samples	867	67	93	108	111	125	125	118	120
Minimum	.06	.24	.14	.24	.13	.06	.06	.29	.06
Median	.75	1.1	.64	1.07	.62	.86	.64	.9	.35
Maximum	22.3	6.01	4.83	6.07	22.3	15.9	10.5	8.94	2.84

[1]Eutrophic level for periphyton chlorophyll *a* is 70 mg/m2 (Dodds and others, 1998)

[2]Eutrophic level for seston chlorophyll *a* is 30 µg/L (Dodds and others, 1998)

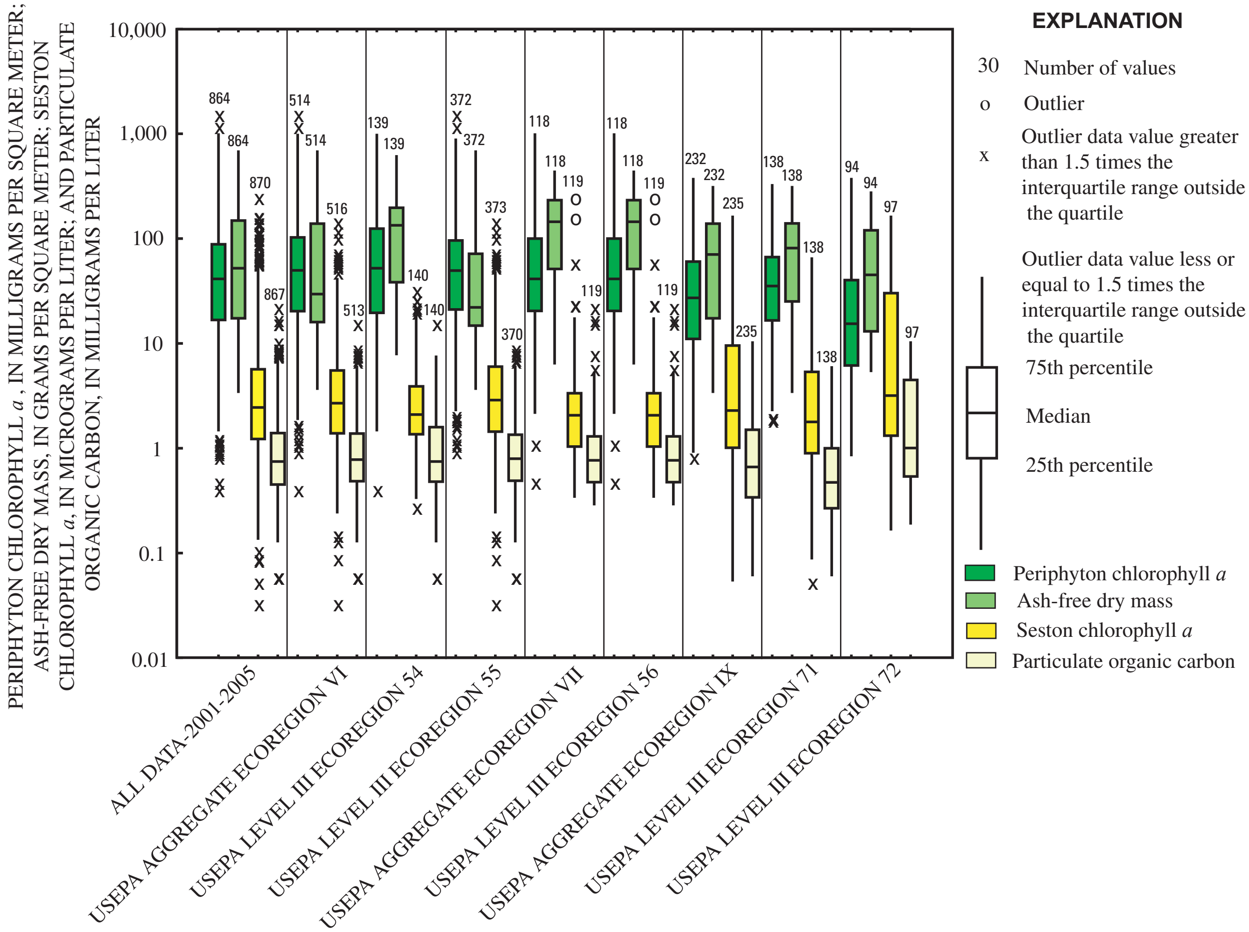

Figure 15. Algal biomass concentrations by USEPA Ecoregions in Indiana, 2001–2005.

concentrations of seston CHLa ranged from 2.00 µg/L in the spring to 2.96 µg/L in the summer and 1.86 µg/L in the fall. The Kruskal-Wallis test indicated a significant difference between the summer concentration and the spring and fall concentrations (p=0.001). There were no significant differences between the spring and fall concentrations.

Seston Chlorophyll *a* Trophic Level

Statewide, about 6 percent of the seston CHLa samples would be considered eutrophic according to trophic-boundary values for seston CHLa according to Dodds and others (1998). By major river basins, the percentage of samples considered eutrophic ranged from 0 percent in the West Fork White River in 2001 to 20 percent in the Lower Wabash River Basin in 2004 (table 1). In the Aggregate Nutrient Ecoregions, approximately 4 percent of samples collected in Ecoregion VI, 2 percent of the samples in Ecoregion VII, and 13 percent of the samples in Ecoregion IX would be considered eutrophic (table 2). Seasonally, 0 percent of the samples collected in the spring, 8 percent of the samples in summer, and 5 percent of the samples collected in the fall were considered eutrophic (table 3).

Particulate Organic Carbon

Concentrations of POC in Indiana streams ranged from 0.06 to 22.3 mg/L with a median of 0.75 mg/L. The highest median concentration of POC, 1.10 mg/L, was in the West Fork White River Basin, sampled in 2001. The lowest median concentration of POC, 0.35 mg/L, was in the Ohio River Tributaries, sampled in 2005 (fig. 14 and table 1). The POC concentrations in Ecoregion VI ranged from 0.06 to 15.7 mg/L with a median of 0.78 mg/L (fig. 15 and table 2). The POC concentrations in Ecoregion VII ranged from 0.29 to 22.3 mg/L with a median of 0.76 mg/L. The POC concentrations in Ecoregion IX ranged from 0.06 to 10.5 mg/L with a median of 0.66 mg/L. Seasonal median concentrations of POC increased slightly from 0.71 mg/L in the spring to 0.81 mg/L in the summer, then decreased to 0.67 mg/L in the fall (fig. 16 and table 3). Like the seston CHLa, the Kruskal-Wallis test indicated significant differences between the summer and fall concentrations (p=0.007). There were no significant differences between summer and spring or spring and fall concentrations.

Table 2. Algal biomass concentrations by U.S. Environmental Protection Agency Ecoregions in Indiana, 2001–2005.

[mg/m^2, milligram per square meter; USEPA, U.S. Environmental Protection Agency; g/m^2, gram per square meter; µg/L, microgram per liter; mg/L, milligram per liter]

Statistic	All data	USEPA Aggregate Ecoregion VI	USEPA Level III Ecoregion 54	USEPA Level III Ecoregion 55	USEPA Aggregate Ecoregion VII	USEPA Level III Ecoregion 56	USEPA Aggregate Ecoregion IX	USEPA Level III Ecoregion 71	USEPA Level III Ecoregion 72
Periphyton chlorophyll *a* (mg/m^2)									
Number of samples	864	514	139	372	118	118	232	138	94
Minimum	.41	.41	.41	.94	.48	.48	.84	1.88	.84
Median	41.2	49.9	52.2	49.5	41.2	41.2	27.3	35.2	15.4
Maximum	1550	1550	1000	1550	1010	1010	379	332	379
Percent of samples above eutrophic level[1]	32	37	38	37	34	34	21	22	18
Ash free dry mass (g/m^2)									
Number of samples	864	514	139	372	118	118	232	138	94
Minimum	3.37	3.60	7.70	3.60	6.30	6.30	3.37	3.37	5.33
Median	52.1	29.6	134	22.1	145	145	70.5	81.4	45.2
Maximum	697	697	627	697	446	446	318	318	282
Seston chlorophyll *a* (µg/L)									
Number of samples	870	516	140	373	119	119	235	138	97
Minimum	.03	.03	.28	.03	.34	.34	.05	.05	.16
Median	2.44	2.69	2.10	2.88	2.06	2.06	2.29	1.79	3.18
Maximum	251	146	32.3	146	251	251	166	66.1	166
Percent of samples above eutrophic level[2]	6	4	<1	5	2	2	13	4	25
Particulate organic carbon (mg/L)									
Number of samples	867	513	140	370	119	119	235	138	97
Minimum	.06	.06	.06	.06	.29	.29	.06	.06	.19
Median	.75	.78	.75	.79	.76	.76	.66	.47	1.00
Maximum	22.3	15.7	15.7	8.94	22.3	22.3	10.5	6.07	10.5

[1]Eutrophic level for periphyton chlorophyll *a* is 70 mg/m^2 (Dodds and others, 1998)

[2]Eutrophic level for seston chlorophyll *a* is 30 µg/L (Dodds and others, 1998)

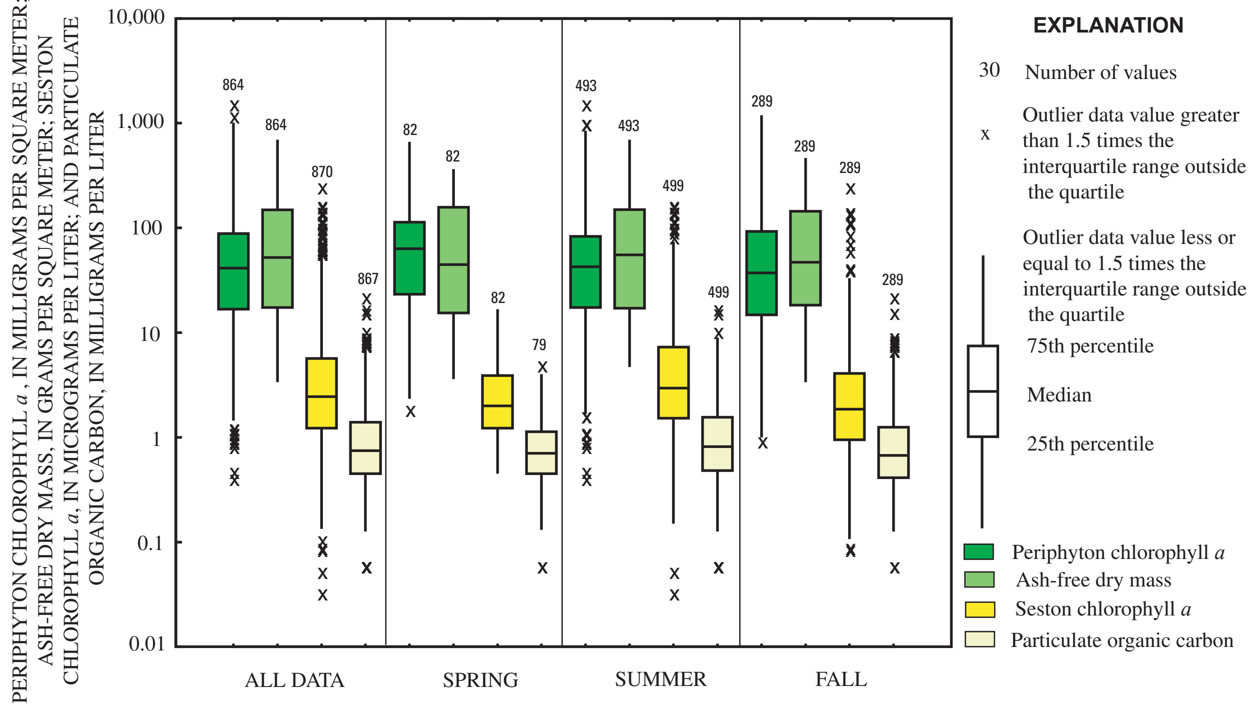

Figure 16. Algal biomass concentrations by season in Indiana, 2001–2005.

Relations of Algal Biomass to Nutrients and Selected Basin Characteristics

Several factors affect concentrations of algal biomass and, thus, can influence the development of nutrient criteria. Nutrients are essential for cellular growth in algae and often limit growth. The form of algal growth, periphytic or sestonic, depends upon basin size. Increased streamflow scours periphyton algae from its substrate and, depending upon when the samples are collected, could affect the assumptions of nutrient conditions in a stream. Algal biomass is frequently used as a measure of stream productivity and is often collected when suitable substrates are available. However, when algal biomass values are cited in other studies, the values are often considered the same whether samples were collected on rocks, sticks, or sand substrates. Turbidity attenuates light penetration and can limit algal growth, especially in larger streams. For these reasons, a more detailed discussion of nutrients, basin size, streamflow, substrate, and turbidity follows.

Nutrients

Seasonal concentrations of nutrients (TKN, nitrate, TN, and TP) were compared to seasonal concentrations of algal biomass parameters (periphyton CHLa, AFDM, seston CHLa, and POC) using data from 2001–05. The only significant positive correlations were between summer POC and summer TP ($r_s = 0.549$, $p<0.001$); summer POC and summer TKN ($r_s = 0.537$, $p<0.001$); spring POC and spring TP ($r_s = 0.582$, $p<0.001$) (table 4). These significant relations suggest that as nutrient concentrations (TP and TKN) within a stream increase, POC concentrations increase. However, these significant relations with TP are most likely related to phosphorus associated within seston algal cells and attached to sediment (Van Nieuwenhuyse and Jones, 1996).

There were no significant relations between nutrient concentrations and periphyton or seston CHLa concentrations. Previous studies of nutrient-rich agricultural streams in Illinois found few relations among concentrations of N or P and periphyton or seston CHLa (Figueroa-Nieves and others, 2006). However, Biggs (2000) listed several studies that found significant relations between nutrients and periphyton CHLa. Dodds and others (1997) found significant relations between TN and TP and periphyton CHLa in temperate streams. Robertson and others (2006) found significant relations between nitrate, TN, dissolved P, and TP and periphyton CHLa in Wisconsin.

In addition, earlier reports from this study that analyzed yearly 2001–2003 data found significant relations between nutrients and algal biomass. The earlier reports combined CHLa and AFDM for periphyton into one algal biomass parameter and CHLa and POC for seston into another parameter. These algal biomass parameters were significantly related to different nutrients in the 2001 (Frey and others, 2007), 2002 (Caskey and others, 2007), 2003 (Leer and others, 2007),

Table 3. Algal biomass concentrations by season, Indiana, 2001–2005.

[mg/m^2 , milligram per square meter; g/m^2, gram per square meter; µg/L, microgram per liter; mg/L, milligram per liter;]

Statistic	All data	Spring[1]	Summer[1]	Fall[1]
Periphyton chlorophyll *a* (mg/m^2)				
Number of samples	864	82	493	289
Minimum	.41	1.88	.41	.94
Median	41.2	63.2	42.5	37.3
Maximum	1,550	663	1,550	1,190
Percent of samples above eutrophic level[2]	32	45	31	31
Ash free dry mass (g/m^2)				
Number of samples	864	82	493	289
Minimum	3.37	3.6	4.7	3.37
Median	52.1	44.8	55.4	47
Maximum	697	365	697	464
Seston chlorophyll *a* (µg/L)				
Number of samples	870	82	499	289
Minimum	.03	.45	.03	.09
Median	2.44	2	2.96	1.86
Maximum	251	16.75	166	251
Percent of samples above eutrophic level[3]	6	0	8	5
Particulate organic carbon (mg/L)				
Number of samples	867	79	499	289
Minimum	.06	.06	.06	.06
Median	.75	.71	.81	.67
Maximum	22.3	4.99	17.1	22.3

[1]Spring season-May; Summer season-June through August; Fall season-September and October (USEPA, 2000a).

[2]Eutrophic level for periphyton chlorophyll *a* is 70 mg/m^2 (Dodds and others, 1998)

[3]Eutrophic level for seston chlorophyll *a* is 30 µg/L (Dodds and others, 1998)

Table 4. Statistically significant Spearman rho relations of the algal biomass and nutrient parameters, Indiana, 2001–2005.

[r_s, Spearman's rho statistic; p-value, probability statistic]

Algal biomass parameter	Nutrient parameter	r_s	p-value	Number of samples
Particulate organic carbon—Spring	Total Phosphorus—Spring	0.582	<0.001	78
Particulate organic carbon—Summer	Total Kjeldahl Nitrogen—Summer	.537	<.001	426
Particulate organic carbon—Summer	Total Phosphorus—Summer	.549	<.001	499

and 2005 (Lowe, 2007) reports. No significant relations were found between the nutrients and periphyton algal biomass. In these earlier reports, the significant relations among nutrients and algal biomass occurred in summer and fall. It was believed that because nutrient concentrations were uniformly high in spring there was not a large enough nutrient gradient to measure significant relations with algal biomass. Nutrient concentrations decreased, however, during summer and fall because of decreased loading of nutrients into streams and losses due to evapotranspiration, greater algal uptake, and more denitrification from bacteria associated with the lower streamflow (and thus more contact time). Therefore a gradient with lower nutrients existed to measure significant relations with algal biomass.

Algal biomass can be influenced by several natural factors that could account for this lack of relations. Scouring of algal growth by increased streamflow can cause algal growth to restart in the stream (Biggs and others, 1999), and annual and seasonal differences in storm events can allow for “wet” and “dry” years with high levels of algal biomass corresponding to high and low nutrients, depending upon the season. Other factors include shading from canopy cover and turbidity (Wehr, 2003) and grazing by snails, invertebrates, and fish (Lamberti and others, 1987).

Several other reasons could account for the lack of significant relations between nutrients and periphyton CHLa. It appears that intraannual (between years) variability associated with differences in wet and dry years is greater than the interannual (within year) variability, and correlations possibly could be masked when the larger dataset (2001–2005) was analyzed. It is also possible that significant relations could be found if the CHLa were combined with AFDM for periphyton and CHLa combined with POC for seston variables as was done in 2001–2003 studies between nutrients and algal biomass. In addition, rivers in the Midwest may be so nutrient rich that not enough low nutrient sites can be found to provide a gradient of nutrients to detect relations between nutrients and periphyton CHLa.

Basin Size

During the 5-year study, eight major drainage basins were studied. Streams located within the study areas were differentiated by drainage area: headwater streams (0–51 km2), wadable streams (52–2,590 km^2), and boatable streams (2,591–38,900 km^2). Algal biomass samples were not collected from boatable sites during the 2001 study of the West Fork White River. Overall, the two measures of algal biomass for periphyton (CHLa and AFDM) and seston (CHLa and POC) showed similar concentration response trends to basin size.

Periphyton Chlorophyll *a*

Concentrations of periphyton CHLa increased with basin size in smaller order streams but decreased in larger order streams. Median concentrations of periphyton CHLa were highest in headwater (37.9 mg/m^2) and wadable streams (49.0 mg/m^2) and lowest in boatable streams (12.7 mg/m^2) (fig. 17 and table 5). This relation supports the River Continuum Concept (Vannote and others, 1980) that periphyton are more important than seston for primary production in small and medium-sized streams compared to large streams. The Lower Wabash River Basin had the highest median concentration of periphyton CHLa for wadable streams (149 mg/m^2). Using boundary values from Dodds and others (1998), approximately 32 percent of samples collected for periphyton CHLa at headwater streams, 37 percent of samples collected at wadable streams, and 9 percent of the samples at collected at boatable streams would be considered eutrophic.

Ash-Free Dry Mass

Concentrations of AFDM decreased as basin size increased. Median concentrations of AFDM were 83.3 g/m^2 in headwater streams, 35.6 g/m^2 in wadable streams, and 22.2 g/m^2 in boatable streams (fig. 18 and table 5). Concentrations of AFDM were highest in 2004 (Kankakee River and Lower Wabash River Basins) and 2005 (Great Lakes and Ohio River Tributaries) when stream discharge was low to moderate during the sampling season. The 2004 and 2005 samples contained nearly 8.5 times more AFDM for headwater streams and nearly 7 times more AFDM for wadable streams compared to samples from 2001–2003. The Great Lakes Tributaries had the highest median concentration of AFDM for headwater streams, 193 g/m^2. The Lower Wabash River basin had the highest median concentration of AFDM for wadable streams, 211 g/m^2.

The East Fork White River Basin (2002) boatable streams had an elevated median AFDM concentration of 94.3 g/m^2 (fig. 18) . Compared to boatable streams in the other study basins, the high median concentration of AFDM in the East Fork White River Basin is likely attributed to epidendric (submerged woody debris) field sampling practices, which consisted of collecting multiple samples from one substrate source (log) due to the limited availability of epidendric substrates. This practice could have potentially increased AFDM concentrations through the collection of heavily populated algal samples from one algal source or location instead of five representative sample locations within the boatable streams.

Seston Chlorophyll *a*

Concentrations of seston CHLa increased as basin size increased. Median concentrations of seston CHLa were 1.88 µg/L in headwater streams, 2.71 in wadable streams, and 22.7 µg/L in boatable streams (fig. 19 and table 5). The Lower Wabash River Basin had the highest median concentration of seston CHLa for boatable streams, 106 µg/L. Wadable streams had a median seston CHLa concentration of 2.71 µg/L, or 0.83 µg/L greater than headwater streams.

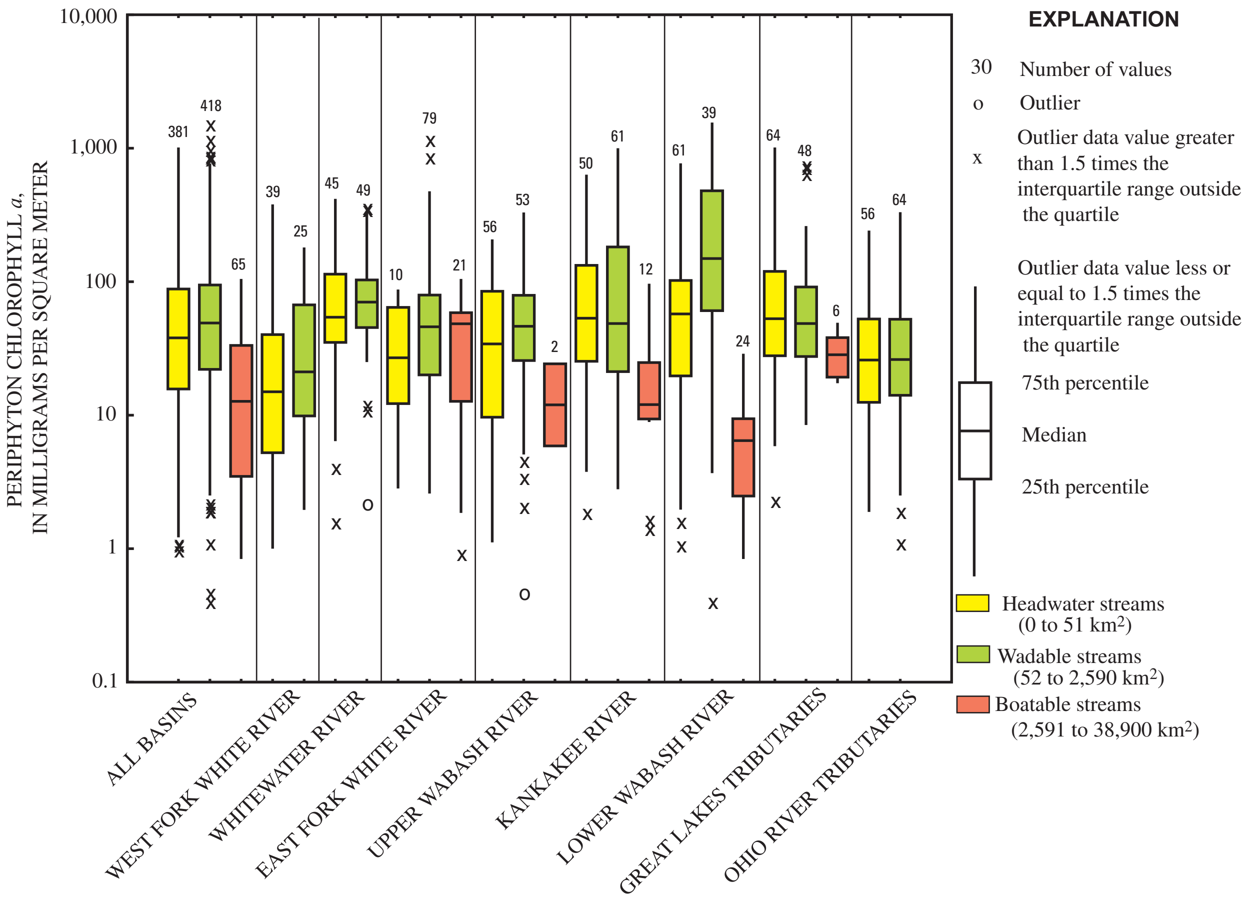

Figure 17. Periphyton chlorophyll *a* concentrations by basin size in Indiana, 2001–2005.

Using boundary values from Dodds and others (1998), about 2 percent of samples collected for seston CHLa at headwater sites, 3 percent wadable sites, and 47 percent of the samples at boatable sites would be considered to have been collected from eutrophic streams.

Particulate Organic Carbon

Similar to seston CHLa, concentrations of POC increased as basin size increased during the 5-year study. Median concentrations of POC were 0.59 mg/L in headwater streams, 0.81 mg/L in wadable streams, and 3.36 mg/L in boatable streams (fig. 20 and table 5). The median concentration of POC for all streams (headwater, wadable, and boatable) was 0.75 mg/L. The Lower Wabash River (7.11 mg/L) and the Upper Wabash River (3.09 mg/L) Basins had the two highest median POC concentrations for boatable streams. The Great Lakes River Basin boatable streams had the lowest median POC concentration (1.15 mg/L) and were likely influenced by drought conditions that caused low streamflow and reduced the suspension of POC during sampling.

Basin Size and Chlorophyll *a*

During this 5-year study, median periphyton CHLa concentrations increased as drainage area increased in smaller order headwater and wadable streams, however, periphyton CHLa concentration decreased as stream size increased to boatable streams of 2,591–38,900 km^2 (fig. 21). This finding supports the River Continuum Concept (Vannote and others, 1980), which suggests that periphyton would dominate primary algal production in smaller streams, that have more suitable substrate (rock, sticks, sand) and shallower water, less turbidity, and more light penetration than larger streams. As streams become larger, deeper, and more turbid, seston would dominate primary algal production. Figure 22 is a scatter plot of periphyton CHLa and seston CHLa plotted against increasing basin size. A locally weighted scatter plot smoothing technique (LOWESS) was used to generate the lines for periphyton CHLa and seston CHLa through the scatter plots. The LOWESS method was selected to depict the relation between concentrations and basin size because it can accommodate outlying data (Helsel and Hirsch, 1992). It appears that both periphyton and seston CHLa have a breakpoint around 1,000 km^2.

Table 5. Algal biomass concentrations by basin size, Indiana, 2001–2005.

[mg/m^2 , milligram per square meter; g/m^2, gram per square meter; µg/L, microgram per liter; mg/L, milligram per liter]

Statistic	All data	Headwater	Wadeable	Boat
Periphyton chlorophyll *a* (mg/m^2)				
Number of samples	864	381	418	65
Minimum	.41	1.00	.41	.84
Median	41.2	37.9	49.0	12.7
Maximum	1,550	1,010	1,550	105
Percent of samples above eutrophic level[1]	32	32	37	9
Ash free dry mass (g/m^2)				
Number of samples	864	381	418	65
Minimum	3.37	3.37	5.13	5.33
Median	52.2	83.3	35.6	22.2
Maximum	697	411	697	245
Seston chlorophyll *a* (µg/L)				
Number of samples	870	384	421	65
Minimum	.03	0.03	.09	.38
Median	2.44	1.88	2.71	22.7
Maximum	251	251	146	166
Percent of samples above eutrophic level[2]	6	2	3	47
Particulate organic carbon (mg/L)				
Number of samples	867	382	420	65
Minimum	.06	.06	.16	.33
Median	.75	.59	.81	3.36
Maximum	22.3	22.3	8.94	10.5

[1]Eutrophic level for periphyton chlorophyll *a* is 70 mg/m^2 (Dodds and others, 1998)

[2]Eutrophic level for seston chlorophyll a is 30 µg/L (Dodds and others, 1998)

Algal growth can be limited by light penetration in larger more turbid streams (Leland and Frey, 2008). Seston algae that are free-floating and can move up and down in the water column are better suited to these large river environments.

Streamflow

The frequency and magnitude of stream discharge, or streamflow, greatly influences algal biomass concentrations within streams (Biggs and others, 1999; Biggs and Kilroy, 2000). When stream discharge is high, the increased velocity and sediment in the water can scour algae from substrate. Once scoured, algae require a week or more to recolonize the substrate (Porter and others, 1993). In years with frequent high discharges, algal biomass concentration tends to be low. Conversely, stable periods of moderate to low discharge are conducive to high algal growth.

The IDEM probabilistic WMP selects one to two major river basins per year for algal biomass monitoring and the USEPA randomly selects sites within the identified study basin. Sample sites are not sampled in consecutive years to measure annual variation. As a result, the effect of variation in annual stream discharge on algal biomass cannot be determined. To investigate differences in annual variability, stream discharge and algal biomass concentrations were monitored at three NAWQA trend sites (table 6). During the 5-year study, NAWQA trend sites were sampled 6–10 times during the same sampling period, from May through October, as the IDEM/USGS sites. These three NAWQA trend sites were in Ecoregion VI and 55. Sugar Creek at New Palestine (USGS Station ID-03361650) drains 243 km^2 and is in the East Fork

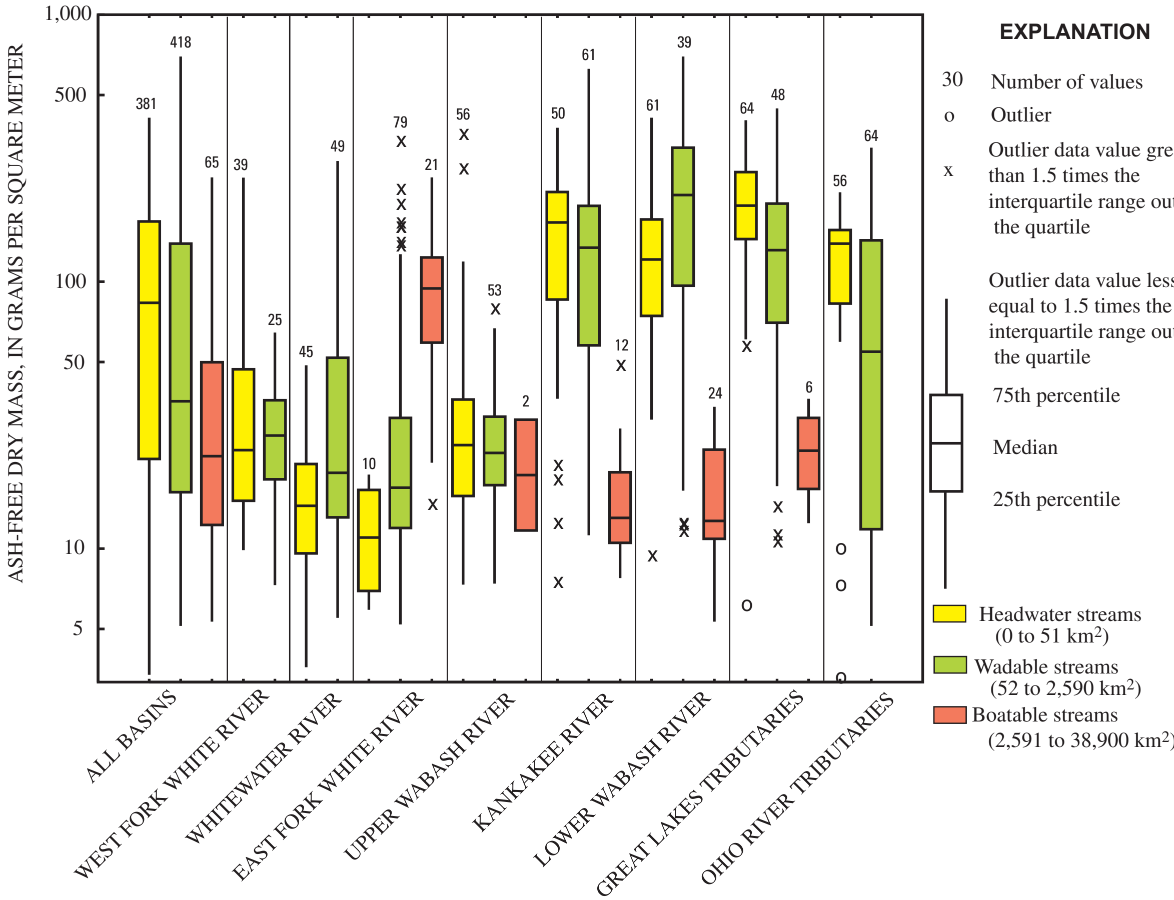

Figure 18. Ash-free dry mass concentrations by basin size in Indiana, 2001–2005.

White River Basin. Big Walnut Creek near Roachdale (USGS Station ID-03357330), which drains 339 km^2, and Little Buck Creek at Indianapolis (USGS Station ID-03353637), which drains 44.0 km^2, are in the West Fork White River Basin. In general, discharge patterns were similar at the three NAWQA trend sites and for purposes of this report, discharges at Big Walnut Creek at Roachdale are used to illustrate the effects of discharge on algal biomass for the NAWQA trend sites.

The frequency and magnitude of stream discharges and algal biomass concentrations varied annually at the NAWQA trend sites during the 5-year study (table 6, figs. 23–25). Differences in stream discharge, for example, during wet or dry years or resulting from evenly spaced storms compared to irregularly spaced storms, appeared to greatly affect algal growth. Algal biomass concentrations at Big Walnut Creek from 2002 through 2004 demonstrate the influence of stream discharge on algal biomass growth through hydrologic scour (figs. 23, 24, 25). Typically, low concentrations of periphyton CHLa were found in samples collected at least 1 week following a storm event. Decreases in concentrations of periphyton CHLa were found after discharges as low as 20–25 m^3/s (figs. 23, 24, 25). In 2003, when regular periodic storms occurred throughout the growing season, concentrations of periphyton CHLa never were detected greater than 200 mg/m^2 and concentrations in five of the seven samples collected were less than 100 mg/m^2 (fig. 24). During the summers of 2002 and 2004, when stream discharge was stable, concentrations of periphyton CHLa increased through the growing season. In 2002, a large spring storm scoured existing algal biomass and the lowest concentration of periphyton CHLa was detected about 1 week after this storm; subsequent small storms that caused periodic increases in stream discharge appeared to keep periphytic concentrations low, mostly less than 100 mg/m^2, until an extended period of low flow in late September and early October produced two periphyton CHLa values over 400 mg/m^2 (fig. 23). In contrast, 2004 was a very dry year with no large storms and few smaller storms; thus, decreases in stream discharge led to conditions that support algal growth (fig. 25). All periphyton CHLa concentrations from June to October were greater than 200 mg/m^2 with the exception of one sample collected after a storm in early July. The highest periphyton concentration of almost 850 mg/m^2 was collected in early October.

Of the 322 randomly selected sites sampled for this study, the highest median concentration of periphyton CHLa was in the spring, although that value was not significantly

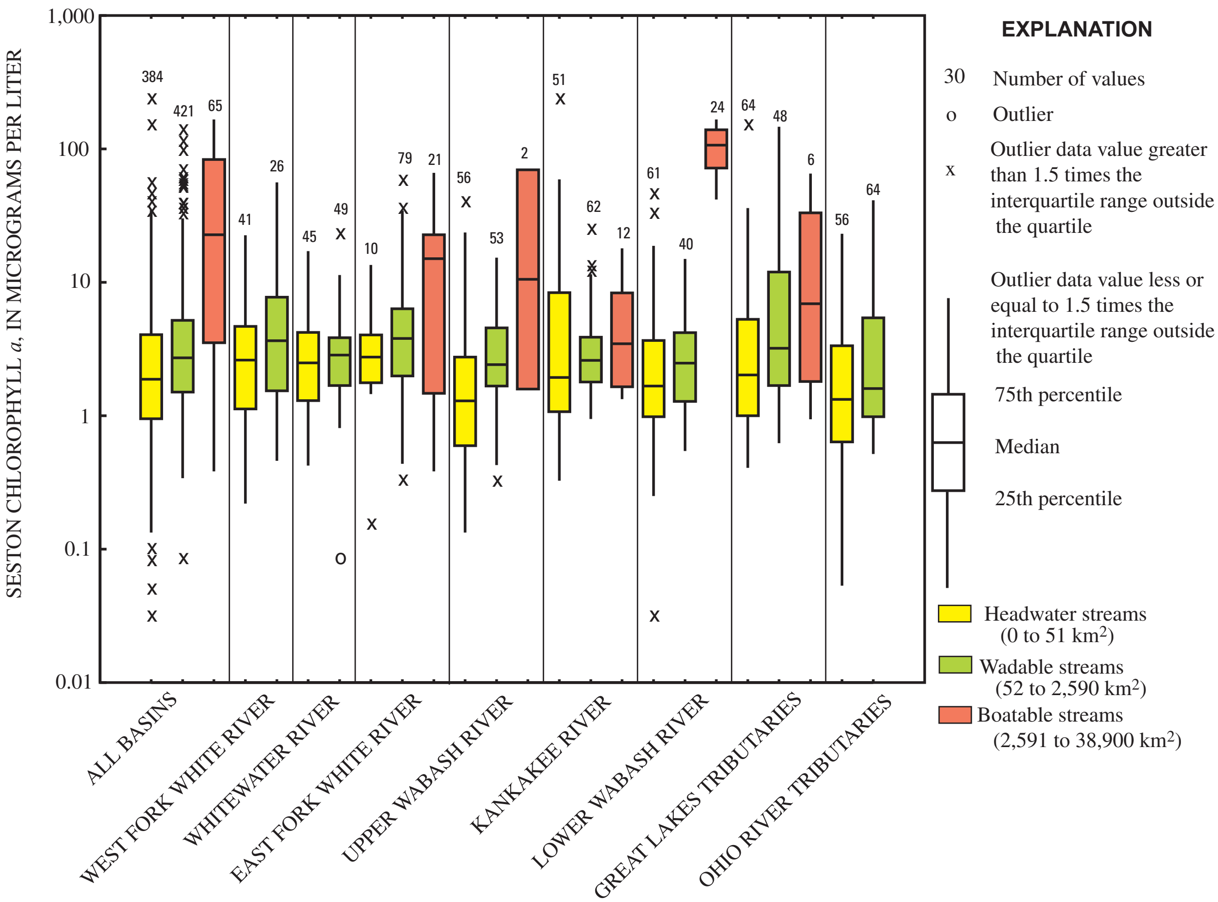

Figure 19. Seston chlorophyll *a* concentrations by basin size in Indiana, 2001–2005.

different than those from the summer or fall samples. Yet at the NAWQA trend sites in 2001, 2002, 2004, and 2005, the highest periphyton CHLa concentrations were found in the fall, during periods of extended stable low flow. The exception was 2003, when the highest concentrations of periphyton CHLa at NAWQA trend sites were found in the spring, during an extended period of stable low flow. This suggests that in the nutrient-rich Midwest, stable flow conditions control seasonal algal biomass levels.

Throughout the 5-year study, streamflow varied seasonally and annually. Very few sites were at or near USGS streamflow-gaging stations to permit continuous monitoring of streamflow. In addition, discharge measurements were not collected in conjunction with algal biomass sampling, so direct comparison of discharge to algal biomass or nutrient concentrations was not possible. Even if discharge had been measured in conjunction with algal biomass sample collection, it would reflect only the static condition and not the discharge fluctuations that may have occurred prior to sample collection. However, when possible, samples were collected during stable, base streamflow. When possible, algal biomass samples were not collected during rising discharges and 1 week was allowed, after peak discharge, before collecting an algal biomass sample.

To assess the effects of streamflow on algal biomass samples for this study, discharge data from three or more USGS streamflow-gaging stations, within each study basin, were selected based on the spatial relations of the stations to the IDEM/USGS sites and drainage basin size (table 7). Hourly discharge data collected at the stations were compared to sampling event schedules to determine if previous high streamflow might have influenced algal biomass development.

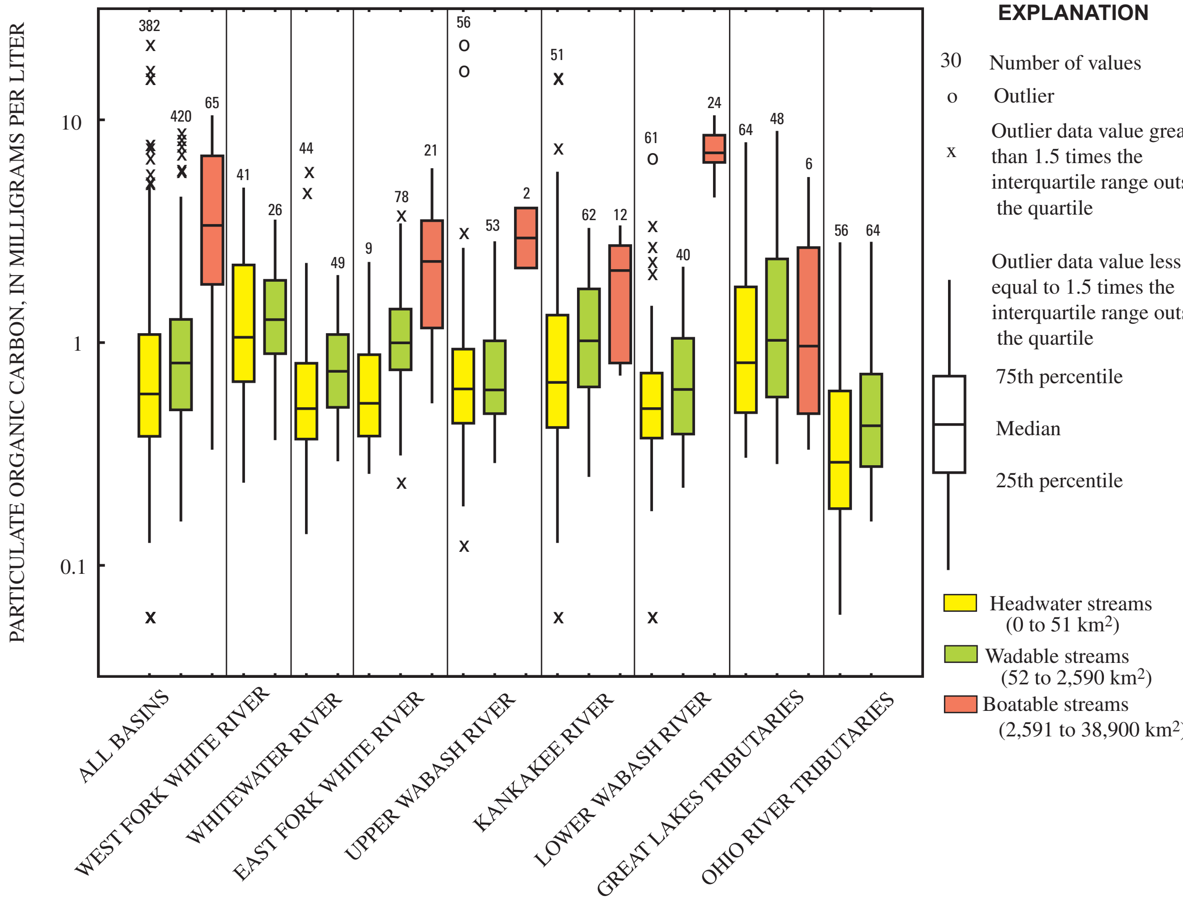

Figure 20. Particulate organic carbon concentrations by basin size in Indiana, 2001–2005.

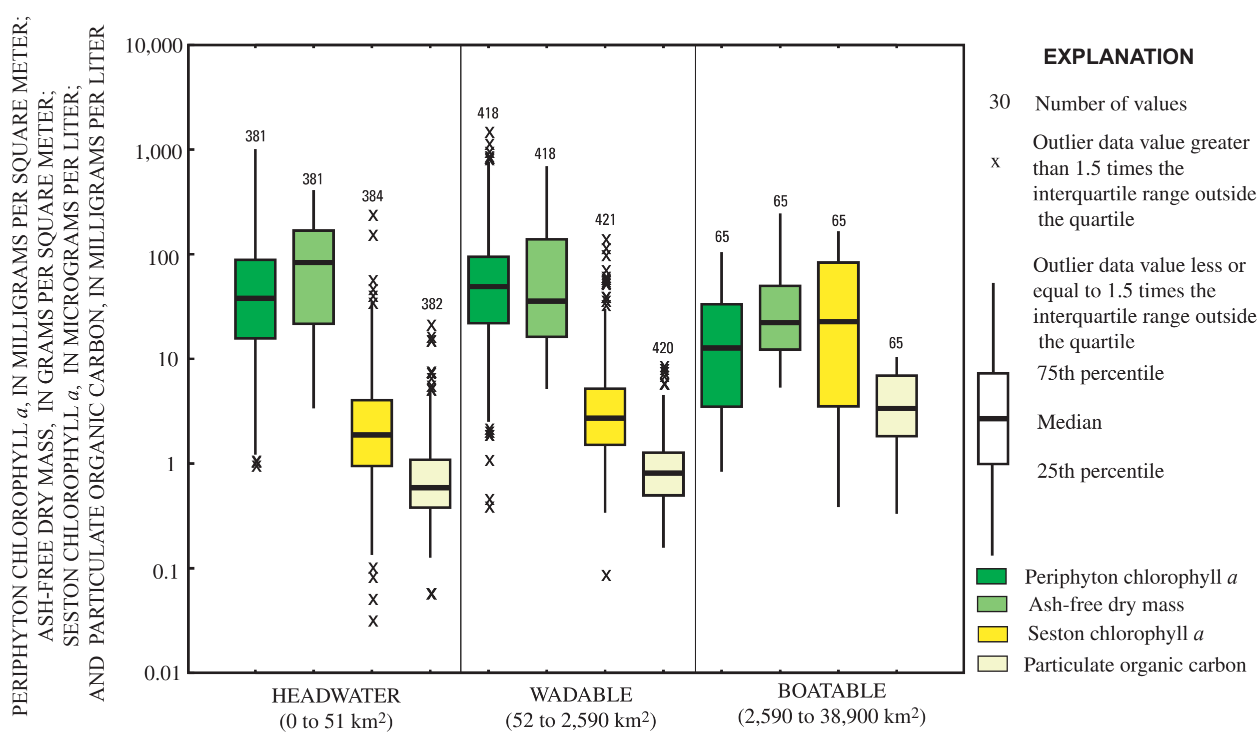

Figure 21. Algal biomass concentrations by basin size in Indiana, 2001–2005.

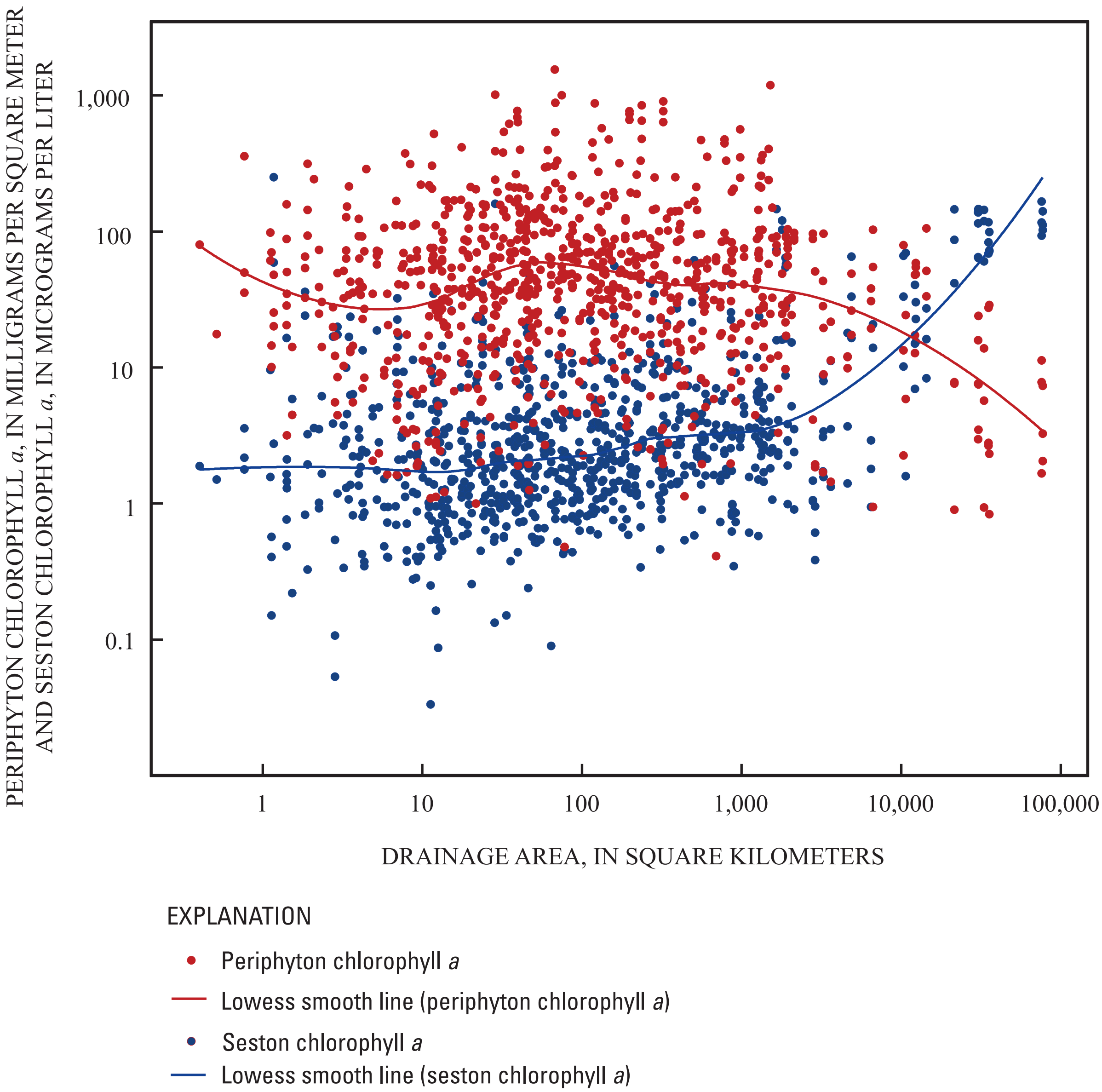

Figure 22. Periphyton and seston chlorophyll *a* relations to drainage area, Indiana, 2001–2005.

Table 6. Discharge summary for U.S. Geological Survey streamflow-gaging stations, for three National Water Quality Assessment trend sites in Indiana, 2001–2005.

[USGS, U.S. Geological Survey; ID, identification; km^2, square kilometers; m^3/s, cubic meter per second]

Basin/section	Year	USGS station ID	USGS streamflow-gaging station	Drainage area (km^2)	Annual mean discharge (yearly data) (m^3/s)	Historical record	Mean annual discharge (historical data) (m^3/s)	Difference (percent)
West Fork White River	2002	03357330	Big Walnut Creek near Roachdale	339	6.44	2002		
	2003	03357330	Big Walnut Creek near Roachdale		5.27	2002–2003	5.27	0
	2004	03357330	Big Walnut Creek near Roachdale		4.28	2002–2004	4.76	-10
	2005	03357330	Big Walnut Creek near Roachdale		5.89	2002–2005	5.15	14
East Fork White River	2001	03361650	Sugar Creek at New Palestine	243	2.37	1968–2001	2.86	-17
	2002	03361650	Sugar Creek at New Palestine		4.44	1968–2002	2.91	52
	2003	03361650	Sugar Creek at New Palestine		3.31	1968–2003	2.92	14
	2004	03361650	Sugar Creek at New Palestine		3.60	1968–2004	2.94	22
	2005	03361650	Sugar Creek at New Palestine		3.82	1968–2005	2.97	29
West Fork White River	2001	03353637	Little Buck Creek near Indianapolis	44	0.44	1990–2001	.59	-26
	2002	03353637	Little Buck Creek near Indianapolis		0.92	1990–2002	.61	49
	2003	03353637	Little Buck Creek near Indianapolis		0.48	1990–2003	.61	-21
	2004	03353637	Little Buck Creek near Indianapolis		0.58	1990–2004	.60	-4
	2005	03353637	Little Buck Creek near Indianapolis		0.74	1990–2005	.61	21

Table 7. Discharge summary for U.S. Geological Survey streamflow-gaging stations, in selected basins in Indiana, 2001–2005.

[USGS, U.S. Geological Survey; ID, identification; km^2, square kilometers; m^3/s, cubic meter per second; NB, North Branch]

Basin/section	Year	USGS station ID	USGS streamflow-gaging station	Drainage area (km^2)	Annual mean discharge (yearly data) (m^3/s)	Historical record	Mean annual discharge (historical data) (m^3/s)	Difference (percent)
West Fork White River	2001	03360500	White River at Newberry	12,142	120	1929–2001	138	-13
	2001	03353620	Lick Creek at Indianapolis	40	.473	1971–2001	.555	-14.8
	2001	03353600	Little Eagle Creek at Speedway	63	.501	1965–2001	.685	-26.9
	2001	03357500	Big Walnut Creek near Reelsville	844	9.26	1950–2001	9.88	-6.3
Whitewater River	2002	03276500	Whitewater River at Brookville	3,170	66.6	1916–2002	37.2	79
	2002	03274650	Whitewater River near Economy	27	0.447	1971–2002	.317	41
	2002	03275600	East Fork Whitewater River at Abington	518	10.7	1966–2002	6.47	65.4
	2002	03275000	Whitewater River near Alpine	1,352	30.2	1929–2002	16.3	85.3
East Fork White River	2002	03373500	East Fork White River at Shoals	12,761	292	1904–2002	158	84.8
	2002	03366500	Muscatatuck River near Deputy	759	19.5	1949–2002	10.2	91.2
	2002	03361650	Sugar Creek at New Palestine	243	4.44	1967–2002	2.91	52.6
Upper Wabash River	2003	03335500	Wabash River at Lafayette	18,822	234	1924–2003	190	23.2
	2003	03333600	Kokomo Creek near Kokomo	64	1.02	1960–2003	.663	53.8
	2003	03325500	Mississinewa River near Ridgeville	344	5.21	1947–2003	3.71	40.4
	2003	03324000	Little River near Huntington	681	8.3	1945–2003	6.8	22.1
Kankakee River	2004	05518000	Kankakee River at Shelby	4,608	45.1	1924–2004	47.9	-5.8
	2004	05516500	Yellow River at Plymouth	761	8.1	1949–2004	7.62	6.3
	2004	05515500	Kankakee River at Davis	1,391	12.3	1926–2004	14.8	-16.9
Lower Wabash River	2004	03378500	Wabash River at New Harmony	75,716	945	1928–2004	807	17.1
	2004	03340800	Big Raccoon Creek near Fincastle	360	3.71	1958–2004	4.05	-8.4
	2004	03339500	Sugar Creek at Crawfordsville	1,318	14.8	1939–2004	14	5.7
	2004	03342000	Wabash River at Riverton	34,087	453	1940–2004	350	29.4

Table 7. Discharge summary for U.S. Geological Survey streamflow-gaging stations, in selected basins in Indiana, 2001–2005.—Continued

[USGS, U.S. Geological Survey; ID, identification; km^2, square kilometers; m^3/s, cubic meter per second; NB, North Branch]

Basin/section	Year	USGS station ID	USGS streamflow-gaging station	Drainage area (km^2)	Annual mean discharge (yearly data) (m^3/s)	Historical record	Mean annual discharge (historical data) (m^3/s)	Difference (percent)
Tributaries to Great Lakes	2005	04101000	St. Joseph River at Elkhart	8,728	87.9	1948–2005	92.2	-4.7
	2005	04183000	Maumee River at New Haven	5,095	60	1957–2005	51.2	17.2
	2005	04095090	Burns Ditch at Portage	857	15.8	1995–2005	13.8	14.5
	2005	04177720	Fish Creek at Hamilton	97	.96	1970–2005	.951	.9
	2005	04094000	Little Calumet River at Porter	171	2.17	1946–2005	2.16	.5
	2005	04100222	NB Elkhart River at Cosperville	368	3.6	1972–2005	3.82	-5.8
Tributaries to Ohio River	2005	03303300	Middle Fork Anderson River at Bristow	103	1.56	1962–2005	1.59	-1.9
	2005	03294000	Silver Creek near Sellersburg	490	7.76	1955–2005	6.4	21.3
	2005	03303000	Blue River near White Cloud	1,233	21.5	1932–2005	18.8	14.4
	2005	03291780	Indian-Kentuck Creek nr Canaan	71	1.42	1970–2005	1.1	29.1

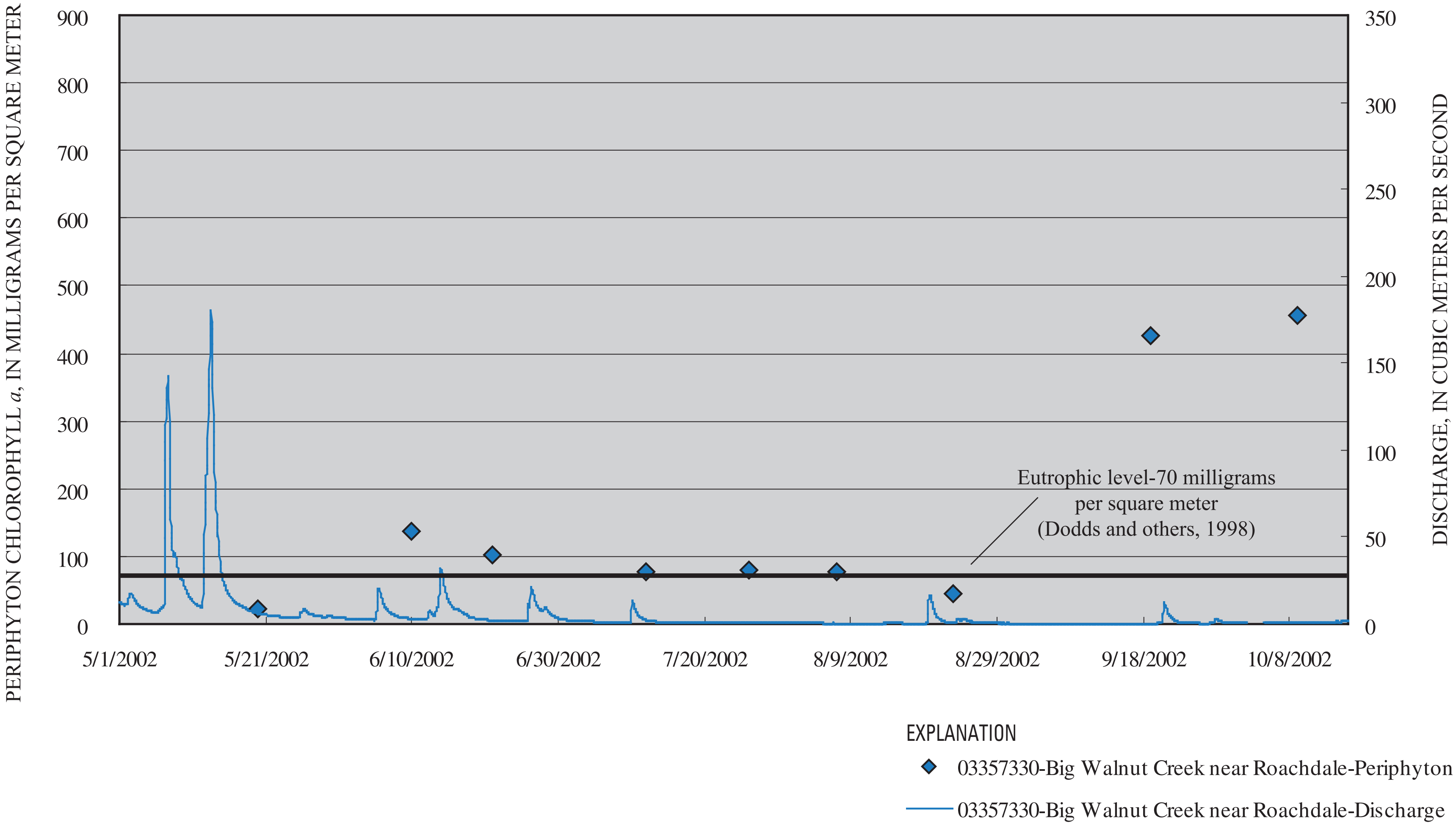

Figure 23. Discharge and periphyton chlorophyll *a* concentrations at Big Walnut Creek near Roachdale, Indiana, 2002.

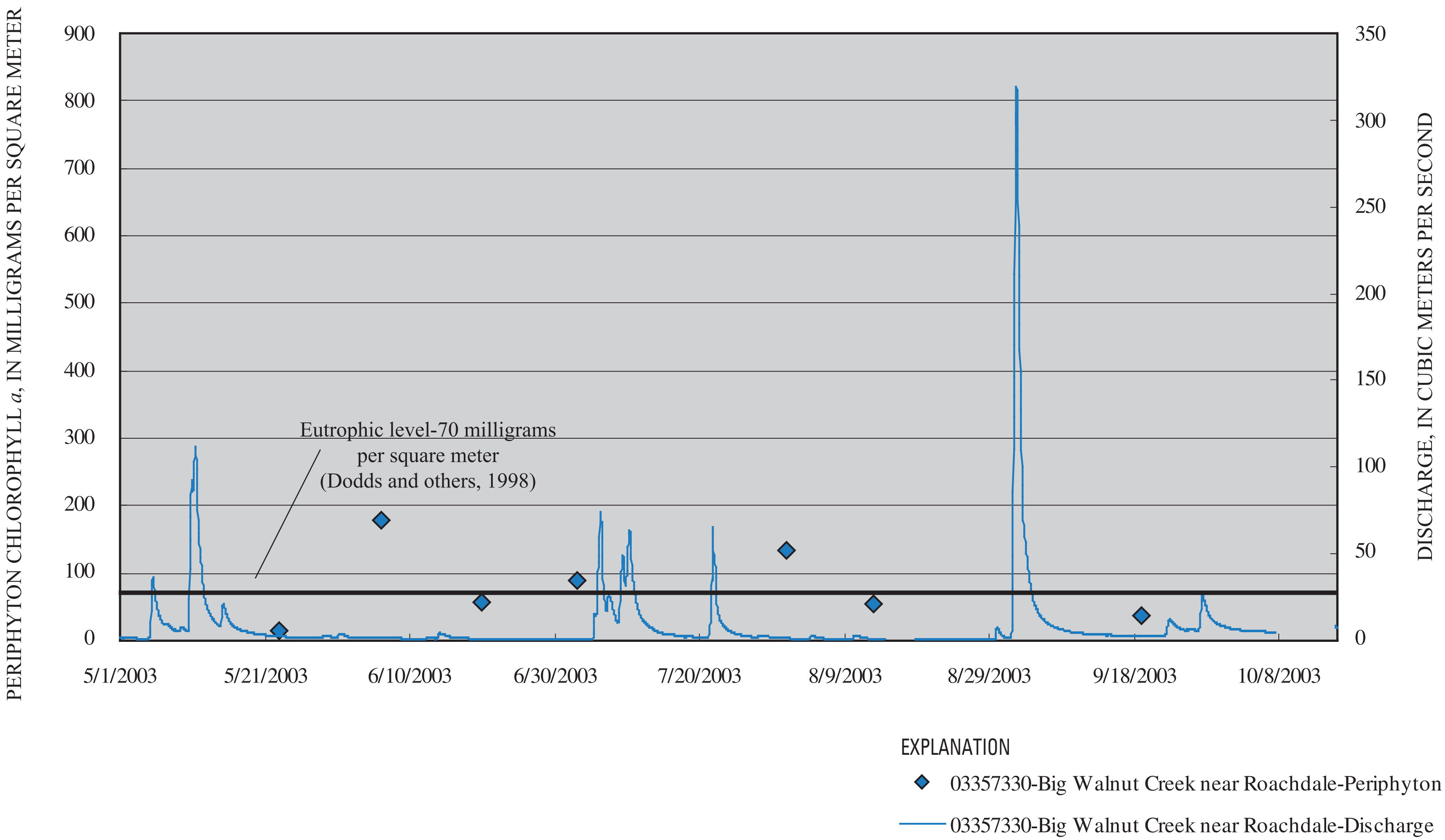

Figure 24. Discharge and periphyton chlorophyll *a* concentrations at Big Walnut Creek near Roachdale, Indiana, 2003.

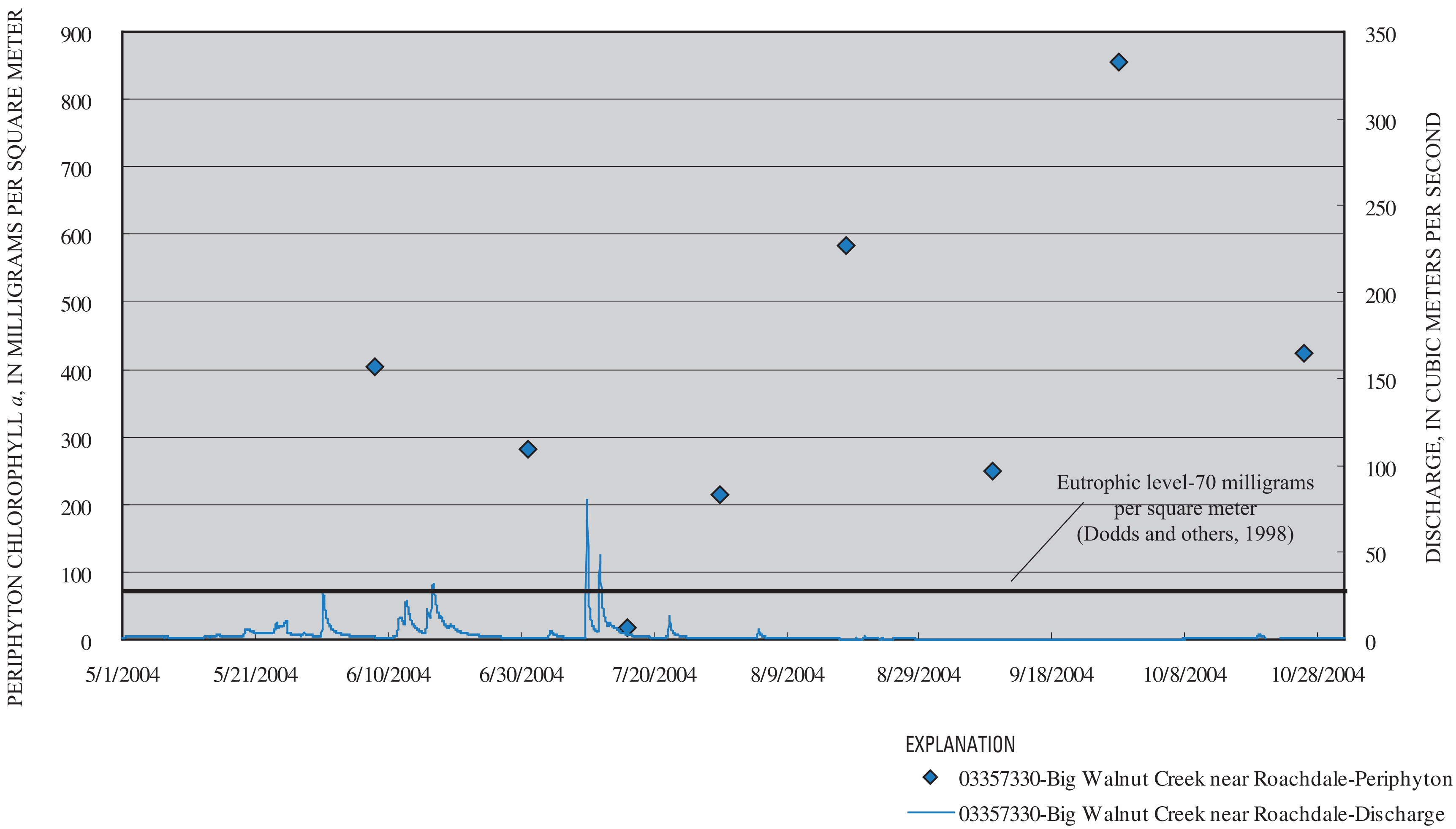

Figure 25. Discharge and periphyton chlorophyll *a* concentrations at Big Walnut Creek near Roachdale, Indiana, 2004.

West Fork White River Basin

Samples were collected in July for round 2 (7/9/2001–7/25/2001) and in September for round 3 (9/4/2001–9/19/2001) on the West Fork White River Basin. Algal biomass samples were not collected in round 1. At the USGS streamflow-gaging station, White River at Newberry, IN (03360500)(fig. 2), the annual mean discharge for water year 2001 of 120 m^3/s was 13 percent lower than the mean annual discharge of 138 m^3/s (table 7) (Stewart and others, 2002a). Streams used in this analysis were Lick Creek at Indianapolis, USGS-03353620; Little Eagle Creek at Speedway, USGS-03353600, and Big Walnut Creek near Reelsville, USGS-03357500 (fig. 26) (Stewart and others, 2002a). Most of the increases in discharge were noticeable at all three streams, indicating that rain events most likely affected streams throughout the basin. Discharge at these streams increased two to three times during each round of sampling. Several high discharge periods prior to round 2 and round 3 probably caused scouring of periphyton within streams that have a rapid hydrologic response because scour occurred at streamflow as low as 20–25 m^3/sec at the NAWQA trend sites.

Whitewater River Basin

Samples were collected in May and June for round 1 (5/21/2002–6/24/2002), in July and August for round 2 (7/1/2002 to 8/8/2002) and September for round 3 (9/3/2002–9/25/2002) on the Whitewater River Basin. At the USGS streamflow-gaging station, Whitewater River at Brookville, IN (03276500)(fig. 3), the annual mean discharge for water year 2002 of 66.6 m^3/s was 79 percent greater than the mean annual discharge of 37.2 m^3/s (table 7) (Stewart and others, 2002b). However, the highest discharges were in early May, prior to sampling; after sampling began, discharge decreased for the most part through the end of September. Streams used for the analysis were: the Whitewater River near Economy, USGS-03274650; East Fork Whitewater River at Abington, USGS-03275600; and Whitewater River near Alpine, USGS-03275000 (fig. 27, table 7) (Stewart and others, 2002b). Most increases in discharge were noticeable on all three streams, indicating that rain events most likely affected streams throughout the basin. The high stream discharges 6 days prior to sampling round 1 probably caused scour at most sites in the basin, but the high discharges were early enough to allow algae to recolonize before samples were collected. However, several rain events that caused discharge to increase greater than 20–25 m^3/sec at larger streams probably caused scour of algae in these streams.

East Fork White River Basin

Samples were collected in May and June for round 1 (5/21/2002–6/24/2002), in July and August for round 2 (7/8/2002–8/19/2002), and September for round 3 (9/2/2002–9/26/2002) on the East Fork White River Basin (fig. 3). At the USGS streamflow-gaging station East Fork White River at Shoals, IN (03373500), the annual mean discharge for water year 2002 of 292 m^3/s was 85 percent greater than the mean annual discharge of158 m^3/s (table 7) (Stewart and others, 2002b). However, the highest discharges were in early May, prior to sampling. Discharge decreased through the end of September when a significant rain event caused discharge to increase (fig. 28). Streams used for the analysis were: Sugar Creek at New Palestine, USGS-03361650; Muscatatuck River near Deputy, USGS-03366500; and East Fork White River at Shoals, USGS-03373500 (fig. 28, table 7) (Stewart and others, 2002b). Most discharge increases were noticeable on all three streams, indicating that rain events most likely affected streams throughout the basin. The high stream discharges 6 days prior to sampling round 1 probably caused scour at most sites in the basin but was early enough to allow algae to recolonize before samples were collected. Two rain events increased streamflow to greater than 20–25 m^3/sec a probably caused algal scour in these streams.

Upper Wabash River Basin

Samples were collected in May through June for round 1 (5/22/2003–6/24/2003), July through mid-August for round 2 (7/22/2003–8/14/2003), and September for round 3 (9/8/2003–9/18/2003) in the Upper Wabash River Basin. At the USGS streamflow-gaging station Wabash River at Lafayette, IN (03335500) (fig. 4), the annual mean discharge for water year 2003 of 234 m^3/s was 23 percent greater than the mean annual discharge of190 m^3/s (table 7) (Morlock and others, 2004a). Intermittent high discharges generally occurred throughout the sample collection period although with less frequency during sampling round 3. Streams used for the analysis were: Kokomo Creek near Kokomo, USGS-03333600; Mississinewa River near Ridgeville, USGS-03325500; and Little River near Huntington, USGS-03324000 (fig. 29, table 7) (Morlock and others, 2004a). Most discharge increases were noticeable at all three streams, indicating that rain events affected streams throughout the basin. The high stream discharges prior to rounds 1–3 probably caused scour at most sites within the basin. However, the increases in discharge in mid-June and July 2003 at Kokomo Creek near Kokomo (0.708 and 53.5 m^3/s), Mississinewa River near Ridgeville (15.3 and 117 m^3/s), and Little River near Huntington (49.0 and 106 m^3/s) probably caused scouring of periphyton. Discharges at all three sites were not stable, but continuously fluctuated from baseflow due to intermittent rainfall and storms throughout the sampling season. Algae samples collected would mostly likely have been collected from newer recolonized algal communities because old growth communities would have been scoured from the periphyton substrates. Several rain events throughout sampling season when discharge was greater than 20–25 m^3/s probably caused scour of algae in these streams.

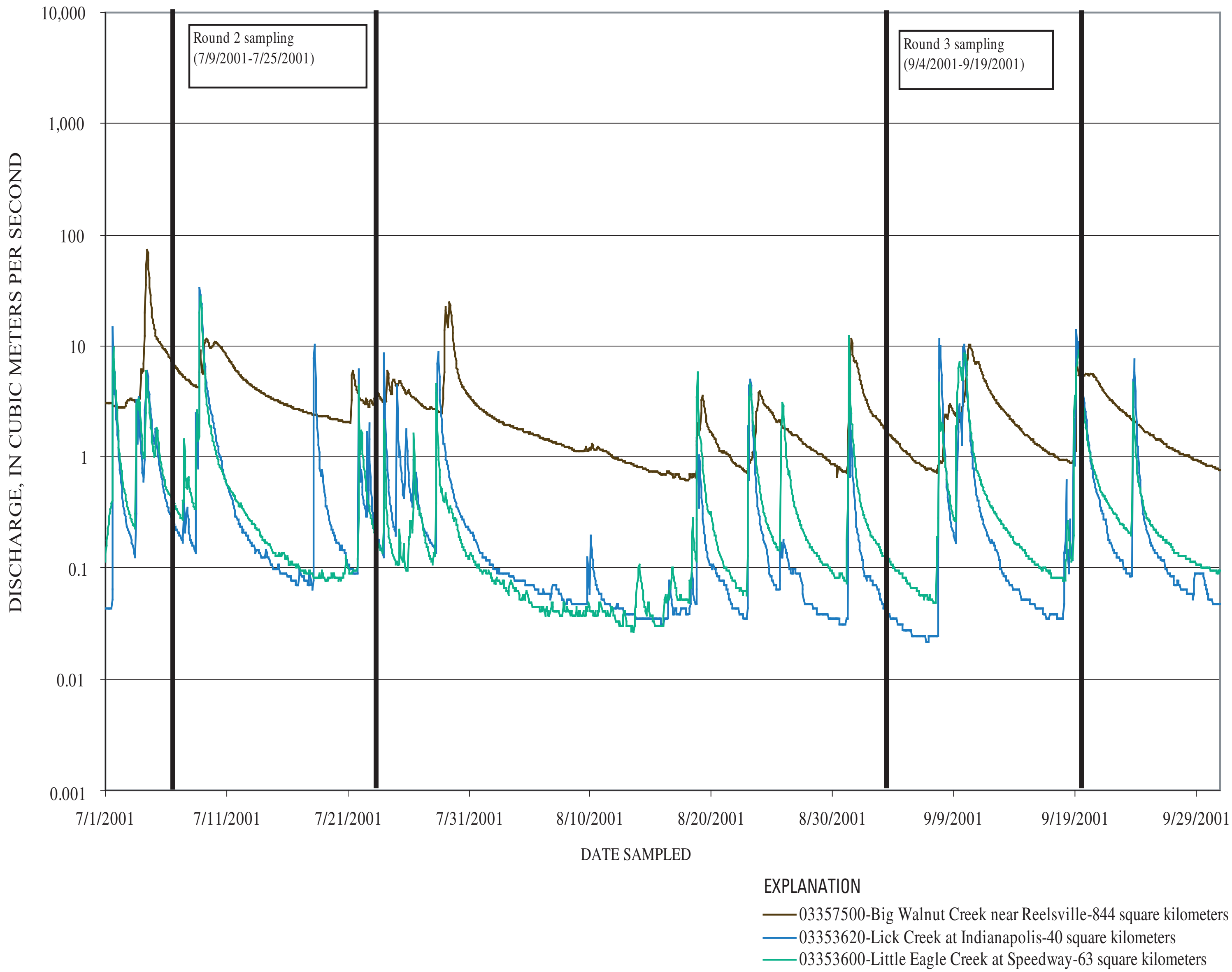

Figure 26. Discharge of three variously sized basins within the West Fork White River Basin, Indiana, 2001.

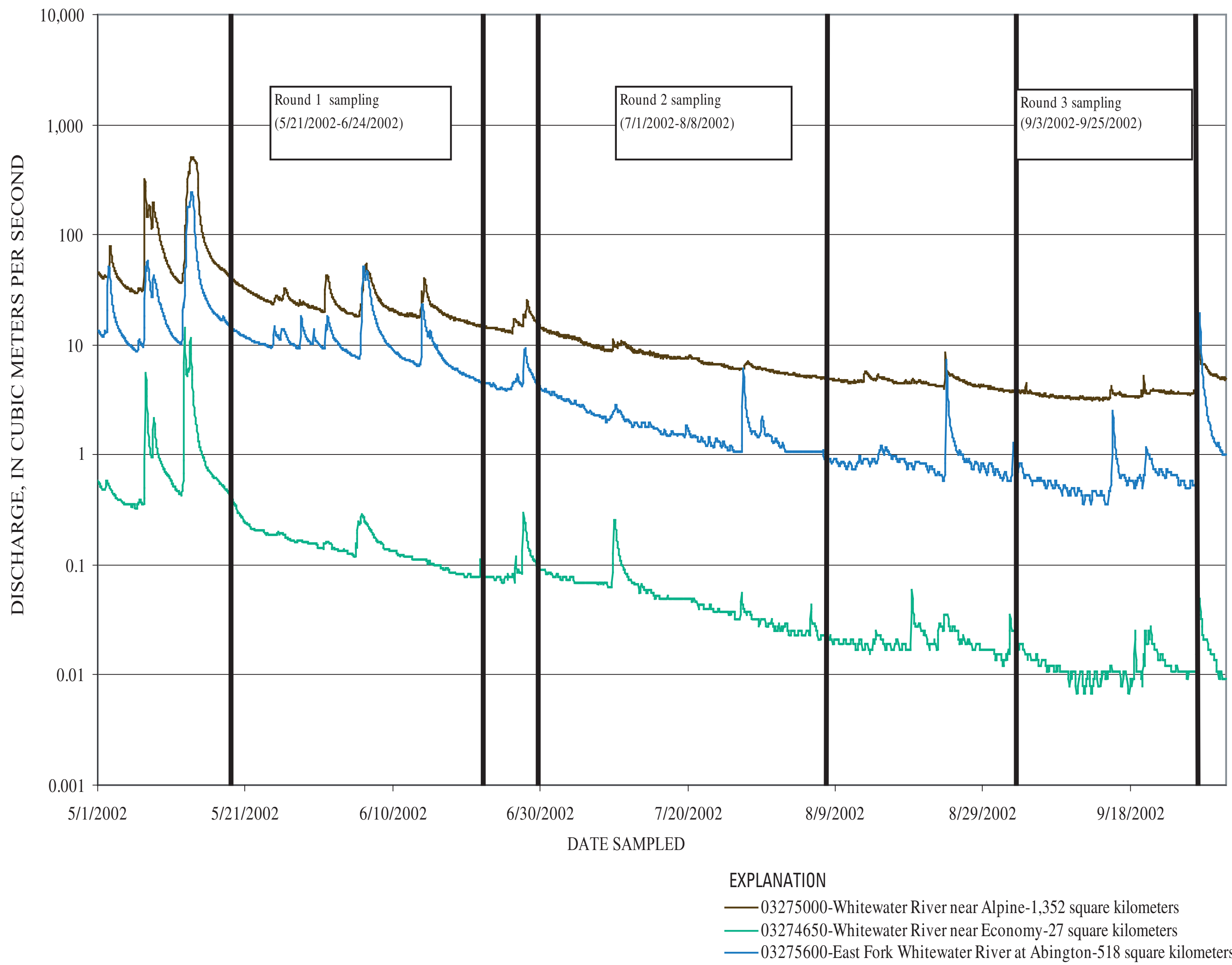

Figure 27. Discharge at three variously sized basins within the Whitewater River Basin, Indiana, 2002.

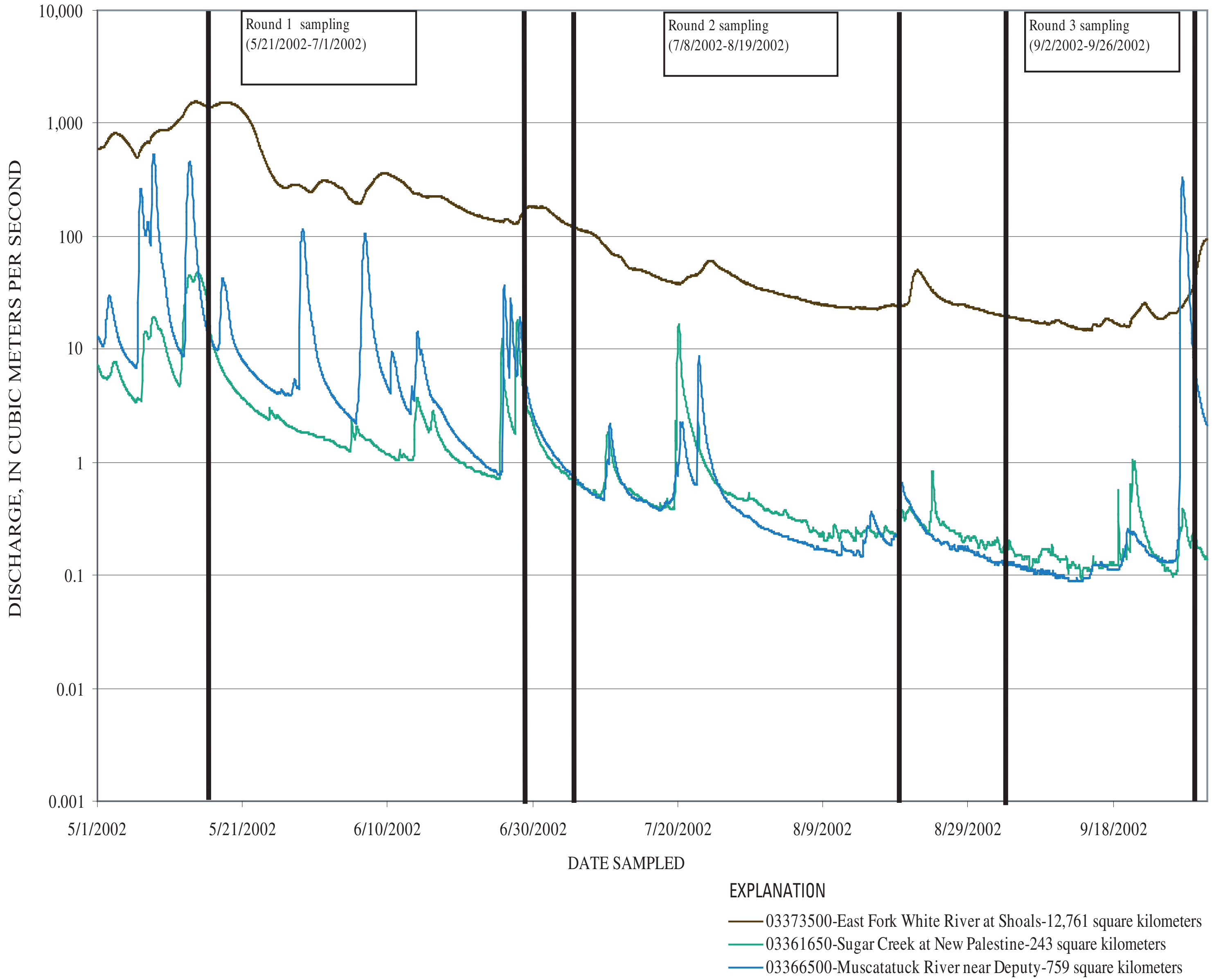

Figure 28. Discharge at three variously sized basins within the East Fork White River Basin, Indiana, 2002.

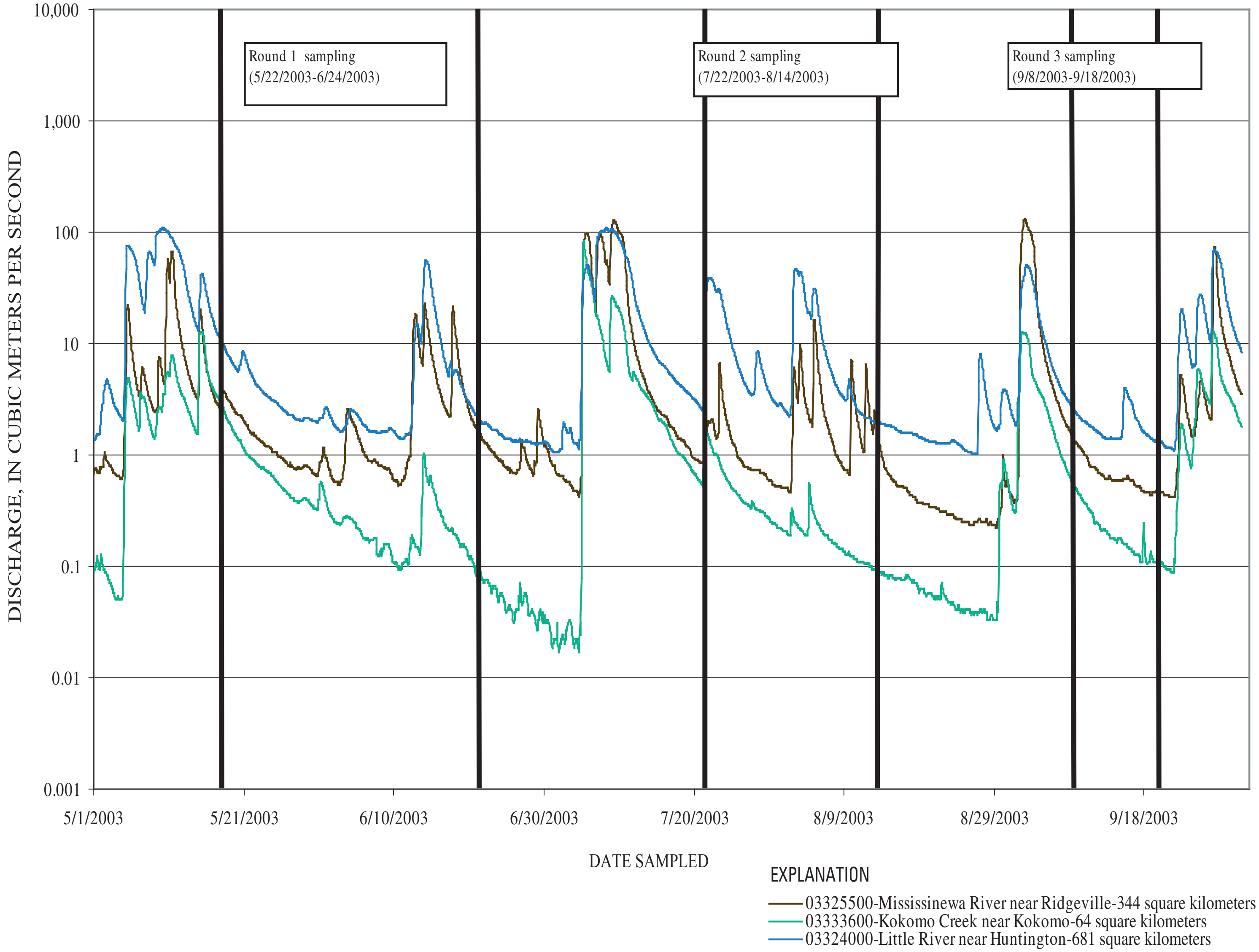

Figure 29. Discharge at three variously sized basins within the Upper Wabash River Basin, Indiana, 2003.

Kankakee River Basin

Samples were collected in mid-June through July for round 1 (6/22/2004–7/28/2004), in August through early September for round 2 (8/2/2004–9/9/2004), and mid-September through mid-October for round 3 (9/13/2004–10/14/2004) on the Kankakee River Basin (fig. 5). At the USGS streamflow-gaging station Kankakee River at Shelby (05518000), the annual mean discharge for water year 2004 of 45.1 m^3/s was 6 percent lower than the mean annual discharge of 47.9 m^3/s (table 7) (Morlock and others, 2004b). During the sample collection period, the highest discharges were in early June, prior to sampling round 2, and late August. Streams used for the analysis were: Yellow River at Plymouth, USGS-05516500; Kankakee River at Davis, USGS-05515500; and Kankakee River at Shelby, USGS-05518000 (fig. 30, table 7) (Morlock and others, 2004b). Most discharge increases were noticeable at all three streams, indicating that rain events most likely affected streams throughout the basin The high stream discharges 9 days prior to round 1 sampling probably caused scour to at most sites in the basin. but scour occurred early enough for algae to recolonize before samples were collected. However, the increases in discharge in late July and late August, 2004, at Yellow River at Plymouth (23.0 and 28.3 m^3/s) and Kankakee River at Shelby (51.8 and 99.7 m^3/s), and late-August, 2004, at Kankakee River at Davis (30.9 m^3/s), probably caused scouring of periphyton within these mid-to-large sized streams. Algae samples were most likely collected from both reestablished and old-growth communities due to generally stable discharges with few intermittent discharge increases. However, four rain events when discharge was greater than 20–25 m^3/sec probably caused scour of algae in these streams.

Lower Wabash River Basin

Samples were collected in mid-June through mid-July for round 1 (6/21/2004–7/22/2004), late July through early September for round 2 (7/26/2004–9/01/2004), and mid-September through early October for round 3 (9/13/200 –10/06/2004) on the Lower Wabash River Basin (fig. 6). At the USGS streamflow-gaging station Wabash River at New Harmony, IN (03378500), the annual mean discharge for water year 2004 of 945 m^3/s was 17 percent greater than the mean annual discharge of 807 m^3/s (table 7) (Morlock and others, 2004b). During the sample collection period, the highest discharges were in early June, prior to sampling, and late August. Streams used in this analysis were: Big Raccoon Creek near Fincastle, USGS-03340800; Sugar Creek at Crawfordsville, USGS-03339500; and Wabash River at Riverton, USGS-03342000 (fig. 31, table 7) (Morlock and others, 2004b). Most discharge increases were noticeable at all three streams, indicating that rain events most likely affected streams throughout the basin. The high stream discharges 9 days prior to and at the beginning of round 1 sampling probably caused scour during streamflows greater than 20–25 m^3/sec at most sites in the basin. Algae samples were most likely collected from both recolonized and old-growth communities due to generally stable discharges with few intermittent discharge increases in these streams.

Tributaries to the Great Lakes Basin

Samples were collected in mid-May through mid-June for round 1 (5/16/2005–6/15/2005), in July through early August for round 2 (7/06/2005–8/10/2005), and in early September through mid-October for round 3 (9/06/2005–10/19/2005) on tributaries to the Great Lakes Basin (fig. 7). At the USGS streamflow-gaging station St. Joseph River at Elkhart, IN (04101000), the annual mean discharge for water year 2005 of 87.9 m^3/s was 5 percent lower than the mean annual discharge of 92.2 m^3/s (Morlock and others, 2005). Streams used in this analysis were: Fish Creek at Hamilton, USGS-04177720; Little Calumet River at Porter, USGS-04094000; and North Branch Elkhart River at Cosperville, USGS-04100222 (fig. 32) (Morlock and others, 2005). The highest discharges were in July during round 2 sampling and likely caused algal scour within these smaller streams when streamflows were greater than 20–25 m^3/sec. Although discharge is regulated on the North Branch of the Elkhart River in July, discharge at all three sites remained low with intermittent increases throughout the sampling season, which would have permitted algal communities to flourish and mature under these discharge conditions.

Tributaries to Ohio River Basin

Samples were collected in mid-May through mid-June for round 1 (5/16/2005–6/22/2005), early July through early August for round 2 (7/05/2005–8/03/2005), and mid-September through mid-October for round 3 (9/12/2005–10/13/2005) on tributaries to the Ohio River Basin (fig. 8). At the USGS streamflow-gaging station Middle Fork Anderson River at Bristow, IN (03303300), the annual mean discharge for water year 2005 of 1.56 m^3/s was 2 percent lower than the mean annual discharge of 1.59 m^3/s (table 7) (Morlock and others, 2005). Streams used in this analysis were: Middle Fork Anderson River at Bristow, USGS-03303300; Silver Creek near Sellersburg; USGS-03294000; and Blue River near White Cloud, USGS-03303000 (fig. 33, table 7) (Morlock and others, 2005). During the sample collection period, the highest discharges were in mid-June, toward the end of round 1 sampling, and early September, prior to round 3 sampling. Most discharge increases were noticeable at all three streams, indicating that rain events most likely affected streams throughout the basin. Additional discharge increases in round 2 and round 3 could largely be attributed to isolated and tropical storm-related rain events that affected the basin. Although total discharge was relatively normal during the sampling season, the sampling season was filled with long-duration rain events that resulted in headwater streams remaining at high discharge levels for a

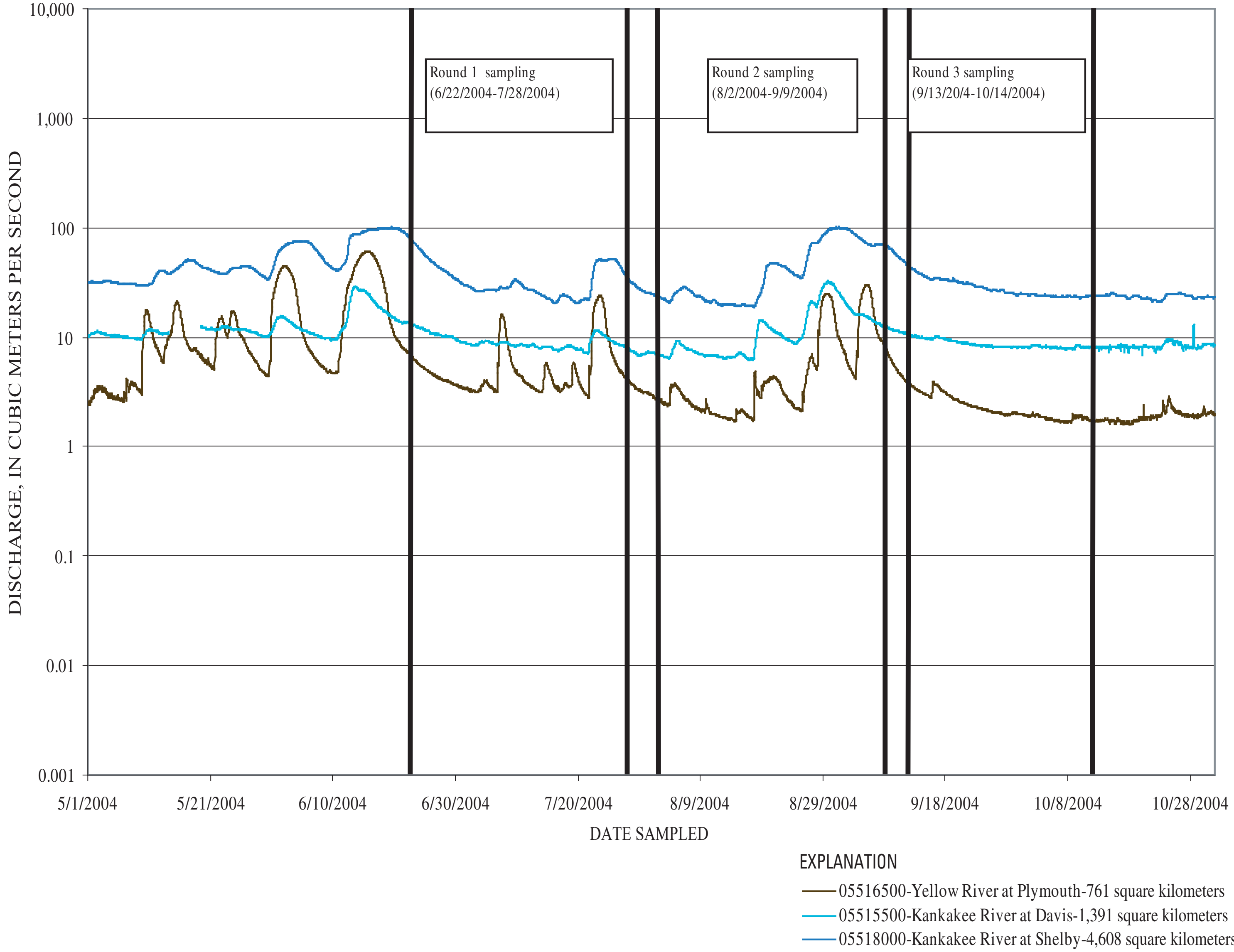

Figure 30. Discharge at three variously sized basins within the Kankakee River Basin, Indiana, 2004.

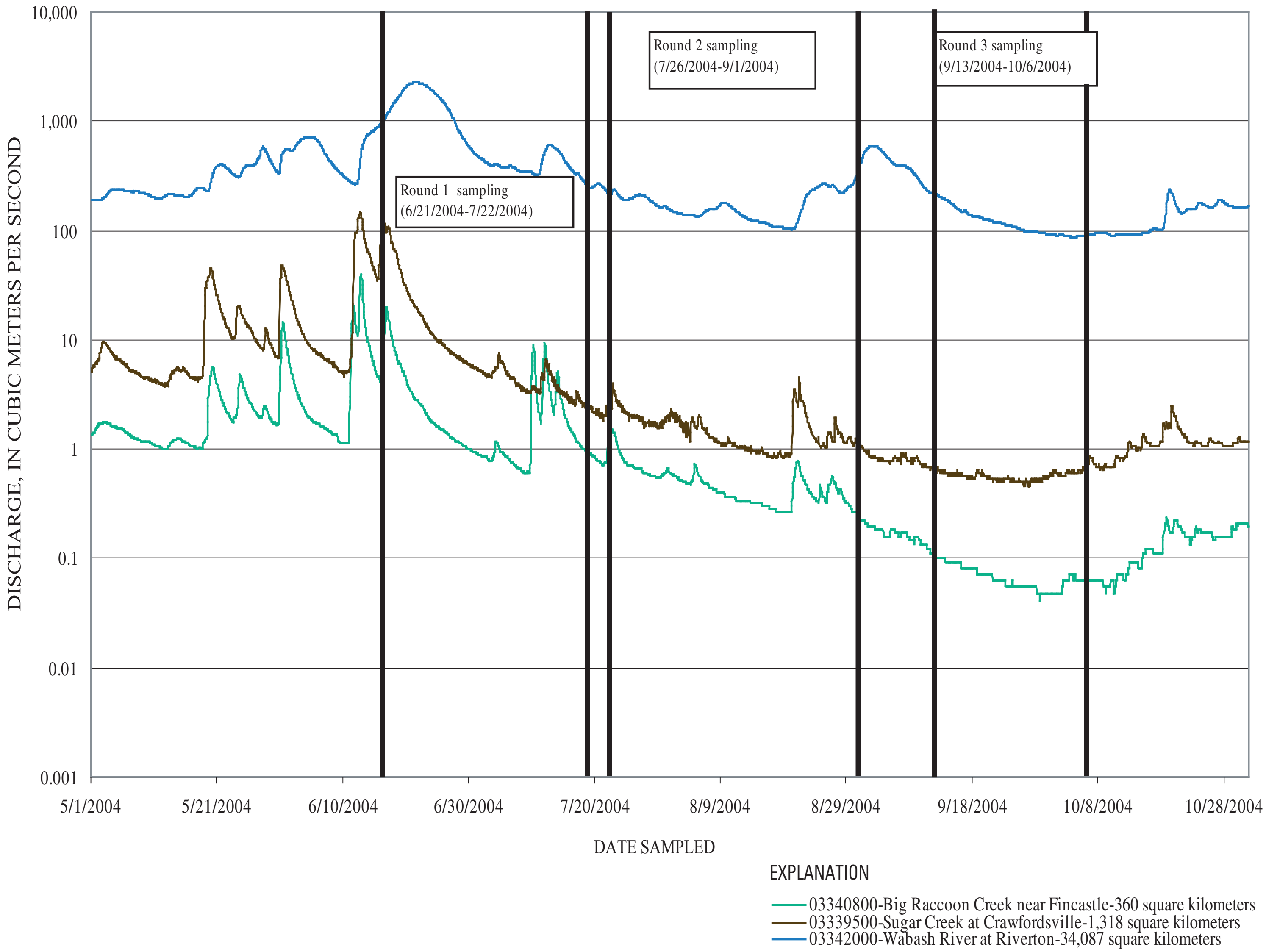

Figure 31. Discharge at three variously sized basins within the Lower Wabash River Basin, Indiana, 2004.

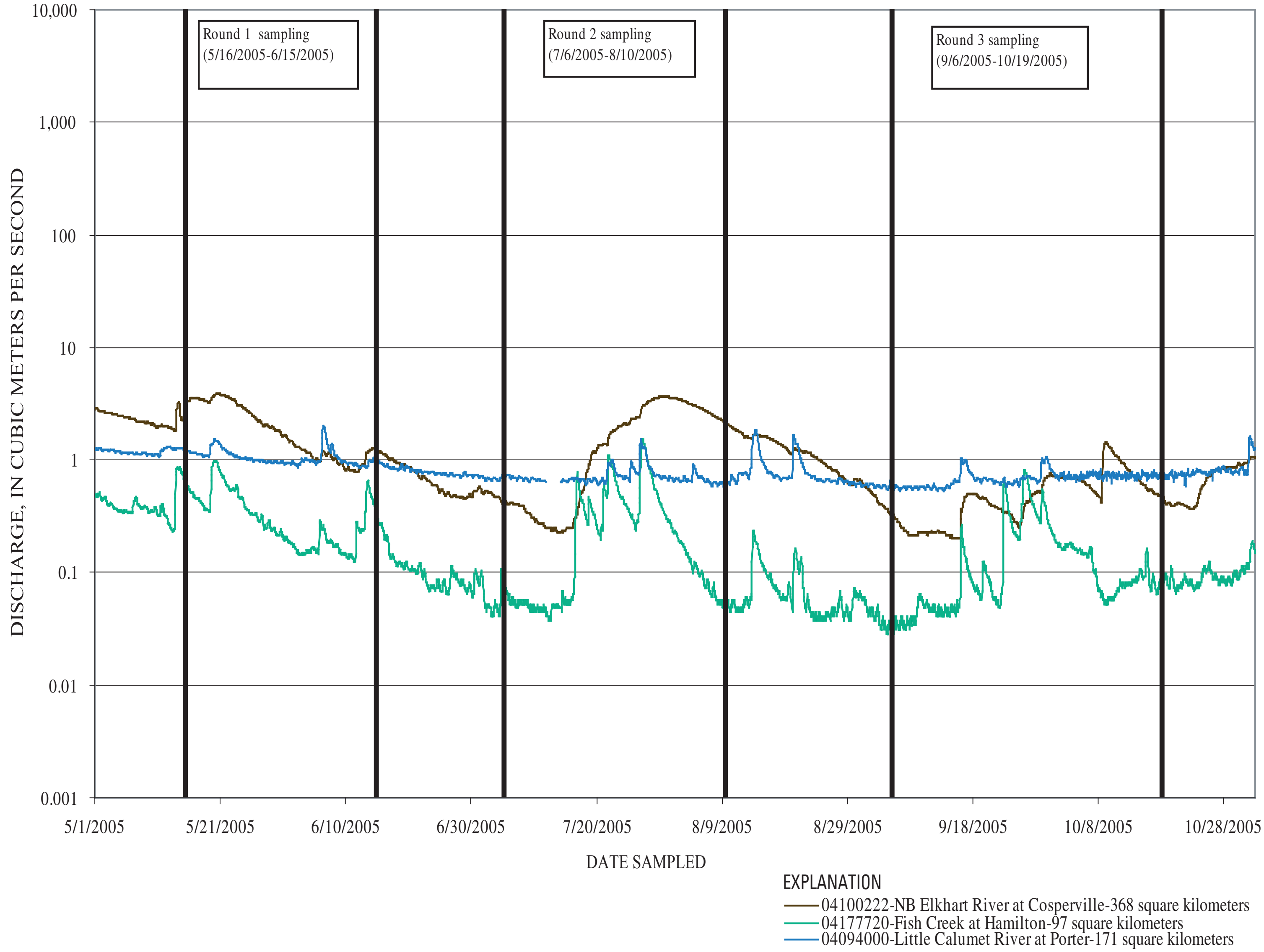

Figure 32. Discharge at three variously sized basins within the Great Lakes Tributaries Basin, Indiana, 2005.

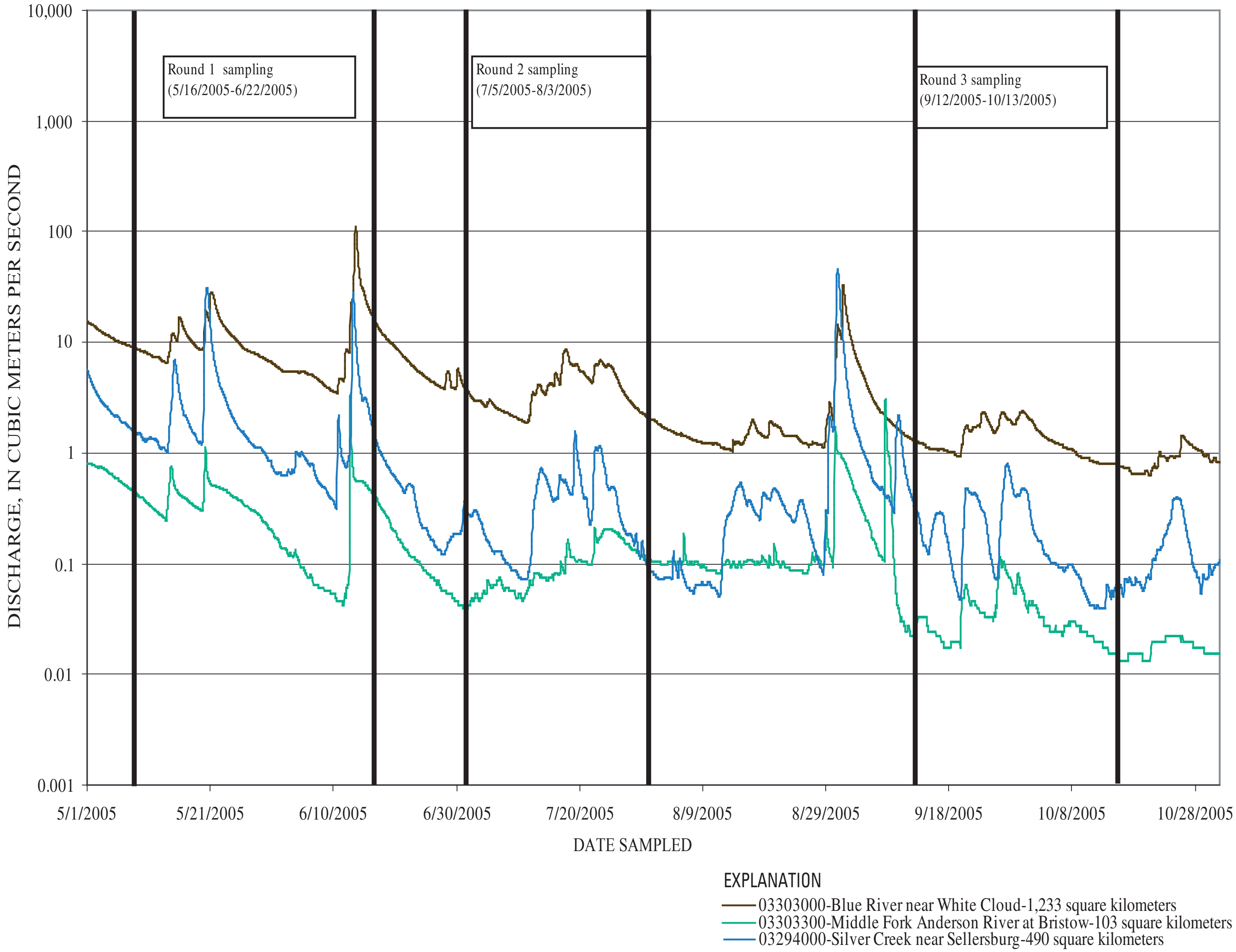

Figure 33. Discharge at three variously sized basins within the Ohio River Tributaries Basin, Indiana, 2005.

long duration, which would increase periphyton scouring. Periphytic samples collected throughout the study period would most likely have been collected from newer recolonized algal communities, because old-growth communities would have been scoured from substrates during streamflows greater than 20–25 m^3/sec.

Substrate Type

Substrate type should be considered when monitoring algal productivity for periphyton CHLa or AFDM. Previous studies indicated the type of substrate that periphyton algae grows on and adheres to is dependent on the texture of the substrate, which allows the algae to remain attached to the substrate during increased streamflow (Bergey and Resh, 2006). Periphyton algal biomass is customarily characterized by the concentration of CHLa or AFDM in algae that is attached to the three stream substrates: epilithic (rocks), epipsammic (sand-sized particles), or epidendric (woody snags). Throughout the 5-year study, periphyton substrate sampling techniques were dependent on the specific habitat features indicative of the ecoregion and stream. Because the study area encompassed diverse landscape and stream types, one common substrate was not available at all 322 sampling sites. Given the differences in substrate types sampled in the study, a comparison of algal biomass concentrations and substrate was investigated.

Predominantly available in many smaller-order Indiana streams, epilithic substrate was the primary periphyton sampling substrate. Epidendric substrates were sampled on larger rivers where water depth was a limiting factor in algal substrate availability. Epipsammic substrates were sampled for periphyton CHLa and AFDM throughout the state, however, most of the epipsammic samples were collected in the northern basins of Indiana (Kankakee, Tributaries to the Great Lakes, and portions of the Upper Wabash) where sandy soils are common.

Periphyton Chlorophyll *a*

Samples collected from epilithic substrates had the highest median concentration of periphyton CHLa. Median concentrations of periphyton CHLa were 53.8 mg/m^2 for epilithic substrates, 41.8 mg/m2 for epipsammic substrates, to 17.2 mg/m^2 for epidendric substrates (fig. 34 and table 8). This trend was seen in each basin except for the West Fork White River in 2001, when no epipsammic samples were collected, and for the Whitewater River Basin in 2002 and the Ohio River Tributaries Basin in 2005, when only two epilithic and three epipsammic samples, respectively, were collected. Epidendric samples tended to have lower periphyton CHLa concentrations than epilithic or epipsammic samples.

Epilithic substrates have been found to be the most conducive to algal attachment (Bergey and Resh, 2006). Algal biomass production appears to increase in the riffle areas of streams where oxygenation occurs. Increased concentrations of CHLa and substrate size have been shown to increase the level of dissolved oxygen in a stream at riffles (Bergey and Resh, 2006). Algae are most likely to remain attached in riffles and thrive in the oxygen-enriched environment. Algal biomass present in epilithic substrate streams has been found to digest nutrients directly from the rocks or the erosion particulates suspended in the water, which indicates that lithology or the types of rocks within a stream affect algal biomass (Brightbill and Bilger, 1998). The periphyton CHLa median concentrations for epilithic substrates were particularly high in samples collected in 2004 in the Kankakee River, 132 mg/m^2; Lower Wabash River,161 mg/m^2, and in 2005, in the Great Lakes Tributaries Basin, 131 mg/m^2. These high concentrations were most likely influenced by the low gradient and low turbidity of the streams in conjunction with the low-to-moderate stream discharges observed in 2004 and 2005, which were ideal for algal biomass growth.

Ash-Free Dry Mass

Samples collected from epipsammic substrates had a much higher median concentration of AFDM than epilithic or epidendric substrates. Median concentrations of AFDM were 28.8 g/m^2 for epilithic substrates, 141 g/m^2 for epipsammic substrates, and 22.9 g/m^2 for epidendric substrates (fig. 35 and table 8). More epipsammic samples were collected in the northern regions of the state, for example in the Great Lakes and Kankakee River Basins, than in the southern regions. The higher concentrations associated with epipsammic AFDM compared to other substrates were due in part to sample collection in low-velocity depositional areas of the streams where more organic matter settles; epilithic and epidendric samples tended to be collected in higher velocity areas, such as riffles and deeper streams. Overall, substrate type was dependent on the geomorphology of the specific drainage basin.

The highest median concentrations of AFDM were collected from epilithic substrate within the Kankakee River Basin, 168 g/m^2; Lower Wabash River Basin, 199 g/m^2; Great Lakes Tributaries, 199 g/m^2; and the Ohio River Tributaries, 141 g/m^2. Increased median concentrations of AFDM collected from epipsammic substrates were apparent in the West Fork White River Basin, 148 g/m^2; Kankakee River Basin, 156 g/m^2; Great Lakes Tributaries, 160 g/m^2; and the Ohio River Tributaries, 144 g/m^2. Hydrologic events significantly affect AFDM concentrations because the substrates are susceptible to scour during high stream flows. Drought conditions in Northern Indiana during the 2005 sampling season likely increased AFDM concentrations found in the tributaries to the Great Lakes through the reduction in stream discharge, which increased AFDM settling, and accumulation on the epipsammic substrates. The AFDM samples collected in 2001 from epipsammic substrates in the West Fork White River Basin were not collected during the spring season, when hydrologic events are generally most frequent and water levels the highest. Lower AFDM concentrations collected in 2003 from the

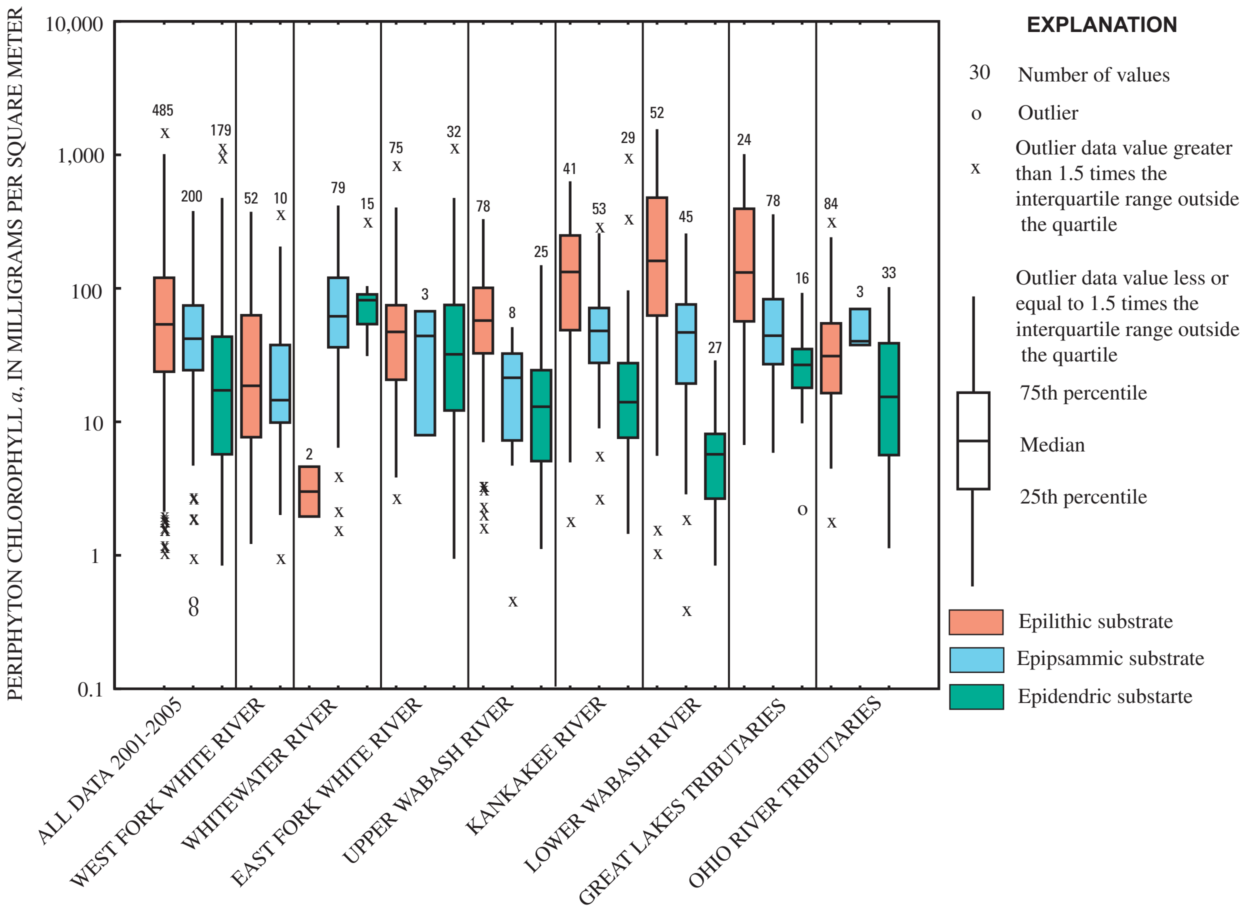

Figure 34. Concentrations of periphyton chlorophyll *a* by substrate type for all basins in Indiana, 2001–2005.

Table 8. Algal biomass concentrations by substrate type in Indiana, 2001–2005.

[mg/m², milligram per square meter; g/m², gram per square meter; nv, no published eutrophic level in Dodds and others, 1998]

Statistic	Periphyton chlorophyll *a* (mg/m²)				Ash free dry mass (g/m²)			
	All data	Epilithic[1]	Epipsammic[1]	Epidendric[1]	All data	Epilithic[1]	Epipsammic[1]	Epidendric[1]
Number of samples	864	485	200	179	864	485	200	179
Minimum	.41	1.09	.41	.837	3	3.6	9.63	3.37
Median	41.2	53.8	41.8	17.2	52.1	28.8	141	22.9
Maximum	1,550	1,550	379	1,190	697	697	585	515
Percent of samples above eutrophic level[2]	32	40	28	17	nv	nv	nv	nv

[1]Epilithic-rock substrate; Epipsammic-sand substrate; Epidendric-stick substrate.

[2]Eutrophic level for periphyton chlorophyll *a* is 70 mg/m² (Dodds and others, 1998).

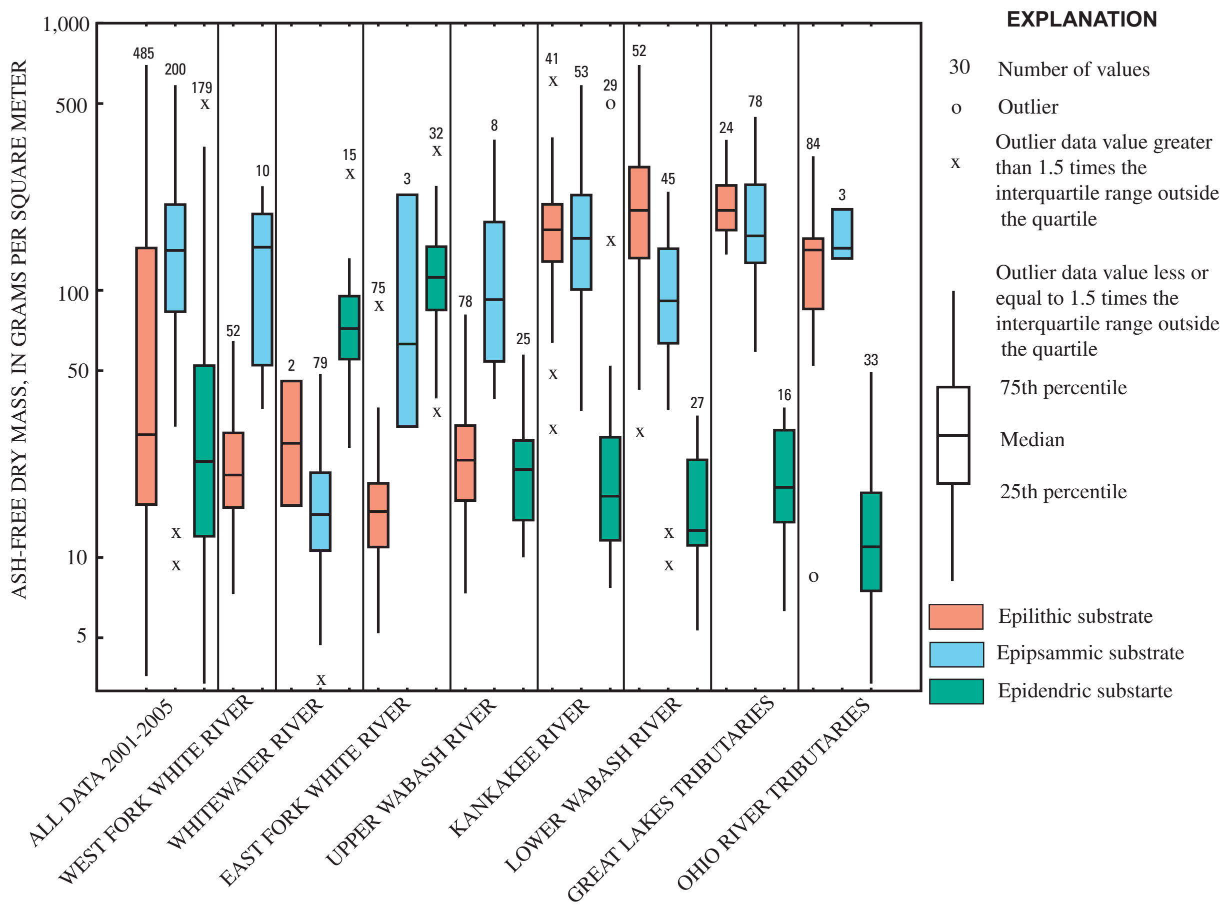

Figure 35. Concentrations of ash-free dry mass by substrate type for all basins in Indiana, 2001–2005.

Upper Wabash River Basin could be attributed to the increased frequency of rain events during the 2003 sampling season.

Higher AFDM concentrations were found in both epilithic and epipsammic substrates than in epidendric substrates, with the exception of epidendric substrates sampled in 2002 in the Whitewater River and East Fork Whitewater River Basins, where multiple AFDM samples were collected from one epidendric substrate source. One possible explanation for higher AFDM concentrations in epilithic substrates is increased grazing by invertebrates. Invertebrate grazers are more abundant in riffle areas where they attach to the epilithic substrate and digest algal biomass that collect on the riffles (Bergey and Resh, 2006). Although algal biomass can be found in abundance on epipsammic substrates, algae collected from the sandy substrate may not provide an accurate assessment of the algal growth of the overall stream due to the tendency of sandy substrate to move and shift during hydrologic events. Sunlight is important to the growth and abundance of algal biomass only if the water velocity is less than the bed movement threshold; otherwise, algae are either washed away or buried with shifting sediment (Kjeldsen and others, 1998). However, AFDM data collected during the study indicate that algal biomass concentrations are similar on epilithic and epipsammic substrates but that hydrologic events could greatly impact concentrations on epipsammic. If no other substrate is available, epipsammic substrate may be the only viable alternative for calculating algal biomass.

Turbidity

Turbidity is a measure of the capability of a liquid to scatter or absorb light. Increased concentrations of suspended and dissolved substances-such as soil particles including clay, silt, fine organic matter, plankton, and other microscopic organisms—all affect turbidity (ASTM International, 2000). Turbid streams are cloudy or muddy and therefore limit the penetration of light needed for optimal algal growth (Figueroa-Nieves and others, 2006).

Turbidity can vary with basin size. During the 5-year study, turbidity increased as basin size increased (fig. 36). Turbidity measurements from grab samples ranged from 0.20 to 215 nephelometric turbidity units (NTU) with a median of 6.95 NTU for headwater streams, from 0.00 to 125 NTU with a median of 8.27 NTU for wadable streams, and from 0.01 to 94.0 NTU with a median of 17.0 NTU for boatable streams.

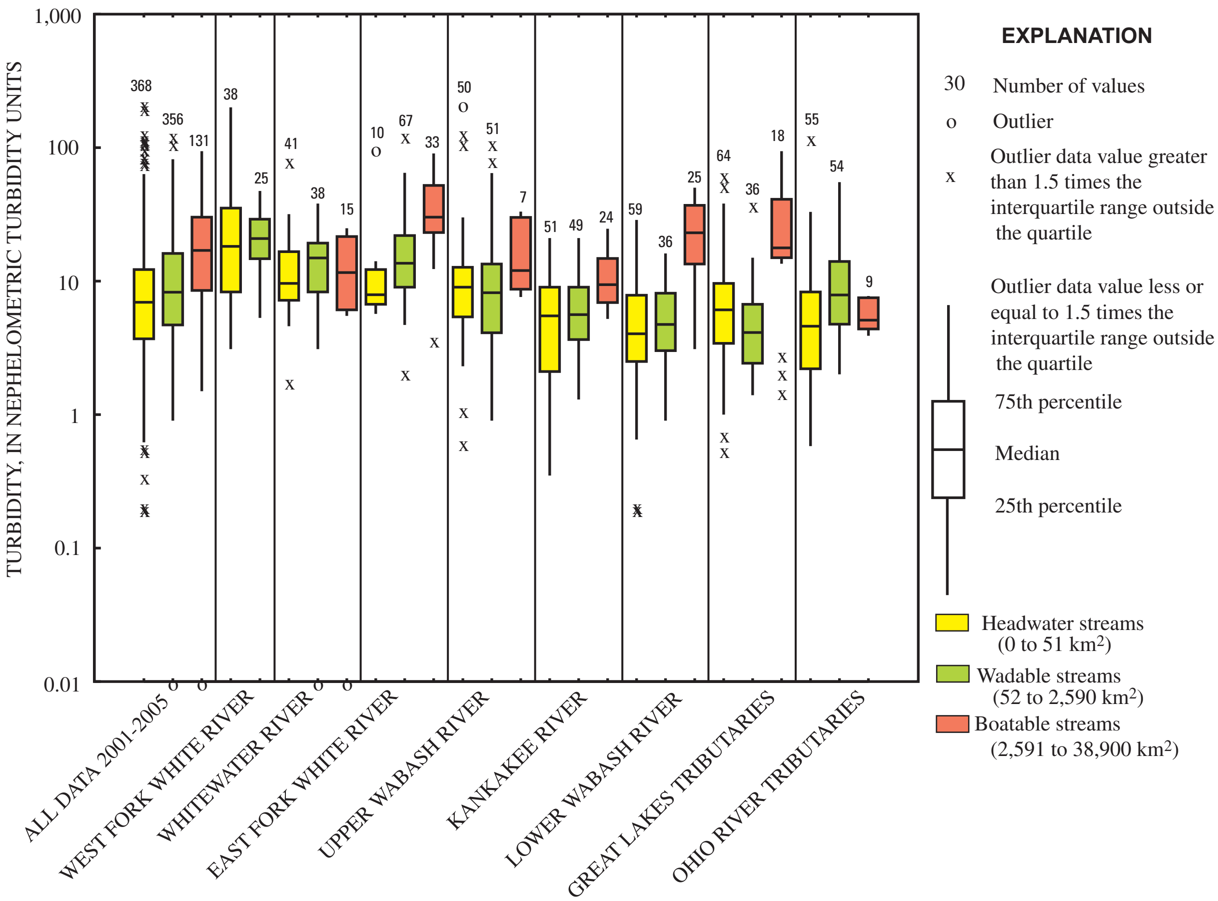

Figure 36. Concentrations of turbidity by basin size in Indiana, 2001–2005.

As basin size increases, the increased streamflow velocities scour streambed material and suspend sediment and periphyton, which increases turbidity.

Although larger boatable streams were not sampled in 2001, the West Fork White River Basin had the highest median turbidity for headwater (18.2 NTU) and wadable (20.8 NTU) streams. Boatable streams within the East Fork White River Basin had the highest median turbidity value of 30.1 NTU. Of the eight major study basins, tributaries to the Ohio River Basin (5.86 NTU) had the lowest median turbidity. Turbidity was highest in basins consisting predominately of wadable (52–2,590 km^2) and boatable streams (2,591–38,900 km^2) and lowest in basins where sample sites were predominantly headwater streams.

Turbidity Comparison to Periphyton and Seston Chlorophyll *a* by Drainage Area

The results of comparison of turbidity data and periphyton CHLa concentrations to drainage area are shown in figure 37. A locally weighted scatterplot smoothing technique (LOWESS) was used to generate the drainage area lines. The LOWESS method was selected to depict the relation between turbidity and periphyton CHLa because it can accommodate outliers in the data (Helsel and Hirsch, 1992). Periphyton CHLa concentrations decreased as turbidity within headwater, wadable, and boatable streams increased (fig. 37). Increased turbidity appeared to restrict the development of periphyton CHLa. Hydrologic events increase discharge, resulting in the scouring of periphyton from algal substrates. Suspended sediment, particles, and seston within the water column increase turbidity and restrict light penetration to periphyton assemblages that remained attached to substrate.

Values of turbidity and concentrations of seston CHLa by drainage area showed that, during the 5-year study, seston concentrations increased as turbidity increased within the (headwater, wadable, and boatable streams, indicating a positive correlation (fig. 38). Increased sunlight availability during the summer aids in seston CHLa development. The increase in summertime seston CHLa production, which causes slower moving streams to exhibit a green color, in conjunction with increased turbidity of the water from hydrologic events would cause seston CHLa concentrations and turbidity values to increase. In addition, as stream discharge increases, periphyton is scoured from its substrate and suspended in the water column further increasing turbidity.

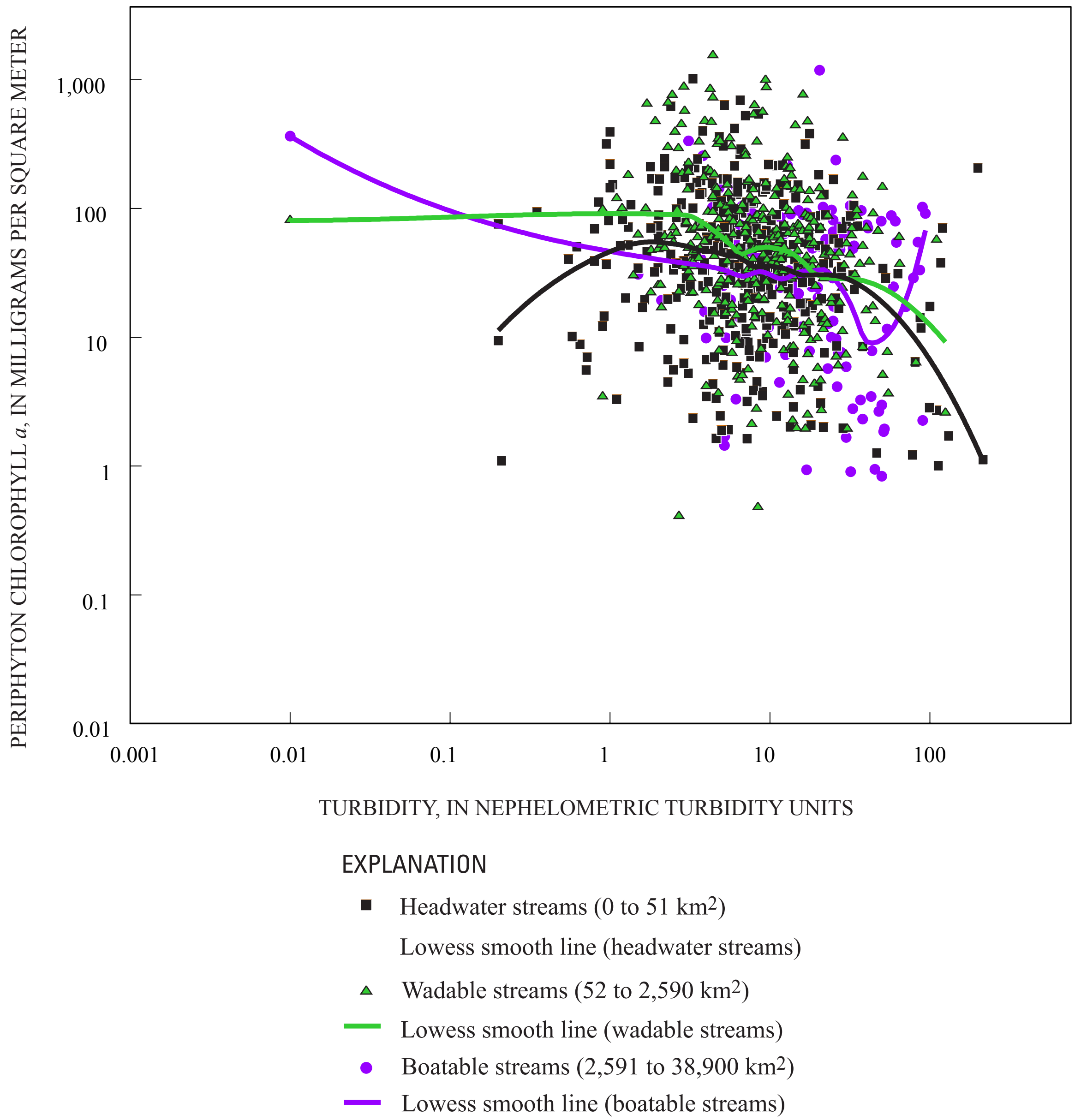

Figure 37. Periphyton chlorophyll *a* relations to turbidity by basin size, Indiana, 2001–2005.

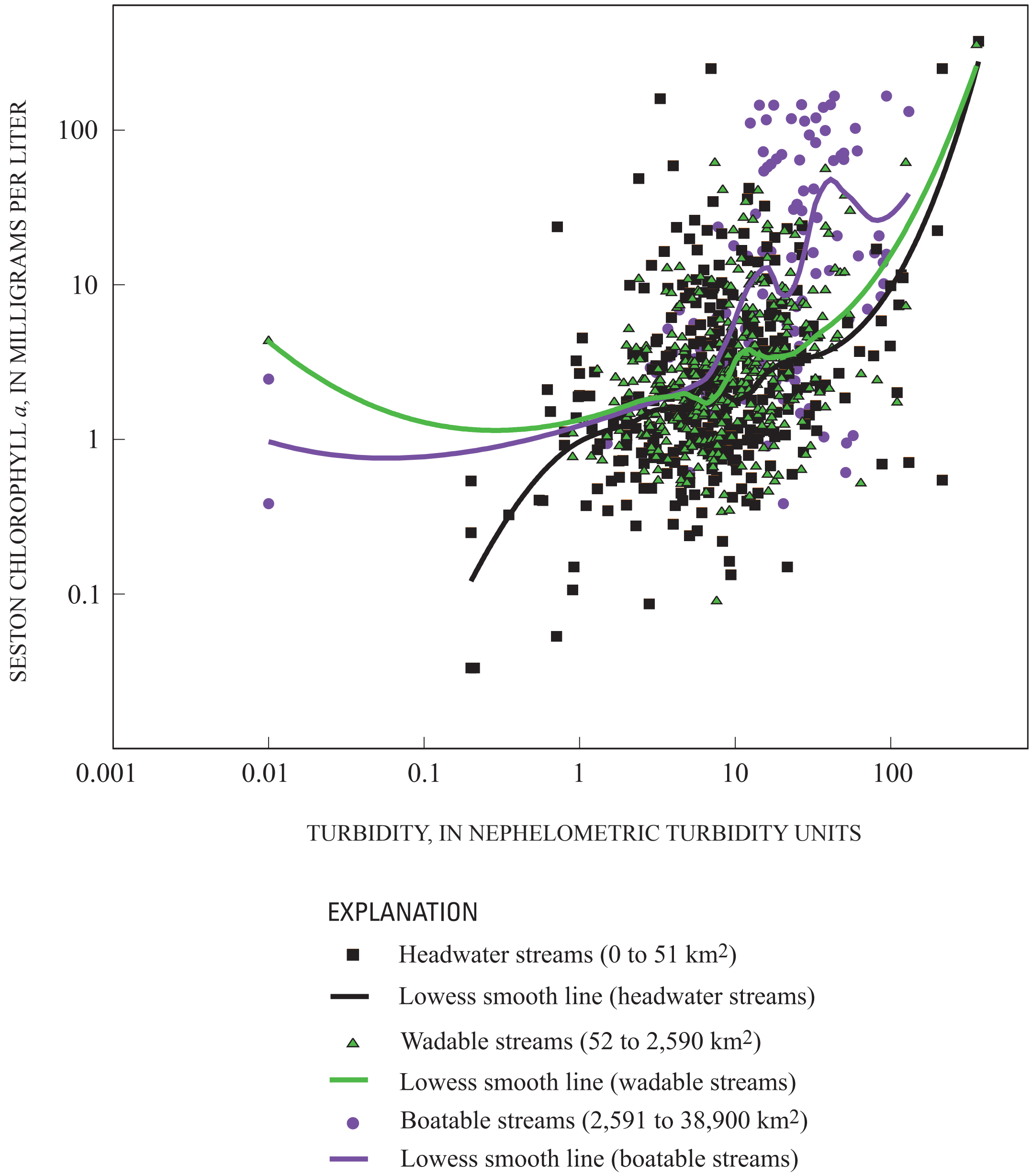

Figure 38. Seston chlorophyll *a* relations to turbidity by basin size, Indiana, 2001–2005.

Comparison of Data to U.S. Environmental Protection Agency Ecoregion Nutrient Criteria

The values for nutrients (nitrate, TKN, TN, and TP) and CHLa (periphyton and seston) were compared to published USEPA values for the respective ecoregions (U.S. Environmental Protection Agency, 2000a, b, c). A comparison of the values from the IDEM/USGS and USEPA data sets was done to (1) determine if USEPA data that were used to set the nutrient water-quality criteria and the IDEM/USGS data had similar ranges and (2) determine if the streams in Indiana would exceed the proposed USEPA 25th-percentile nutrient water-quality criteria for the ecoregions. Of the 322 sites sampled on 261 streams, 190 sites on 155 streams were in Ecoregion VI; 44 sites on 40 streams were in Ecoregion VII; and 90 sites on 66 streams were in Ecoregion IX (figs. 2–8, Appendixes 1–16). Of the 155 streams in Ecoregion VI, 36 streams were in Ecoregion 54—Central Cornbelt Plains, 118 streams were in Ecoregion 55—Eastern Corn Belt Plains, and 1 stream was in Ecoregion 57—Huron/Erie Lake Plain. Of the 44 sites on 40 streams in Ecoregion VII, all 40 streams were in Ecoregion 56—Southern Michigan/Northern Indiana Drift Plains. Of the 90 sites on 66 streams in Ecoregion IX, 37 streams were in Ecoregion 71—Interior Plateau and 29 streams were in Ecoregion 72—Interior River Lowland. No comparison was made with published USEPA values for USEPA Level III Ecoregion 57, located in Ecoregion VII, because only one stream was sampled in this Level III Ecoregion.

The IDEM/USGS values for TKN were within the range of the published values for Ecoregions VI, IX, 54, 55, 71, and 72 (table 9). The IDEM/USGS 25th percentile TKN values were greater than USEPA values for Ecoregions VII, IX, 55, and 71. New minimum concentrations were reported for Ecoregion 54 and new maximum concentrations were reported for Ecoregions VII and 56. If the proposed USEPA TKN water-quality criterion for Ecoregions VI, VII, and IX, 54, 55, 56, 71, and 72 were enacted, 51 percent of the individual samples collected in Ecoregion VI, 100 percent of the samples in Ecoregion VII, and 75 percent of the samples collected in Ecoregion IX would have exceeded those criteria.

The IDEM/USGS values for nitrate were within the range of the published values for Ecoregions IX and 72 (table 10). The IDEM/USGS 25th percentile nitrite values were greater than USEPA values for Ecoregions VII and 56. New minimum concentrations were reported for Ecoregions 55, 56, and 71 and new maximum concentrations were reported for Ecoregions VI, VII, 54, 55, and 56. If the proposed USEPA nitrate water-quality criterion for Ecoregions VI, VII, and IX, 54, 55, 56, 71, and 72 were enacted, 72 percent of the individual samples collected in Ecoregion VI, 84 percent of the samples in Ecoregion VII, and 74 percent of the samples in Ecoregion IX would have exceeded those criteria

The IDEM/USGS values for TN extended the range of the published values for the Ecoregions (table 11). The IDEM/USGS 25th percentile TN values were greater than USEPA values for Ecoregions VII and 56. New minimum concentrations were reported for Ecoregions VI, IX, 54, 55, 56, 71, and 72 and new maximum concentrations were reported for Ecoregions VI, VII, 54, 55, 56, 71, and 72. If the proposed USEPA TN water-quality criterion for Ecoregions VI, VII, and IX, 54, 55, 56, 71, and 72 were enacted, 59 percent of the individual samples collected in Ecoregion VI, 92 percent of the samples in Ecoregion VII, and 71 percent of the samples in Ecoregion IX would have exceeded those criteria.

The IDEM/USGS values for TP were within the range of the published values for Ecoregions VI, IX, 54, 55, and 71 (table 12). The IDEM/USGS 25th percentile TP values were greater than USEPA values for Ecoregions VII and 56. A new maximum concentration was reported for Ecoregions VII, 56, and 72. If the proposed USEPA TP water-quality criterion for Ecoregions VI, VII, and IX, 54, 55, 56, 71, and 72 were enacted, 48 percent of the individual samples collected in Ecoregion VI, 80 percent of the samples in Ecoregions VII, and 62 percent of the samples in Ecoregion IX would have exceeded those criteria.

The IDEM/USGS values for mean periphyton CHLa provide a new range for Ecoregions VI, VII, 54, 55, and 56 (table 13). New minimum and maximum concentrations were reported for Ecoregion IX. No comparison was made for Ecoregions VI or VII because of the lack of published values in the USEPA nutrient-criteria document (Environmental Protection Agency, 2000a, b). The IDEM/USGS maximum concentration was about four times higher than that published for Ecoregion IX. No criteria were set for Ecoregions VI, VII, 54, 55, 56, 71, or 72. If the proposed USEPA mean periphyton CHLa water-quality criterion for Ecoregion IX were enacted, 59 percent of the individual samples collected in Ecoregion IX would have exceeded that criterion.

The IDEM/USGS values for seston CHLa extended the range of the published values for Ecoregions VI, VII, IX, 54, 55, 56, 71, and 72 and provided a new range for Ecoregion 55, where no data previously existed (table 14). A new minimum concentration was reported for Ecoregions IX, 54, 71, and 72. The IDEM/USGS 25th percentile seston CHLa values were less than published values for Ecoregions VI, VII, IX, 54, 56, 71, and 72. If the proposed USEPA seston CHLa water-quality criterion for Ecoregions VI, VII, and IX, 54, 55, 56, 71, and 72 were enacted, 49 percent of the individual samples collected in Ecoregion VI, 65 percent of the samples in Ecoregion VII, and 51 percent of the samples in Ecoregion IX would have exceeded those criteria.

The IDEM/USGS values for AFDM and POC provide a new range for Ecoregions VI, VII, IX, 54, 55, 56, 71, and 72 because AFDM and POC were not previously identified as nutrient criteria parameters (table 15 and 16). No comparison was made for Ecoregions VI, VII, IX, 54, 55, 56, 71, or 72 because of the lack of published values in the USEPA nutrient-criteria document (U.S. Environmental Protection Agency, 2000 a, b, c).

Table 9. Total Kjeldahl nitrogen-N concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71 and 72.

[mg/L, milligram per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; shading indicates value falls below published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; not calculated in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	152	628	35	113	116	198	40	705	40	50	66	1609	37	65	29	154
Minimum	0.05	0.025	0.05	0.138	0.125	0.05	0.25	0.05	0.25	0.11	0.15	0.00	0.15	0.05	0.153	0.025
10th Percentile	.25	nc	.25	nc	.301	nc	.25	nc	.25	nc	.25	nc	.265	nc	.25	nc
25th Percentile	.394	.591	.25	.663	**.428**	.40	**.25**	.24	.25	.58	**.31**	.30	**.37**	.284	.28	.539
50th Percentile	.588	nc	.58	nc	.593	nc	.46	nc	.46	nc	.485	nc	.49	nc	.463	nc
75th Percentile	.803	nc	.808	nc	.80	nc	.949	nc	.949	nc	.715	nc	.60	nc	.965	nc
90th Percentile	1.07	nc	1.10	nc	1.05	nc	1.76	nc	1.76	nc	1.01	nc	.82	nc	1.46	nc
Maximum	2.55	4.5	1.29	3.33	2.55	3.50	**23.0**	4.70	**23.0**	2.06	1.55	4.83	1.01	2.05	1.55	4.32
Number of samples	461	nc	124	nc	335	nc	114	nc	114	nc	206	nc	111	nc	95	nc
Percent of samples above Criteria	51	nc	46	nc	73	nc	100	nc	45	nc	75	nc	81	nc	54	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 10. Nitrate-N concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71 and 72.

[mg/L, milligram per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; shading indicates value falls below published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; not calculated in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	154	717	36	185	117	219	40	435	40	73	66	1671	37	109	29	173
Minimum	0.02	0.01	0.03	0.115	0.02	0.025	0.025	0.003	0.025	0.05	0.005	0.00	0.005	0.008	0.009	0.003
10th Percentile	.265	nc	.215	nc	.265	nc	.05	nc	.05	nc	.04	nc	.06	nc	.018	nc
25th Percentile	.549	.633	.433	1.80	.60	1.6	**.495**	.30	**.495**	.41	.10	.125	.10	.345	.10	.215
50th Percentile	2.11	nc	2.20	nc	2.10	nc	1.50	nc	1.50	nc	.391	nc	.395	nc	.387	nc
75th Percentile	3.70	nc	4.05	nc	3.30	nc	2.76	nc	2.76	nc	1.25	nc	1.10	nc	1.70	nc
90th Percentile	5.80	nc	7.79	nc	5.65	nc	5.75	nc	5.75	nc	2.50	nc	2.40	nc	4.10	nc
Maximum	**14.4**	10.65	**14.4**	10.7	**8.40**	8.13	**24.0**	9.54	**24.0**	6.45	5.80	9.78	5.00	5.37	5.80	8.63
Number of samples	510	nc	140	nc	367	nc	119	nc	119	nc	232	nc	135	nc	97	nc
Percent of samples above Criteria	72	nc	45	nc	56	nc	84	nc	78	nc	74	nc	62	nc	63	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 11. Total nitrogen-N concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[mg/L, milligram per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; shading indicates value falls below published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; not calculated in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	152	77	35	11	116	2	40	125	40	5	66	274	37	10	29	21
Minimum	0.264	.885	0.264	1.44	0.45	3.63	0.30	0.10	0.30	0.90	0.155	0.24	0.155	0.625	0.213	0.47
10th Percentile	.80	nc	.75	nc	.82	nc	.55	nc	.55	nc	.405	nc	.415	nc	.323	nc
25th Percentile	1.39	2.18	1.29	2.95	1.47	3.63	1.20	.54	1.20	1.15	.575	.692	.75	.80	.503	1.67
50th Percentile	2.77	nc	2.70	nc	2.78	nc	2.26	nc	2.26	nc	1.01	nc	1.01	nc	1.01	nc
75th Percentile	4.50	nc	4.50	nc	4.52	nc	3.69	nc	3.69	nc	2.42	nc	1.82	nc	2.59	nc
90th Percentile	6.43	nc	7.88	nc	6.43	nc	7.33	nc	7.33	nc	3.46	nc	2.99	nc	5.90	nc
Maximum	**11.3**	10.06	**11.3**	7.35	**9.26**	3.78	**26.7**	7.94	**26.7**	2.55	7.16	12.4	**5.51**	4.35	**7.16**	7.09
Number of samples	459	nc	124	nc	333	nc	115	nc	115	nc	204	nc	109	nc	95	nc
Percent of samples above Criteria	59	nc	38	nc	37	nc	92	nc	76	nc	71	nc	70	nc	42	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 12. Total phosphorus-P concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[µg/L, microgram per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; not calculated in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	154	815	36	203	117	225	40	910	40	64	66	2,104	37	117	29	183
Minimum	15.0	5.00	15.0	10.0	15.0	10.0	15.0	0.50	15.0	3.75	15.0	0.00	15.0	2.5	15.0	1.25
10th Percentile	25.0	nc	15.0	nc	25.0	nc	25.0	nc	25.0	nc	25.0	nc	25.0	nc	15.0	nc
25th Percentile	45.0	76.3	35.0	72.5	48.0	62.5	**67.0**	33.0	**67.0**	31.3	25.0	36.6	25.0	30	39.0	83.1
50th Percentile	72.3	nc	53.8	nc	76.0	nc	100	nc	100	nc	56.8	nc	47.0	nc	75.0	nc
75th Percentile	109	nc	80.5	nc	110	nc	160	nc	160	nc	105	nc	74.0	nc	190	nc
90th Percentile	170	nc	157	nc	190	nc	525	nc	525	nc	200	nc	125	nc	350	nc
Maximum	480	2,225	480	1,471	435	1,820	**2,000**	1715	**2,000**	295	**1,770**	2,400	210	1,280	1,770	1,600
Number of samples	512	nc	140	nc	369	nc	119	nc	119	nc	234	nc	137	nc	97	nc
Percent of samples above Criteria	48	nc	38	nc	62	nc	80	nc	80	nc	62	nc	57	nc	52	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 13. Mean periphyton chlorophyll *a* concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[mg/m^2, milligram per square meter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; nd, no data collected or reported in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; shading indicates value falls below published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	154	nd	36	nd	117	nd	40	nd	40	nd	66	6	37	nd	29	nd
Minimum	2.89	nd	3.77	nd	2.89	nd	2.34	nd	2.34	nd	2.00	11	3.07	nd	2.00	nd
10th Percentile	10.6	nd	12.1	nd	9.40	nd	6.81	nd	6.81	nd	7.57	nc	11.6	nd	7.34	nd
25th Percentile	27.5	nd	31.2	nd	26.1	nd	29.5	nd	29.5	nd	15.0	20.4	22.7	nd	10.6	nd
50th Percentile	53.4	nd	65.1	nd	52.2	nd	41.4	nd	41.4	nd	27.5	nc	31.9	nd	19.7	nd
75th Percentile	88.8	nd	138	nd	72.5	nd	82.0	nd	82.0	nd	51.2	nc	48.2	nd	51.2	nd
90th Percentile	174	nd	350	nd	145	nd	201	nd	201	nd	103	nc	81.2	nd	165	nd
Maximum	766	nd	690	nd	766	nd	729	nd	729	nd	**242**	62.0	113	nd	242	nd
Number of samples	514	nc	139	nc	372	nc	118	nc	118	nc	232	nc	138	nc	94	nc
Percent of samples above Criteria	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	59	nc	nc	nc	nc	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 14. Mean seston chlorophyll a concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[µg/L, micrograms per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; nd, no data collected or reported in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; shading indicates value falls below published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; bold text indicates value exceeds published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons and Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons; nc, not calculated in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	154	63	36	15	117	nd	40	55	40	21	66	71	37	9	29	2
Minimum	0.25	0.25	0.407	1.30	0.25	nd	0.48	0.33	0.48	0.33	0.107	0.225	0.107	2.60	0.563	1.50
10th Percentile	.993	nc	.93	nc	.993	nd	.732	nc	.732	nc	.843	nc	.563	nc	1.01	nc
25th Percentile	1.59	2.70	1.27	2.00	1.67	nd	1.00	1.54	1.00	3.50	1.07	2.25	1.01	3.85	1.29	1.50
50th Percentile	2.66	nc	1.91	nc	2.82	nd	2.07	nc	2.07	nc	1.59	nc	1.45	nc	2.22	nc
75th Percentile	4.74	nc	3.72	nc	4.97	nd	3.08	nc	3.08	nc	3.58	nc	3.48	nc	3.58	nc
90th Percentile	9.39	nc	9.08	nc	10.3	nd	7.25	nc	7.25	nc	10.9	nc	8.20	nc	15.0	nc
Maximum	**88.2**	47.6	22.5	39.9	88.2	nd	**59.0**	36.4	**59.0**	36.4	**107**	36.7	**25.4**	15.4	**107**	6.55
Number of samples	516	nc	140	nc	373	nc	119	nc	119	nc	235	nc	138	nc	97	nc
Percent of samples above Criteria	49	nc	51	nc	nc	nc	65	nc	24	nc	51	nc	29	nc	70	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 15. Mean Ash-Free Dry Mass concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[g/m^2, grams per square meter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; nd, no data collected or reported in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	154	nd	36	nd	117	nd	40	nd	40	nd	66	nd	37	nd	29	nd
Minimum	4.15	nd	12.8	nd	4.15	nd	6.30	nd	6.30	nd	7.50	nd	7.50	nd	11.3	nd
10th Percentile	12.6	nd	23.8	nd	12.0	nd	22.4	nd	22.4	nd	12.7	nd	9.33	nd	13.0	nd
25th Percentile	16.9	nd	90.5	nd	15.9	nd	51.3	nd	51.3	nd	25.2	nd	24.0	nd	28.6	nd
50th Percentile	29.0	nd	144	nd	23.0	nd	149	nd	149	nd	81.4	nd	92.4	nd	80.3	nd
75th Percentile	147	nd	183	nd	113	nd	198	nd	198	nd	140	nd	139	nd	153	nd
90th Percentile	209	nd	275	nd	182	nd	266	nd	266	nd	174	nd	149	nd	201	nd
Maximum	366	nd	366	nd	321	nd	354	nd	354	nd	220	nd	174	nd	220	nd
Number of samples	514	nc	139	nc	372	nc	118	nc	118	nc	232	nc	138	nc	94	nc
Percent of samples above Criteria	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Table 16. Mean Particulate Organic Carbon (POC) concentrations for water samples collected 2001 through 2005, from the Indiana Department of Environmental Management/U.S. Geological Survey study of Indiana streams and published U.S. Environmental Protection Agency concentrations for Aggregate Nutrient Ecoregions VI, VII, and IX and Level III Ecoregions 54, 55, 56, 71, and 72.

[mg/L, milligrams per liter; IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA,U.S. Environmental Protection Agency; nd, no data collected or reported in published U.S. Environmental Protection Agency value for Aggregate Nutrient Ecoregions VI, VII and IX, all seasons or published U.S. Environmental Protection Agency value for Level III Ecoregions 54, 55, 56, 71 and 72 reference conditions, all seasons]

Statistic	Aggregate Nutrient Ecoregion VI		Level III Ecoregion 54		Level III Ecoregion 55		Aggregate Nutrient Ecoregion VII		Level III Ecoregion 56		Aggregate Nutrient Ecoregion IX		Level III Ecoregion 71		Level III Ecoregion 72	
	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]	IDEM/ USGS[1]	USEPA values, all seasons[2,3]
Number of streams	153	nd	36	nd	116	nd	40	nd	40	nd	66	nd	37	nd	29	nd
Minimum	0.06	nd	0.268	nd	0.06	nd	0.386	nd	0.386	nd	0.06	nd	0.06	nd	0.207	nd
10th Percentile	.387	nd	.379	nd	.405	nd	.466	nd	.466	nd	.216	nd	.19	nd	.352	nd
25th Percentile	.509	nd	.479	nd	.516	nd	.586	nd	.586	nd	.34	nd	.265	nd	.535	nd
50th Percentile	.738	nd	.64	nd	.794	nd	.732	nd	.732	nd	.62	nd	.44	nd	.736	nd
75th Percentile	1.25	nd	1.15	nd	1.28	nd	1.26	nd	1.26	nd	1.03	nd	.886	nd	1.27	nd
90th Percentile	1.81	nd	2.00	nd	1.80	nd	2.82	nd	2.82	nd	2.12	nd	1.60	nd	2.75	nd
Maximum	7.51	nd	2.13	nd	7.51	nd	5.85	nd	5.85	nd	7.11	nd	3.07	nd	7.11	nd
Number of samples	513	nc	140	nc	370	nc	119	nc	119	nc	235	nc	138	nc	97	nc
Percent of samples above Criteria	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc

[1]Indicates values equal to median of all samples collected on a sample stream within a specific ecoregion.

[2]Indicates values equal to median seasonal value of the median value for streams within an ecoregion and by season.

[3]US Environmental Protection Agency, 2000 a, b, c.

Summary

Excessive inputs of nutrients into streams have human-health, economic, and ecological consequences. In 2000, the USEPA proposed nutrient water-quality criteria to protect streams from excess nutrients. This study was completed as a cooperative effort between IDEM and the USGS to collect algal biomass and nutrient data that would assist IDEM in the development of nutrient criteria. Algal biomass and nutrient data were gathered at 322 randomly selected sites on 261 streams within 8 major river basin in Indiana (the West Fork White River, Whitewater River, East Fork White River, Upper Wabash River, Kankakee River, Lower Wabash River, Tributaries to the Great Lakes, and Tributaries to the Ohio River) from May through October from 2001 through 2005. Basin characteristics (land use and drainage area), substrate, turbidity, and nutrient concentrations were determined for the basin and sampling sites. The relations of seasonal algal biomass parameters (periphyton CHLa, AFDM, seston CHLa, and POC) to seasonal nutrient concentrations (nitrate, TKN, TN, and TP) were determined using Spearman's rho. The effect of streamflow was determined using data collected at USGS streamflow-gaging stations spatially located in the eight major river basins.

The frequency and magnitude of stream discharge varied seasonally and annually and greatly influenced algal biomass concentrations through scour and algal drift. Median concentrations of algal biomass in Indiana streams were 41.2 mg/m^2 for periphyton CHLa; 52.1 g/m^2 for AFDM; 2.44 µg/L for seston CHLa; 0.75 mg/L for POC,. Approximately 32 percent of the periphyton CHLa and 6 percent of the seston CHLa samples would be considered eutrophic according to nutrient boundary levels from Dodds and others (1998).

The occurrence and distribution of algal biomass varied among USEPA Aggregate and Level III Ecoregions. Ecoregions containing streams and agricultural ditches with lower discharge velocities and stream gradients appeared to have higher median concentrations of periphyton CHLa, AFDM, and POC. Ecoregion median algal biomass concentrations were: Ecoregion VI—periphyton CHLa, 49.5 mg/m^2; AFDM, 29.6 g/m^2; seston CHLa, 2.69 µg/L; POC, 0.78 mg/L; Ecoregion VII—periphyton CHLa, 41.2 mg/m^2; AFDM, 145 g/m^2; seston CHLa, 2.06 µg/L; POC, 0.76 mg/L; Ecoregion IX—periphyton CHLa, 27.3 mg/m^2; AFDM, 70.5 g/m^2; seston CHLa, 2.29 µg/L; POC, 0.66 mg/L. Seston CHLa concentrations were relatively consistent among Ecoregions. Comparisons of data collected in this study to nutrient boundaries from Dodds and others (1998) indicated periphyton and seston CHLa samples would be considered eutrophic in Ecoregion VI for 37 percent of periphyton CHLa and 4 percent of the seston CHLa samples; Ecoregion VII for 34 percent of periphyton CHLa and 2 percent of the seston CHLa; Ecoregion IX for 21 percent of periphyton CHLa and 13 percent of the seston CHLa samples.

Seasonal variability of the collected samples was determined by sampling three times during the growing season; samples were classified as spring (May), summer (June through August), and fall (September through October). The highest median concentrations of periphyton CHLa were in the spring, 63.2 mg/m2, and the highest median concentration of AFDM, seston CHLa, and POC were in the summer, 55.4 g/m^2, 2.96 µg/L, 0.81 mg/L, respectively. However, there were no significant differences among seasons for periphyton CHLa and AFDM; there were significant differences among seasons for seston CHLa and POC. Of the algal biomass samples collected during all three seasons, 31–45 percent of the samples collected were considered eutrophic for periphyton CHLa and 8 percent of the seston samples collected were considered eutrophic for seston CHLa.

There were no significant relations among nutrients and periphyton or seston CHLa parameters. The only significant positive relations were observed between summer POC and summer TP as well as summer POC and summer TKN. Positive relations also related spring POC and spring TP. However, these significant relations with TP are most likely related to phosphorus associated within seston algal cells and attached to sediment. The lack of significant positive algal biomass and nutrient relations is likely attributed to several natural factors such as scouring of algal growth by increased streamflow, canopy cover, turbidity, and grazing by snails, invertebrates, and fish.

Basin characteristics (land use, drainage area), substrate, turbidity, and nutrients affected the concentrations of algal biomass parameters. Of the eight basins sampled during the 5-year study, the Whitewater River Basin in 2001 had the highest median concentration of periphyton CHLa of 63.1 mg/m^2, the tributaries to the Great Lakes in 2005 exhibited the highest median concentration for AFDM of 160 g/m^2. The East Fork White River Basin in 2002 had nearly twice the median concentration (4.01 µg/L) of seston CHLa as the other basins, and the West Fork White River Basin in 2001 exhibited the highest median concentration of POC of 1.10 mg/L. According to the boundary values from Dodds and others (1998), of the eight major river basins sampled, 1–45 percent of the samples were eutrophic for periphyton CHLa and as much as 20 percent of the seston samples collected were eutrophic for seston CHLa. At headwater and wadable streams, 31–36 percent of samples were eutrophic for periphyton CHLa, and 28 percent of samples from boatable streams were eutrophic for seston CHLa.

As basin size increases, seston CHLa and POC concentrations increase while periphyton CHLa and AFDM concentrations decrease. The median turbidity values of Indiana streams associated with periphyton scour and restriction of light penetration were 6.95 NTU for headwater streams, 8.27 NTU for wadable streams, and 17.0 NTU for boatable streams. The types and availability of periphytic substrates (epilithic, epipsammic, or epidendric) proved to be an important factor when periphyton CHLa and AFDM concentrations were compared. Periphyton CHLa median concentrations ranged from 53.8 mg/m^2 for epilithic substrates, 41.8 mg/m^2 for epipsammic substrates, to 17.2 mg/m^2 for epidendric substrates. Due to the low discharge velocity of some streams, such as tributaries to the Great Lakes, settling of organic matter was found to increase AFDM concentrations in samples collected from epipsammic substrates. Median AFDM concentrations were 141 g/m^2 for epipsammic, 28.8 g/m^2 for epilithic, and 22.9 g/m^2 for epidendric.

The seasonal values for nutrients (nitrate, TKN, TN, and TP) and CHLa (periphyton and seston) were compared to published USEPA values for their respective ecoregions. The CHLa (periphyton and seston) values either were greater than 25th percentile published USEPA values or extended data ranges in Aggregate Nutrient and Level III Ecoregions. If the values for the 25th percentile proposed by the USEPA were adopted as nutrient water-quality criteria, 75 percent of the TKN samples, 77 percent of the nitrate, 74 percent of the TN, and 63 percent of the TP would have exceeded the proposed criteria in the eight study basins. In addition, 59 percent of the 864 periphyton CHLa samples and 55 percent of the 870 seston CHLa samples collected during the 5-year study would have exceeded the proposed criteria in the eight study basins.

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Appendixes

The following abbreviations are used throughout the appendix tables.

AV	avenue
BR	branch
CK	creek
CR	creek/county road
D and DCH	ditch
DS	downstream
DR	drive
FK	fork
FT	foot/feet
I-70	Interstate 70
IN	Indiana
INDPLS	Indianapolis
LK	lake
MI	mile
MT	mount
MUSC	Muscatatuck
NR	near
OH	Ohio
PL	place
R	river
RD	road
RMI	river mile
S6THSTRD	South 6th Street Road
SR	state road
ST	Saint or street
TRIB	tributary
US	upstream
USHWY	U.S. Highway
USHWY50BUS	U.S. Highway 50 Business
WW	Whitewater
WWTF	wastewater-treatment facility

Appendix 1. Location and ecoregion designations of the 34 algal-biomass sampling sites in the West Fork White River Basin, Indiana, July through September 2001.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
301	384211087065501	EAGAN DITCH 1000 FT US CR 350N NR WASHINGTON, IN	IX	72	38.70314	-87.11519
302	400620086050901	HINKLE CK 1500 FT US EAST 216TH ST AT DEMING, IN	VI	55	40.10550	-86.08569
303	391009086403001	RICHLAND CREEK 2200 FT US SR 43 AT WHITEHALL, IN	IX	71	39.16925	-86.67497
304	393410086085901	HONEY CR 2300 FT US SR 135 AT STONES CROSSING, IN	VI	55	39.56947	-86.14986
305	385847087123301	BREWER DCH 2000 FT DS CR 1450W NR PLEASANTVILLE, IN	IX	72	38.97981	-87.20928
306	392659086181801	SOUTH PRONG STOTTS CK 1200 FT US SR 44 AT COPE, IN	VI	55	39.44967	-86.30492
311	401606085532301	POLYWOG CK 3000 FT US CR 300S AT NEW LANCASTER, IN	VI	55	40.26842	-85.88969
313	384949087024201	KANE DITCH 1200 FT DS CR 700E NR EPSOM, IN	IX	72	38.83017	-87.04497
314	394234086112801	LICK CREEK 1200 FT DS SOUTH HARDING ST AT INDPLS	VI	55	39.70931	-86.19117
316	395256086242601	BEAMAN DITCH 3800 FT US CR 800N NR BROWNSBURG, IN	VI	55	39.88219	-86.40722
318	394734086133501	LITTLE EAGLE CREEK 2100 FT US WEST 16TH ST INDPLS	VI	55	39.79292	-86.22642
319	401451086110701	KIGIN DITCH 300 FT US CR 900W NR EKIN, IN	VI	55	40.24744	-86.18542
320	393046086573501	BIG WALNUT CK 3700 FT US 1-70 NR PLEASANT GARDENS	IX	72	39.51281	-86.95969
321	385116086565701	UNNAMED CREEK 3500 FT DS CR 1100E NR FARLEN, IN	IX	72	38.85442	-86.94911
322	393855086245601	W FK WHITE LICK CK 1500 FT US I-70 NR PLAINFIELD	VI	55	39.64856	-86.41567
323	401449085311801	JAKES CREEK 600 FT DS CR 700W AT BETHEL, IN	VI	55	40.24683	-85.52169
324	395003086410401	BIG WALNUT CREEK 1600 FT US CR 900E NR BARNARD, IN	VI	55	39.83422	-86.68439
327	400046085370901	FALL CREEK 1300 FT DS CR 300E NR EMPORIA, IN	VI	55	40.01286	-85.61917
330	393022086313401	LAMBS CREEK 1600 FT DS BEREAN RD NR WILBUR,IN	IX	71	39.50614	-86.52622
331	400409086022401	CICERO CREEK 5000 FT US SR 38 AT NOBLESVILLE, IN	VI	55	40.06925	-86.03997
332	394648086432701	PLUM CREEK 1800 FT US CR 800N AT NEW MAYSVILLE, IN	VI	55	39.77997	-86.72403
335	400831084552901	WHITE RIVER 2800 FT DS CR 200S NR WINCHESTER, IN	VI	55	40.14186	-84.92461

Appendix 1. Location and ecoregion designations of the 34 algal-biomass sampling sites in the West Fork White River Basin, Indiana, July through September 2001.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
336	393047087030601	BILLY CREEK 400 FT DS CR 125S NR HARMONY, IN	IX	72	39.51308	-87.05164
337	390555087002601	SLOAN DITCH 4800 FT DS SR 67 NR DIXON, IN	IX	72	39.09850	-87.00711
338	393713086213101	E FK WHITE LICK CK 1400FT US OLD 67 MOORESVILLE	VI	55	39.62025	-86.35869
339	401237085510001	LAMBERSON DITCH 1300 FT US CR 700N NR AROMA, IN	VI	55	40.21039	-85.85003
340	392755086444401	MILL CREEK 3800 FT US CR 1150N AT WALLACE JUNCTION	IX	71	39.46536	-86.74544
341	384333087082001	N FK PRARIE CK 3000 FT US CR 100E NR WASHINGTON, IN	IX	72	38.72586	-87.13886
342	395935086163801	EAGLE CREEK 2600 FT US WEST 146TH ST AT ZIONSVILLE	VI	55	39.99303	-86.27725
343	394214086065501	LICK CK 600 FT DS OF CARSON AV AT BEECH GROVE, IN	VI	55	39.70392	-86.11519
344	392116087052501	TURKEY CREEK 500 FT US CR 665 NR SALINE CITY, IN	IX	72	39.35447	-87.09036
346	393402086384301	MUD CREEK 5300 FT DS CR 1100W AT LITTLE POINT, IN	VI	55	39.56731	-86.64531
347	401219085344901	KILLBUCK CREEK 500 FT DS CR 800N NR GILMAN, IN	VI	55	40.20533	-85.58031
348	394307086474301	BLEDSOE BRANCH 500 FT US CR 400N NR FILLMORE, IN	VI	55	39.71867	-86.79542

[1]The full IDEM site number has a prefix of INRB, for example INRB01-301.

[2]U.S. Environmental Protection Agency, 2000a, b.

[3]U.S. Environmental Protection Agency, 1977b.

Appendix 2. Basin characteristics of the 34 algal-biomass sampling sites in the West Fork White River Basin, Indiana, July through September 2001.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
301	EAGAN DITCH 1000 FT US CR 350N NR WASHINGTON, IN	21.7	95.9	2.9	1.1	0.0
302	HINKLE CK 1500 FT US EAST 216TH ST AT DEMING, IN	46.9	96.7	2.0	.3	1.0
303	RICHLAND CREEK 2200 FT US SR 43 AT WHITEHALL,IN	17.9	49.8	45.8	.6	3.8
304	HONEY CR 2300 FT US SR 135 AT STONES CROSSING,IN	7.8	90.3	1.1	8.6	.0
305	BREWER DCH 2000 FT DS CR 1450W NR PLEASANTVILLE,IN	32.1	49.8	37.7	.4	12.1
306	SOUTH PRONG 1200 FT US SR 44 AT COPE,IN	83.7	77.9	21.0	.7	.4
311	POLYWOG CK 3000 FT US CR 300S AT NEW LANCASTER, IN	38.0	98.0	.9	.5	.6
313	KANE DITCH 1200 FT DS CR 700E NR EPSOM,IN	23.4	90.0	4.8	5.1	.1
314	LICK CREEK 1200 FT DS SOUTH HARDING ST AT INDPLS	58.5	39.7	5.0	55.0	.4
316	BEAMAN DITCH 3800 FT US CR 800N NR BROWNSBURG, IN	6.9	98.7	.2	1.2	.0
318	LITTLE EAGLE CREEK 2100 FT US WEST 16TH ST INDPLS	49.6	44.8	5.3	49.4	.5
319	KIGIN DITCH 300 FT US CR 900W NR EKIN, IN	4.1	98.0	1.2	0	.9
320	BIG WALNUT CK 3700 FT US 1-70 NR PLEASANT GARDENS	853.8	81.7	16.4	1.2	.8
321	UNNAMED CREEK 3500 FT DS CR 1100E NR FARLEN, IN	1.5	60.6	38.8	0	.6
322	W FK WHITE LICK CK 1500 FT US I-70 NR PLAINFIELD	160.5	89.0	7.9	2.6	.6
323	JAKES CREEK 600 FT DS CR 700W AT BETHEL, IN	46.1	73.9	5.3	19.8	1.0
324	BIG WALNUT CREEK 1600 FT US CR 900E NR BARNARD, IN	308.8	96.7	2.2	.8	.3
327	FALL CREEK 1300 FT DS CR 300E NR EMPORIA, IN	118.3	92.3	5.9	1.1	.7
330	LAMBS CREEK 1600 FT DS BEREAN RD NR WILBUR,IN	30.2	43.9	54.7	.4	1.1
331	CICERO CREEK 5000 FT US SR 38 AT NOBLESVILLE, IN	558.0	94.2	1.4	1.9	2.5
332	PLUM CREEK 1800 FT US CR 800N AT NEW MAYSVILLE, IN	4.9	97.1	2.9	0	0
335	WHITE RIVER 2800 FT DS CR 200S NR WINCHESTER, IN	26.7	97.4	2.3	0	.3
336	BILLY CREEK 400 FT DS CR 125S NR HARMONY,IN	19.3	74.9	13.3	10.1	1.7
337	SLOAN DITCH 4800 FT DS SR 67 NR DIXON,IN	9.4	86.9	1.8	11.3	.1

Appendix 2. Basin characteristics of the 34 algal-biomass sampling sites in the West Fork White River Basin, Indiana, July through September 2001.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
338	E FK WHITE LICK CK 1400FT US OLD 67 MOORESVILLE	125.7	79.7	5.3	14.5	.5
339	LAMBERSON DITCH 1300 FT US CR 700N NR AROMA, IN	14.5	96.6	.9	1.6	.9
340	MILL CREEK 3800 FT US CR 1150N AT WALLACE JUNCTION	563.1	91.5	7.5	0.7	0.3
341	N FK PRARIE CK 3000 FT US CR 100E NR WASHINGTON,IN	159.7	91.2	7.5	.1	1.2
342	EAGLE CREEK 2600 FT US WEST 146TH ST AT ZIONSVILLE	154.8	95.8	2.6	.7	.8
343	LICK CK 600 FT DS OF CARSON AV AT BEECH GROVE,IN	46.6	43.3	5.4	50.9	.4
344	TURKEY CREEK 500 FT US CR 665 NR SALINE CITY, IN	13.7	84.2	13.4	.1	2.3
346	MUD CREEK 5300 FT DS CR 1100W AT LITTLE POINT,IN	93.4	95.4	3.3	1.3	.1
347	KILLBUCK CREEK 500 FT DS CR 800N NR GILMAN, IN	158.8	85.8	5.1	8.1	1.0
348	BLEDSOE BRANCH 500 FT US CR 400N NR FILLMORE, IN	12.6	71.5	24.5	4.0	0
	Minimum	1.5	39.7	.2	0	0
	Mean	113.8	81.0	10.5	7.5	1.1
	Median	42.0	89.5	5.2	1.1	.6
	Maximum	853.8	98.7	54.7	55.0	12.1
	Standard deviation	188.9	19.1	13.9	14.8	2.1

[1]The full IDEM site number has a prefix of INRB, for example INRB01-301.

[2]Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 3. Location and ecoregion designations of the 38 algal-biomass sampling sites in the Whitewater River Basin, Indiana, May through September, 2002.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
401	395620085090801	WHITEWATER R 400 FT DS HOOVER RD NR HAGERSTOWN, IN	VI	55	39.93886	-85.15209
402	394041084562001	RICHLAND CK 3800 FT US CR 100W NR CLIFTON, IN	VI	55	39.67814	-84.93903
403	393827085001401	E FK WHITEWATER R 2700 FT US SR 44 NR LIBERTY, IN	VI	55	39.64075	-85.00390
404	392010085163801	SALT CK 1500 FT DS ENOCHSBURG RD AT ENOCHSBURG, IN	VI	55	39.33613	-85.27721
407	393249085113501	N BR GARRISON CK 200 FT DS CR 650S AT ALPINE, IN	IX	71	39.54706	-85.19307
408	395649084545201	FOUNTAIN CK AT WHITEWATER RD AT FOUNTAIN CITY, IN	VI	55	39.94703	-84.91431
409	395350085054001	MORGAN CK 2000 FT DS SR 38 NR GREENS FK, IN	VI	55	39.89713	-85.09450
410	392254084554401	BIG CEDAR CK 9400 FT US USHWY52 NR CEDAR GROVE, IN	IX	71	39.38171	-84.92901
411	393609085155801	FALL CK 1000 FT DS CR 425W NR COLUMBIA, IN	VI	55	39.60240	-85.21611
412	392251085074801	PIPE CK 900 FT US PUMPHOUSE RD NR OAK FOREST, IN	IX	71	39.38089	-85.12989
413	395148085074801	MARTINDALE CK 3900 FT US I-70 NR JACKSONBURG, IN	VI	55	39.86319	-85.12989
415	393514084580001	UNNAMED TRIB 1800 FT DS CR 175W NR ROSEBURG, IN	VI	55	39.58728	-84.96669
416	395158084535701	W FK WHITEWATER R 2000 FT DS I-70 NR RICHMOND, IN	VI	55	39.86605	-84.89922
417	394735084561001	LICK CK 2200 FT US ABINGTON PIKE NR RICHMOND, IN	VI	55	39.79307	-84.93633
419	393439085092401	WHITEWATER R 1200 FT US CR 480S AT NULLTOWN, IN	VI	55	39.57748	-85.15678
420	392645085071101	WHITEWATER R 8200 FT DS USHWY 52 AT METAMORA, IN	IX	71	39.44582	-85.11985
421	395344085064201	OSER CK 2700 FT DS SR 38 NR HAGERSTOWN, IN	VI	55	39.89553	-85.11174
422	392616085042301	WHITEWATER R 4 MI DS USHWY 52 AT YELLOW BANK, IN	IX	71	39.43783	-85.07293
423	393913084491301	LITTLE FOUR MI CK 2 MI US SR 44 NR FAIRHAVEN, OH	VI	55	39.65362	-84.82024
425	394904085002401	CROWN CK 400 FT DS MCMINN RD AT CENTERVILLE, IN	VI	55	39.81765	-85.00669
427	394318085073301	WHITEWATER R 7200 FT US CR 440N AT BEESONS, IN	VI	55	39.72157	-85.12593

Appendix 3. Location and ecoregion designations of the 38 algal-biomass sampling sites in the Whitewater River Basin, Indiana, May through September, 2002.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
428	395902084530801	FOUNTAIN CK 2800 FT US SEANEY RD NR BETHEL, IN	VI	55	39.98391	-84.88557
429	394649085023001	NOLANDS FK 2600 FT DS MCCONAHA RD NR PINHOOK, IN	VI	55	39.78034	-85.04153
430	392142085152501	SALT CK 2300 FT US CR 250W NR HAMBURG, IN	VI	55	39.36165	-85.25686
431	393259084502801	INDIAN CK 900 FT DS SAND RUN RD NR CONTRERAS, OH	VI	55	39.54973	-84.84098
432	395301084511501	M FK E FK WW R 2500 FT US SR 227 NR MIDDLEBORO, IN	VI	55	39.88351	-84.85426
433	394527084541701	ELKHORN CK 5000 FT US USHWY 27 NR LOCUST GROVE, IN	VI	55	39.75750	-84.90459
434	394545084540201	ELKHORN CK 6600 FT US USHWY 27 NR LOCUST GROVE, IN	VI	55	39.76244	-84.90065
435	393450085061401	WILSON CK 700 FT DS SR 1 NR EVERTON, IN	VI	55	39.58044	-85.10384
436	392755085181001	BULL FK 2 MI US STIPPS HILL RD NR BUENA VISTA, IN	VI	55	39.46538	-85.30271
437	394550085073301	WHITEWATER R 2 ML DS E MILTON RD NR MILTON, IN	VI	55	39.76390	-85.12593
438	392638085063101	WHITEWATER R 2 MI DS USHWY 52 NR METAMORA, IN	IX	71	39.44398	-85.10865
439	392809085103801	WHITEWATER R 2 MI DS LAUREL RD NR LAUREL, IN	IX	71	39.46913	-85.17668
440	395821084572801	MORGAN CK 2600 FT US MEYERS RD NR WILLIAMSBURG, IN	VI	55	39.97276	-84.95754
441	395348085023701	GREENS FK 1200 FT US SR 38 AT GREENS FK, IN	VI	55	39.89619	-85.04318
442	392610084531501	E FK BIG CEDAR CK 2 MI US SR 252 NR PALESTINE, IN	VI	55	39.43597	-84.88743
443	394147085064301	WHITEWATER R 2900 FT DS CR 440N AT WATERLOO, IN	VI	55	39.69634	-85.11201
445	394540085031701	CENTERAL RUN 7100 FT US CHAPEL RD NR PINHOOK, IN	VI	55	39.76121	-85.05469

[1]The full IDEM site number has a prefix of INRB, for example INRB01-301.

[2]U.S. Environmental Protection Agency, 2000a, b.

[3]U.S. Environmental Protection Agency, 1977b.

Appendix 4. Basin characteristics of the 38 algal-biomass sampling sites in the Whitewater River Basin, Indiana, May through September 2002.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km², square kilometer; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
401	WHITEWATER R 400 FT DS HOOVER RD NR HAGERSTOWN, IN	64.2	86.9	12.5	0.2	0.4
402	RICHLAND CK 3800 FT US CR 100W NR CLIFTON, IN	17.8	98.2	1.8	0	.1
403	E FK WHITEWATER R 2700 FT US SR 44 NR LIBERTY, IN	607	78.2	15.2	5.5	1.1
404	SALT CK 1500 FT DS ENOCHSBURG RD AT ENOCHSBURG, IN	71.5	79.8	19.5	.5	.2
407	N BR GARRISON CK 200 FT DS CR 650S AT ALPINE, IN	29.2	51.5	48.4	.1	.1
408	FOUNTAIN CK AT WHITEWATER RD AT FOUNTAIN CITY, IN	17.6	92.6	7.1	0	.3
409	MORGAN CK 2000 FT DS SR 38 NR GREENS FK, IN	38.6	95.3	4.6	0	.1
410	BIG CEDAR CK 9400 FT US USHWY52 NR CEDAR GROVE, IN	57.7	86.9	12.7	0	.3
411	FALL CK 1000 FT DS CR 425W NR COLUMBIA, IN	8.4	88.3	11.7	0	0
412	PIPE CK 900 FT US PUMPHOUSE RD NR OAK FOREST, IN	93.2	66.8	31.5	1.0	.8
413	MARTINDALE CK 3900 FT US I-70 NR JACKSONBURG, IN	139	92.4	6.7	.2	.7
415	UNNAMED TRIB 1800 FT DS CR 175W NR ROSEBURG, IN	4.0	94.4	5.3	0	.3
416	W FK WHITEWATER R 2000 FT DS I-70 NR RICHMOND, IN	46.7	90.2	7.0	2.2	.6
417	LICK CK 2200 FT US ABINGTON PIKE NR RICHMOND, IN	40.4	68.2	8.9	22.1	.8
419	WHITEWATER R 1200 FT US CR 480S AT NULLTOWN, IN	1,352	88.0	9.3	1.7	1.0
420	WHITEWATER R 8200 FT DS USHWY 52 AT METAMORA, IN	1,944	79.2	18.5	1.4	.9
421	OSER CK 2700 FT DS SR 38 NR HAGERSTOWN, IN	4.5	95.9	3.0	.2	.9
422	WHITEWATER R 4 MI DS USHWY 52 AT YELLOW BANK, IN	2,134	77.5	20.3	1.3	.9
423	LITTLE FOUR MI CK 2 MI US SR 44 NR FAIRHAVEN, OH	49.0	96.4	3.1	.3	.3
425	CROWN CK 400 FT DS MCMINN RD AT CENTERVILLE, IN	6.9	81.7	4.1	14.2	.1
427	WHITEWATER R 7200 FT US CR 440N AT BEESONS, IN	798	89.7	8.2	1.1	1.0
428	FOUNTAIN CK 2800 FT US SEANEY RD NR BETHEL, IN	5.3	89.3	10.3	0	.3
429	NOLANDS FK 2600 FT DS MCCONAHA RD NR PINHOOK, IN	187	90.6	7.0	1.6	.8

Appendix 4. Basin characteristics of the 38 algal-biomass sampling sites in the Whitewater River Basin, Indiana, May through September 2002.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
430	SALT CK 2300 FT US CR 250W NR HAMBURG, IN	102	73.6	23.8	1.5	1.1
431	INDIAN CK 900 FT DS SAND RUN RD NR CONTRERAS, OH	45.4	96.7	2.5	.4	.4
432	M FK E FK WW R 2500 FT US SR 227 NR MIDDLEBORO, IN	107	91.4	7.6	.3	.7
433	ELKHORN CK 5000 FT US USHWY 27 NR LOCUST GROVE, IN	50.8	87.0	11.1	.3	1.6
434	ELKHORN CK 6600 FT US USHWY 27 NR LOCUST GROVE, IN	50.4	87.3	10.9	.3	1.5
435	WILSON CK 700 FT DS SR 1 NR EVERTON, IN	3.3	82.7	15.2	2.1	.1
436	BULL FK 2 MI US STIPPS HILL RD NR BUENA VISTA, IN	7.1	97.5	2.5	0	0
437	WHITEWATER R 2 ML DS E MILTON RD NR MILTON, IN	520	89.1	8.6	1.3	1.0
438	WHITEWATER R 2 MI DS USHWY 52 NR METAMORA, IN	1,949	79.1	18.7	1.4	1.0
439	WHITEWATER R 2 MI DS LAUREL RD NR LAUREL, IN	1,557	83.6	13.9	1.5	1.0
440	MORGAN CK 2600 FT US MEYERS RD NR WILLIAMSBURG, IN	4.2	95.7	4.1	0	.2
441	GREENS FK 1200 FT US SR 38 AT GREENS FK, IN	172	92.8	5.7	.7	.8
442	E FK BIG CEDAR CK 2 MI US SR 252 NR PALESTINE, IN	13.6	94.4	5.1	0	.5
443	WHITEWATER R 2900 FT DS CR 440N AT WATERLOO, IN	805	89.7	8.2	1.1	1.1
445	CENTERAL RUN 7100 FT US CHAPEL RD NR PINHOOK, IN	7.4	96.4	3.4	0	.2
	Minimum	3.3	51.5	1.8	0	0
	Mean	345.0	86.7	11.0	1.7	.6
	Median	50.6	89.2	8.4	.3	.6
	Maximum	2,134	98.2	48.4	22.1	1.6
	Standard deviation	613.5	9.9	9.1	4.2	.4

[1]The full IDEM site number has a prefix of INRB, for example INRB01-301.

[2]Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 5. Location and ecoregion designations of the 38 algal-biomass sampling sites in the East Fork White River Basin, Indiana, May through September, 2002.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
501	395651085222501	BIG BLUE R 2000 FT N NORTH RD AT NEW CASTLE,IN	VI	55	39.94761	-85.37384
502	390637085350201	SAND CK 1450 FT N CR 850N NR BREWERSVILLE, IN	VI	55	39.11014	-85.58388
503	392348085315501	CLIFTY CK 840 FT N CR 400N NR ADAMS, IN	VI	55	39.39670	-85.53197
504	384632086094201	E FK WHITE R 1 RMI US MUSCATATUCK R NR MEDORA, IN	VI	55	38.77558	-86.16173
505	392221085483701	FLATROCK R 300 FT DS CR 150W NR FLATROCK, IN	VI	55	39.37244	-85.81015
506	385657086275601	LITTLE SALT CK 400 FT DS CR 650N NR COVEYVILLE, IN	IX	71	38.94904	-86.46553
508	384054086530301	BOGGS CK 1600 FT DS CR 15 NR LOOGOOTEE, IN	IX	71	38.68172	-86.88416
509	394628085321301	BIG BLUE R 1400 FT W CR 450W NR KNIGHTSTOWN, IN	VI	55	39.77432	-85.53700
510	391917085520901	FLATROCK R 900 FT N CR 800N AT ST LOUIS CROSSING, IN	VI	55	39.32146	-85.86906
511	385539085431501	VERNON FK MUSC R 2700 FT E CR 400 S NR HAYDEN, IN	VI	55	38.92737	-85.72081
512	384810086284601	E FK WHITE R I MI N CR 500 S NR YOCKEY, IN	IX	71	38.80266	-86.47955
513	395149085263701	BIG BLUE R 1200 FT N CR 500S NR GREENSBORO, IN	VI	55	39.86362	-85.44368
515	385836086062401	LITTLE SALT CK 2700 FT S SR 258 AT FREETOWN, IN	IX	71	38.97669	-86.10655
516	383934086463201	BEAVER CK 900 FT S CR 44 AT IRONTON, IN	IX	71	38.65946	-86.77551
518	390659085383801	WYALOOSING CK 200 FT S 900N NR SARDINIA, IN	VI	55	39.11632	-85.64397
519	390745085273801	SUGAR CK 1000 FT W CR 1000N NR ZENAS, IN	VI	55	39.12909	-85.46048
521	392751085291801	LITTLE FLATROCK R 2700 FT W SR 3 NR MILROY, IN	VI	55	39.46429	-85.48840
522	385730086102801	S FK SALT CK 1200 FT N SR 58 NR KURTZ, IN	IX	71	38.95841	-86.17455
523	384717085320901	BIG CK I MI W CR 700W AT VOLGA, IN	VI	55	38.78793	-85.53588
524	383107086502501	E FK WHITE R 4000 FT W CR 400E NR THALES, IN	IX	71	38.51858	-86.84026

Appendix 5. Location and ecoregion designations of the 38 algal-biomass sampling sites in the East Fork White River Basin, Indiana, May through September, 2002.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
525	392508085545301	BIG BLUE R 2700 FT E CR 750W NR MT AUBURN, IN	VI	55	39.41886	-85.91475
526	384832086340901	E FK WHITE R 1300 FT W CR 450W NR COXTON, IN	IX	71	38.80884	-86.56921
527	384838085383401	BIG CK 900 FT E SR 3 NR DEPUTY, IN	VI	55	38.81067	-85.64281
528	382939087060901	BEAR CK 200 FT N CR 400N NR OTWELL, IN	IX	72	38.49412	-87.10251
530	384635086041401	MUSCATATUCK R 2600 FT N MT EDEN RD NR MILLPORT,IN	VI	55	38.77645	-86.07056
531	390939086202001	N FK SALT CK 2250 FT US SR 46 AT BELMONT, IN	IX	71	39.16073	-86.33886
532	384433086434501	E FK WHITE R 100 FT N WILLIAMS RD NR HURON, IN	IX	71	38.74239	-86.72917
533	393950085544601	SUGAR CK 1500 FT DS CR 1000N NR PLEASANT VIEW, IN	VI	55	39.66397	-85.91280
534	390028085365701	VERNON FK MUSC R 1150 FT US WWTF AT N VERNON, IN	VI	55	39.00767	-85.61584
535	391848085333801	FALL FK 650 FT N SR 3 AT EWINGTON, IN	VI	55	39.31332	-85.56055
536	384525086014401	MUSCATATUCK R 1200 FT E MT EDEN RD NR MILPORT, IN	VI	55	38.75708	-86.02883
537	393249085294401	FLATROCK R 500 FT DS CR 450S NR MILROY, IN	VI	55	39.54688	-85.49546
539	385607085325901	GRAHAM CK 300 FT S CR 350E AT WALNUT RIDGE, IN	VI	55	38.93529	-85.54985
542	392105085592401	BIG BLUE R 2400 FT W SR 31 AT EDINBURGH, IN	VI	55	39.35142	-85.99013
543	384858085525501	VERNON FK MUSC R 1800 FT E CR 800E NR RETREAT, IN	VI	55	38.81615	-85.88198
544	383726086202701	LOST R 100 FT N CR 450N NR ORLEANS, IN	IX	71	38.62390	-86.34069
545	392544085585801	SUGAR CK 2600 FT E CR 350S AT AMITY, IN	VI	55	39.42880	-85.98279
551	395221085483001	SUGAR CK 500 FT N CR 600N NR MAXWELL, IN	VI	55	39.87275	-85.80836

[1]The full IDEM site number has a prefix of INRB, for example INRB01-301.

[2]U.S. Environmental Protection Agency, 2000a, b.

[3]U.S. Environmental Protection Agency, 1977b.

Appendix 6. Basin characteristics of the 38 algal-biomass sampling sites in the East Fork White River Basin, Indiana, May through September 2002.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
501	BIG BLUE R 2000 FT N NORTH RD AT NEW CASTLE,IN	113	85.7	9.7	1.6	3.0
502	SAND CK 1450 FT N CR 850N NR BREWERSVILLE, IN	34	81.0	16.0	2.5	.5
503	CLIFTY CK 840 FT N CR 400N NR ADAMS, IN	145	96.0	3.4	.1	.4
504	E FK WHITE R 1 RMI US MUSCATATUCK R NR MEDORA, IN	6,662	85.3	10.5	2.8	1.3
505	FLATROCK R 300 FT DS CR 150W NR FLATROCK, IN	1,037	93.4	4.6	1.1	1.0
506	LITTLE SALT CK 400 FT DS CR 650N NR COVEYVILLE, IN	113	21.7	77.9	.3	.1
508	BOGGS CK 1600 FT DS CR 15 NR LOOGOOTEE, IN	224	33.2	57.1	.6	9.2
509	BIG BLUE R 1400 FT W CR 450W NR KNIGHTSTOWN, IN	414	84.6	8.9	4.9	1.5
510	FLATROCK R 900 FT N CR 800N AT ST LOUIS CROSSING, IN	1,280	93.4	4.2	1.4	1.0
511	VERNON FK MUSC R 2700 FT E CR 400 S NR HAYDEN, IN	595	61.0	36.5	1.3	1.2
512	E FK WHITE R I MI N CR 500 S NR YOCKEY, IN	10,355	76.2	19.5	2.3	2.0
513	BIG BLUE R 1200 FT N CR 500S NR GREENSBORO, IN	176	78.3	10.5	8.6	2.6
515	LITTLE SALT CK 2700 FT S SR 258 AT FREETOWN, IN	28.8	39.1	58.9	.2	1.7
516	BEAVER CK 900 FT S CR 44 AT IRONTON, IN	179	22.4	76.6	.2	.8
518	WYALOOSING CK 200 FT S 900N NR SARDINIA, IN	62.1	89.1	9.9	.6	.4
519	SUGAR CK 1000 FT W CR 1000N NR ZENAS, IN	18.4	66.5	33.2	0	.3
521	LITTLE FLATROCK R 2700 FT W SR 3 NR MILROY, IN	120	96.5	2.5	.6	.4
522	S FK SALT CK 1200 FT N SR 58 NR KURTZ, IN	75.8	40.8	58.0	.5	.8
523	BIG CK I MI W CR 700W AT VOLGA, IN	215	43.8	44.3	1.2	10.7

Appendix 6. Basin characteristics of the 38 algal-biomass sampling sites in the East Fork White River Basin, Indiana, May through September 2002.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
524	E FK WHITE R 4000 FT W CR 400E NR THALES, IN	14,362	65.8	29.9	2.2	2.1
525	BIG BLUE R 2700 FT E CR 750W NR MT AUBURN, IN	1,480	89.6	6.1	3.0	1.3
526	E FK WHITE R 1300 FT W CR 450W NR COXTON, IN	12,196	69.3	26.0	2.5	2.2
527	BIG CK 900 FT E SR 3 NR DEPUTY, IN	415	54.2	37.6	1.4	6.8
528	BEAR CK 200 FT N CR 400N NR OTWELL, IN	12.1	93.7	6.3	0	0
530	MUSCATATUCK R 2600 FT N MT EDEN RD NR MILLPORT, IN	2,898	60.4	34.5	1.5	3.5
531	N FK SALT CK 2250 FT US SR 46 AT BELMONT, IN	278	14.5	83.6	.5	1.3
532	E FK WHITE R 100 FT N WILLIAMS RD NR HURON, IN	12,311	69.1	26.2	2.5	2.2
533	SUGAR CK 1500 FT DS CR 1000N NR PLEASANT VIEW, IN	327	92.5	4.4	2.2	.8
534	VERNON FK MUSC R 1150 FT US WWTF AT N VERNON, IN	284	70.5	28.0	.7	.8
535	FALL FK 650 FT N SR 3 AT EWINGTON, IN	9.3	98.4	.2	1.3	.1
536	MUSCATATUCK R 1200 FT E MT EDEN RD NR MILPORT, IN	2,799	61.4	33.4	1.6	3.6
537	FLATROCK R 500 FT DS CR 450S NR MILROY, IN	505	93.9	3.5	1.6	1.0
539	GRAHAM CK 300 FT S CR 350E AT WALNUT RIDGE, IN	195	48.2	44.7	.3	6.8
542	BIG BLUE R 2400 FT W SR 31 AT EDINBURGH, IN	1,520	89.5	6.2	2.9	1.4
543	VERNON FK MUSC R 1800 FT E CR 800E NR RETREAT, IN	993	63.9	32.2	1.9	2.0
544	LOST R 100 FT N CR 450N NR ORLEANS, IN	86.8	91.7	7.7	.1	.4

Appendix 6. Basin characteristics of the 38 algal-biomass sampling sites in the East Fork White River Basin, Indiana, May through September 2002.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; R, River; RD, Road; CR, County Road; SR, State Route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana; OH, Ohio; trib, tributary; USHWY, U.S. Highway; RMI, River mile]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
545	SUGAR CK 2600 FT E CR 350S AT AMITY, IN	891	91.3	4.0	4.0	.7
551	SUGAR CK 500 FT N CR 600N NR MAXWELL, IN	147	94.1	4.4	.6	.9
	Minimum	9.3	14.5	.2	0	0
	Mean	1,943.8	71.1	25.3	1.6	2.0
	Median	305.8	77.3	17.7	1.4	1.2
	Maximum	14,362	98.4	83.6	8.6	10.7
	Standard deviation	3,825.5	23.8	23.4	1.6	2.4

[1]The full IDEM site number has a prefix of INRB, for example INRB02-501.

[2] Land use percentages were determined by the USGS using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 7. Location and ecoregion designations of the 38 algal-biomass sampling sites in the Upper Wabash River Basin, Indiana, May through October 2003.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
601	403857085593501	PIPE CK 100 FT US PIPE CK AT SANTA FE, IN	VI	55	40.64950	-85.99200
602	401643084521501	HARSHMAN CK 0.9 MI US MISSISSINEWA R NR SALEM, IN	VI	55	40.27870	-84.87020
603	404805086333701	GALBREATH DITCH 0.5 MI DS CR 200N NR LK CICOTT, IN	VII	56	40.80107	-86.56016
604	402554085305901	MISSISSINEWA R 0.8 MI US SR 26 NR FOWLERTON, IN	VI	55	40.43180	-85.51480
605	405236086495201	BIG MONON CK 0.5 MI US SR 16 NR MONON, IN	VI	54	40.87680	-86.83150
606	405243085564701	PAW PAW CK 0.3 MI US CR 800N NR ROANN, IN	VI	55	40.87859	-85.94648
607	401943086385101	S FK WILDCAT CK 0.6 MI US CR 800W NR MULBERRY, IN	VI	55	40.32850	-86.64740
608	410301086184501	MUD CK 0.3 MI US GRUBE DITCH NR PERSHING, IN	VII	56	41.04981	-86.31161
609	403712086593901	MEYERS DITCH 820 FT US I-65 NR BADGER GROVE, IN	VI	54	40.61974	-86.99414
610	410543085373101	CLEAR CK 980 FT US SPRING CK AT SOUTH WHITLEY, IN	VII	56	41.09500	-85.62430
611	404156086024501	LITTLE PIPE CK 900 FT DS CR 150E NR SOUTH PERU, IN	VI	55	40.69930	-86.04680
612	403633085115401	ROCK CK 770 FT US CR 900S NR PETROLEUM, IN	VI	55	40.60936	-85.19817
613	403542086305901	DEER CK 0.7 MI US MERIDIAN LINE RD NR CAMDEN, IN	VI	55	40.59506	-86.51631
614	405208085093701	EIGHTMILE CK 0.4 MI US SR 1 AT OSSIAN, IN	VI	55	40.86910	-85.16019
615	403603086325101	DEER CK 0.6 MI DS SR 75 AT CAMDEN, IN	VI	55	40.60070	-86.54740
616	411707085593601	EASTERDAY DITCH 0.3 MI DS CR 400N NR ATWOOD, IN	VII	56	41.28654	-85.99596
617	402612086094301	E FK LITTLE WILDCAT CK 880 FT US CR200W AT ALTO, IN	VI	55	40.43653	-86.16117
618	405346085595201	WILSON RHODES DITCH 0.6 MI US CR850N NR ROANN, IN	VII	56	40.89640	-85.99760
619	404912086080401	UNNAMED TRIB 1.2 MI US EEL R AT MEXICO, IN	VI	55	40.82060	-86.13430

Appendix 7. Location and ecoregion designations of the 38 algal-biomass sampling sites in the Upper Wabash River Basin, Indiana, May through October 2003.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
621	405856086223001	MILL CK 600 FT US HINES DITCH NR MARSHTOWN, IN	VII	56	40.98213	-86.37508
622	410526085291501	STONY CK 720 FT US MERIDIAN RD AT PEABODY, IN	VII	56	41.09090	-85.48870
623	402423086423501	MID FK WILDCAT CK 0.4 MI DS HOG RUN AT PETTIT, IN	VI	55	40.40630	-86.71070
624	411753085493801	TIPPECANOE R 880 FT DS CR 100E NR ISLAND PARK, IN	VII	56	41.29765	-85.82738
625	403639086402301	WABASH R 1.9 MI US SR 39 NR DELPHI, IN	VI	55	40.61088	-86.67318
626	404739085210101	ROCK CK 0.4 MI US SR 3 NR MARKLE, IN	VI	55	40.79580	-85.35150
627	402135086211701	KILMORE CK 500 FT US CR 800E NR FOREST, IN	VI	55	40.35993	-86.35473
628	410048086350101	MILL CK 0.6 MI US TIPPECANOE R NR WINAMAC, IN	VI	55	41.01320	-86.58340
629	404248086341901	UNNAMED TRIB 0.8 MI US BURNETTS CK AT LOCKPORT, IN	VI	55	40.71320	-86.57180
630	404203085274901	DETAMORE DITCH 700 FT DS I-69 NR WARREN, IN	VI	55	40.70118	-85.46385
631	401517084495201	LITTLE MISSISSINEWA R 2.8 MI DS SR28 NR COSMOS, OH	VI	55	40.25505	-84.83130
632	411625085372301	UNNAMED TRIB 450 FT US GAFF DITCH NR ETNA, IN	VII	56	41.27390	-85.62304
633	402739085413701	DEER CK 0.25 MI US CR 100W NR WEAVER, IN	VI	55	40.46050	-85.69430
634	401401085413701	ELKHORN CK 0.25 MI US CR 500N NR FARMLAND, IN	VI	55	40.23280	-85.16620
635	405501086490201	BIG MONON CK 0.2 MI US BIG MONON DITCH NR MONON, IN	VI	54	40.91790	-86.81700
636	402425084574101	LITTLE SALAMONIE R 0.4 MI US CR 120S AT LIBER, IN	VI	55	40.40696	-84.96156
637	405617086260401	TRAVERS DITCH 560 FT DS CR1000W NR GRASS CREEK, IN	VII	56	40.93800	-86.43380
638	410106085191601	ABOITE CK 0.3 MI US USHWY 24 AT TIMBERCREST, IN	VI	55	41.01850	-85.32080
639	402710086510501	WILDCAT CK 150 FT US SR 25 AT LAFAYETTE, IN	VI	55	40.45283	-86.85122

[1] The full IDEM site number has a prefix of INRB, for example INRB03-601.

[2] U.S. Environmental Agency, 2000a,b.

[3] U.S. Environmental Protection Agency, 1997b.

Appendix 8. Basin characteristics of the 38 algal-biomass sampling sites in the Upper Wabash River Basin, Indiana, May through October 2003.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
601	UNNAMED TRIB 100 FT US PIPE CK AT SANTA FE, IN	359.7	96.2	2.3	1.1	0.4
602	HARSHMAN CK 0.9 MI US MISSISSINEWA R NR SALEM, IN	33.6	95.7	2.8	.5	1.0
603	GALBREATH DITCH 0.5 MI DS CR 200N NR LK CICOTT, IN	6.1	73.5	25.2	.1	1.2
604	MISSISSINEWA R 0.8 MI US SR 26 NR FOWLERTON, IN	1,251.2	91.2	5.8	1.5	1.5
605	BIG MONON CK 0.5 MI US SR 16 NR MONON, IN	87.4	91.4	6.3	0	2.3
606	PAW PAW CK 0.3 MI US CR 800N NR ROANN, IN	93.8	94.7	4.2	.4	.7
607	S FK WILDCAT CK 0.6 MI US CR 800W NR MULBERRY, IN	460.1	94.8	1.6	2.5	1.1
608	MUD CK 0.3 MI US GRUBE DITCH NR PERSHING, IN	131.2	94.6	3.1	.6	1.7
609	MEYERS DITCH 820 FT US I-65 NR BADGER GROVE, IN	1.4	96.5	.4	3.0	.1
610	CLEAR CK 980 FT US SPRING CK AT SOUTH WHITLEY, IN	24.9	82.0	14.7	0	3.3
611	LITTLE PIPE CK 900 FT DS CR 150E NR SOUTH PERU, IN	28.4	93.9	5.2	0	.9
612	ROCK CK 770 FT US CR 900S NR PETROLEUM, IN	7.6	96.0	3.8	0	.2
613	DEER CK 0.7 MI US MERIDIAN LINE RD NR CAMDEN, IN	524.6	95.8	2.6	.7	.9
614	EIGHTMILE CK 0.4 MI US SR 1 AT OSSIAN, IN	64.2	96.1	3.2	.1	.6
615	DEER CK 0.6 MI DS SR 75 AT CAMDEN, IN	583.0	95.9	2.5	.7	.9
616	EASTERDAY DITCH 0.3 MI DS CR 400N NR ATWOOD, IN	14.7	88.4	8.7	.1	2.8
617	E FK LITTLE WILDCAT CK 880 FT US CR200W AT ALTO, IN	24.0	86.0	2.7	9.4	1.9
618	WILSON RHODES DITCH 0.6 MI US CR850N NR ROANN, IN	12.1	91.3	8.7	0	0
619	UNNAMED TRIB 1.2 MI US EEL R AT MEXICO, IN	4.2	92.2	6.8	0	1.0

Appendix 8. Basin characteristics of the 38 algal-biomass sampling sites in the Upper Wabash River Basin, Indiana, May through October 2003.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
621	MILL CK 600 FT US HINES DITCH NR MARSHTOWN, IN	77.8	95.5	2.5	.5	1.5
622	STONY CK 720 FT US MERIDIAN RD AT PEABODY, IN	24.9	94.4	3.9	.6	1.2
623	MID FK WILDCAT CK 0.4 MI DS HOG RUN AT PETTIT, IN	289.1	97.1	1.7	.5	.7
624	TIPPECANOE R 880 FT DS CR 100E NR ISLAND PARK, IN	317.3	76.2	11.3	1.6	10.9
625	WABASH R 1.9 MI US SR 39 NR DELPHI, IN	10,652.1	88.2	7.7	1.9	2.2
626	ROCK CK 0.4 MI US SR 3 NR MARKLE, IN	240.8	96.3	3.1	.1	.5
627	KILMORE CK 500 FT US CR 800E NR FOREST, IN	120.2	97.9	0.7	0.6	0.8
628	MILL CK 0.6 MI US TIPPECANOE R NR WINAMAC, IN	233.2	96.0	2.4	.4	1.2
629	UNNAMED TRIB 0.8 MI US BURNETTS CK AT LOCKPORT, IN	8.0	87.7	10.6	0	1.7
630	DETAMORE DITCH 700 FT DS I-69 NR WARREN, IN	12.9	96.2	2.3	1.0	.5
631	LITTLE MISSISSINEWA R 2.8 MI DS SR28 NR COSMOS, OH	44.0	92.7	2.3	4.2	.8
632	UNNAMED TRIB 450 FT US GAFF DITCH NR ETNA, IN	3.2	96.2	1.0	0	2.8
633	DEER CK 0.25 MI US CR 100W NR WEAVER, IN	76.0	97.6	1.1	.2	1.1
634	ELKHORN CK 0.25 MI US CR 500N NR FARMLAND, IN	9.1	95.8	3.1	.2	.9
635	BIG MONON CK 0.2 MI US BIG MONON DITCH NR MONON, IN	8.7	96.0	3.4	0	.6
636	LITTLE SALAMONIE R 0.4 MI US CR 120S AT LIBER, IN	50.6	88.2	9.8	.1	1.9
637	TRAVERS DITCH 560 FT DS CR1000W NR GRASS CREEK, IN	3.5	88.5	8.6	0	2.9

Appendix 8. Basin characteristics of the 38 algal-biomass sampling sites in the Upper Wabash River Basin, Indiana, May through October 2003.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
638	ABOITE CK 0.3 MI US USHWY 24 AT TIMBERCREST, IN	132.6	86.1	8.9	2.1	2.9
639	WILDCAT CK 150 FT US SR 25 AT LAFAYETTE, IN	2,064.8	91.9	3.2	3.4	1.5
	Minimum	1.4	73.5	.3	0	.1
	Maximum	10,652.1	97.9	25.2	9.4	10.9
	Mean	475.8	92.2	5.2	1.0	1.6
	Median	57.4	94.7	3.2	.4	1.1
	Standard deviation	1,740.1	5.7	4.8	1.8	1.8

[1] The full IDEM site number has a prefix of INRB, for example INRB03-601.

[2] Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 9. Location and ecoregion designations of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
701	412029086435701	KANAKEE R 1320 FT US SR39 NR HANNA IN	VI	54	41.34139	-86.73250
702	413242087254801	CADY MARSH D 720 FT DS OF BROAD ST AT GRIFFITH IN	VI	54	41.54500	-87.43000
703	410737087273101	LAWLER D 2900 FT DS OF N400W AT LAKE VILLAGE IN	VI	54	41.12694	-87.45861
705	411021087020901	WOLF CK 60 FT DS E1100N NR WHEATFIELD IN	VI	54	41.17250	-87.03583
706	412400086420601	KANAKEE R 3.89 MI DS OF W1200S NR HANNA IN	VI	54	41.40000	-86.70167
707	412122087035901	COBB D 3220 FT US OF W600S NR KOUTS IN	VI	54	41.35611	-87.06639
708	405002087233501	IROQUOIS R 3430 FT US OF S100W NR BROOK IN	VI	54	40.83389	-87.39306
709	411752087120701	UNNAMED TRIB 900 FT US OF USHWY231 NR HEBRON IN	VI	54	41.29778	-87.20194
710	412251086110301	YELLOW R 1700 FT US OF E 8TH ST NR BREMEN IN	VII	56	41.38083	-86.18417
711	411219087275101	SINGLETON D 350 FT DS OF USHWY41 NR SCHNEIDER IN	VI	54	41.20528	-87.46417
712	403952087271401	SUGAR CK 8120 FT DS OF N600W NR EARL PARK IN	VI	54	40.66444	-87.45389
713	405728087033201	RYAN D 4840 FT US OF S250W NR RENSSELAER IN	VI	54	40.95778	-87.05889
714	413841086391401	COLLINS D 3100 FT US OF SR2 NR LA PORTE IN	VII	56	41.64472	-86.65389
715	412118087182401	STONY RUN 60 FT US OF IOWA ST NR CROWN POINT IN	VI	54	41.35500	-87.30667
716	404940087182801	WEISS D 510 FT DS OF SR 55 NR BROOK IN	VI	54	40.82778	-87.30778
717	411619086501501	KANAKEE R 3890 FT DS OF S650W AT ENGLISH LAKE IN	VI	54	41.27194	-86.83750
718	411814086334801	EAGLE CK 150 FT DS OF N700E NR KNOX IN	VI	54	41.30389	-86.56333
719	411056087204401	KANAKEE R 1370 FT DS OF SR55 AT SHELBY IN	VI	54	41.18222	-87.34556
720	403551087282201	MINIER LATERAL 960 FT US S800W NR FREELAND PARK IN	VI	54	40.59750	-87.47278

Appendix 9. Location and ecoregion designations of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
723	412247087081101	WOLF CK 6320 FT DS OF W300S NR KOUTS IN	VI	54	41.37972	-87.13639
724	405127087211401	IROQUOIS R 2150 FT US E LK KENOYER RD AT BROOK IN	VI	54	40.85750	-87.35389
725	411541087024601	KANAKEE R 4320 FT DS OF SR49 NR KOUTS IN	VI	54	41.26139	-87.04611
726	412017085591401	DOUSMAN D 7930 FT US OF N625W NR ETNA GREEN IN	VII	56	41.33806	-85.98722
727	405248087262301	CLARK D 1770 FT US OF S325W AT ADE IN	VI	54	40.88000	-87.43972
728	404335087232101	UNNAMED TRIB 4400 FT US OF W1800S NR KENTLAND IN	VI	54	40.72639	-87.38917
729	405552087102801	IROQUOIS R 5700 FT DS OF USHWY231 AT RENSSELAER IN	VI	54	40.93111	-87.17444
730	413328086141801	E BUNCH D 2480 FT DS OF NEW RD NR SOUTH BEND IN	VII	56	41.55778	-86.23833
731	412624087285201	WEST CK 700 FT US OF OLCOTT AV AT ST JOHN IN	VI	54	41.44000	-87.48111
732	405210087043401	HOWE D 850 FT DS OF SR 16 NR RENSSELAER IN	VI	54	40.86944	-87.07611
733	411556086513401	KANAKEE R 2 MI DS S650W NR ENGLISH LAKE IN	VI	54	41.26556	-86.85944
734	411635086265901	YELLOW R 2650 FT US OF S UPAS RD NR CULVER IN	VI	54	41.27639	-86.44972
735	411324087300401	WEST CK 3750 US OF W223RD AV NR SCHNEIDER IN	VI	54	41.22333	-87.50111
736	413216086262301	POTATO CK 1830 FT US SMILAX RD AT NORTH LIBERTY IN	VI	54	41.53778	-86.43972
737	411936087045301	COBB D 3000 FT US OF SR8 NR KOUTS IN	VI	54	41.32667	-87.08139
738	412759086453401	MILL CK 770 FT US OF LONG LANE NR UNION MILLS IN	VII	56	41.46639	-86.75944
739	412750086573301	W BR CROOKED CK 230 FT US E200N NR VALPARAISO IN	VI	54	41.46389	-86.95917
741	411514087054501	HODGE D 2230 FT US N300W NR WHEATFIELD IN	VI	54	41.25389	-87.09583
742	412211086145001	YELLOW R 3360 FT DS OF N JARRAH RD NR PLYMOUTH IN	VII	56	41.36972	-86.24722

Appendix 9. Location and ecoregion designations of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
743	405732087275001	BEAVER CK 70 FT DS OF W275S AT MOROCCO IN	VI	54	40.95889	-87.46389
744	404652087100501	CARPENTER CK 475 FT DS OF W1600S AT REMINGTON IN	VI	54	40.78111	-87.16806
745	405341087100801	SLOUGH CK 80 FT DS OF S650W NR RENSSELAER IN	VI	54	40.89472	-87.16889
748	405335087075801	SLOUGH CK 1640 FT US OF S480W NR RENSSELAER IN	VI	54	40.89306	-87.13278
752	413225087220001	CADY MARSH D 1740FT DS CLEVELANDST AT MERRILLVILLE	VI	54	41.54028	-87.36667
753	405751087102001	UNNAMED TRIB 9600 FT US OF SR114 NR RENSSELAER IN	VI	54	40.96417	-87.17222
754	413237086251301	POTATO CK 2080 FT US OF SR23 AT NORTH LIBERTY IN	VI	54	41.54361	-86.42028

[1]The full IDEM site number has a prefix of INRB04, for example INRB04-701.

[2] U.S. Environmental Protection Agency, 1998a.

[3] U.S. Environmental Protection Agency, 2003.

Appendix 10. Basin characteristics of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometers; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
701	KANAKEE R 1320 FT US SR39 NR HANNA IN	1,690	78.3	12.3	7.0	2.4
702	CADY MARSH D 720 FT DS OF BROAD ST AT GRIFFITH IN	15.2	10.3	18.7	3.2	67.8
703	LAWLER D 2900 FT DS OF N400W AT LAKE VILLAGE IN	32.4	88.4	7.9	3.7	0
705	WOLF CK 60 FT DS E1100N NR WHEATFIELD IN	37.5	66.3	26.1	7.3	.3
706	KANAKEE R 3.89 MI DS OF W1200S NR HANNA IN	1,370	77.4	12.2	7.6	2.8
707	COBB D 3220 FT US OF W600S NR KOUTS IN	74.8	75.4	16.2	6.3	2.1
708	IROQUOIS R 3430 FT US OF S100W NR BROOK IN	1,370	88.3	7.0	4.0	.7
709	UNNAMED TRIB 900 FT US OF USHWY231 NR HEBRON IN	12.5	83.7	5.8	5.4	5.1
710	YELLOW R 1700 FT US OF E 8TH ST NR BREMEN IN	384	89.5	6.5	2.4	1.6
711	SINGLETON D 350 FT DS OF USHWY41 NR SCHNEIDER IN	346	79.1	8.9	7.3	4.7
712	SUGAR CK 8120 FT DS OF N600W NR EARL PARK IN	96.3	98.1	.8	.5	.6
713	RYAN D 4840 FT US OF S250W NR RENSSELAER IN	117	94.6	2.7	2.6	.1
714	COLLINS D 3100 FT US OF SR2 NR LA PORTE IN	11.5	70.0	19.3	10.0	.7
715	STONY RUN 60 FT US OF IOWA ST NR CROWN POINT IN	11.0	80.5	11.3	7.2	1.0
716	WEISS D 510 FT DS OF SR 55 NR BROOK IN	13.9	99.4	.5	.1	0
717	KANAKEE R 3890 FT DS OF S650W AT ENGLISH LAKE IN	323	80.1	11.5	6.3	2.0
718	EAGLE CK 150 FT DS OF N700E NR KNOX IN	86.4	63.0	28.8	7.7	.5
719	KANAKEE R 1370 FT DS OF SR55 AT SHELBY IN	4,600	80.7	11.2	6.2	1.9
720	MINIER LATERAL 960 FT US S800W NR FREELAND PARK IN	4.0	99.8	.1	0	0

Appendix 10. Basin characteristics of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometers; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
723	WOLF CK 6320 FT DS OF W300S NR KOUTS IN	21.9	57.0	26.7	11.5	4.8
724	IROQUOIS R 2150 FT US E LK KENOYER RD AT BROOK IN	1,220	87.4	7.7	4.3	.6
725	KANAKEE R 4320 FT DS OF SR49 NR KOUTS IN	3,610	80.5	11.3	6.3	1.9
726	DOUSMAN D 7930 FT US OF N625W NR ETNA GREEN IN	1.2	91.0	4.6	4.4	0
727	CLARK D 1770 FT US OF S325W AT ADE IN	28.6	97.4	1.6	1.0	0
728	UNNAMED TRIB 4400 FT US OF W1800S NR KENTLAND IN	1.9	100.0	0	0	0
729	IROQUOIS R 5700 FT DS OF USHWY231 AT RENSSELAER IN	555	83.9	9.5	5.8	0.8
730	E BUNCH D 2480 FT DS OF NEW RD NR SOUTH BEND IN	3.4	83.5	13.3	3.1	.2
731	WEST CK 700 FT US OF OLCOTT AV AT ST JOHN IN	11.5	79.4	8.5	4.0	8.0
732	HOWE D 850 FT DS OF SR 16 NR RENSSELAER IN	35.7	88.9	8.9	2.2	0
733	KANAKEE R 2 MI DS S650W NR ENGLISH LAKE IN	3,260	80.1	11.6	6.3	2.0
734	YELLOW R 2650 FT US OF S UPAS RD NR CULVER IN	977	88.7	6.4	3.2	1.8
735	WEST CK 3750 US OF W223RD AV NR SCHNEIDER IN	140	76.2	12.8	6.6	4.5
736	POTATO CK 1830 FT US SMILAX RD AT NORTH LIBERTY IN	74.4	79.2	15.1	4.4	1.2
737	COBB D 3000 FT US OF SR8 NR KOUTS IN	81.3	77.3	14.9	5.8	1.9
738	MILL CK 770 FT US OF LONG LANE NR UNION MILLS IN	75.2	79.5	12.6	7.2	.8
739	W BR CROOKED CK 230 FT US E200N NR VALPARAISO IN	39.7	67.8	15.2	8.7	8.4
741	HODGE D 2230 FT US N300W NR WHEATFIELD IN	7.0	83.7	10.6	5.5	.2
742	YELLOW R 3360 FT DS OF N JARRAH RD NR PLYMOUTH IN	671	90.9	5.6	2.4	1.0

Appendix 10. Basin characteristics of the 45 algal-biomass sampling sites in the Kankakee River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometers; FT, feet; US, upstream; trib, tributary; CR, county road; R, River; SR, state route; DS, downstream; CK, Creek; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S,South; E, East; W, West; USHWY, U.S. Highway; IN, Indiana; OH, Ohio]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
743	BEAVER CK 70 FT DS OF W275S AT MOROCCO IN	127	86.2	10.6	2.8	.5
744	CARPENTER CK 475 FT DS OF W1600S AT REMINGTON IN	60.8	95.8	1.1	1.1	2.0
745	SLOUGH CK 80 FT DS OF S650W NR RENSSELAER IN	220	88.9	7.9	3.1	.1
748	SLOUGH CK 1640 FT US OF S480W NR RENSSELAER IN	202	89.1	7.7	3.1	.2
752	CADY MARSH D 1740FT DS CLEVELANDST AT MERRILLVILLE	2.8	7.6	14.0	2.4	76.0
753	UNNAMED TRIB 9600 FT US OF SR114 NR RENSSELAER IN	0.4	98.4	.7	.9	0
754	POTATO CK 2080 FT US OF SR23 AT NORTH LIBERTY IN	44.7	73.7	19.7	6.2	.4
	Minimum	0.4	7.6	0	0	0
	Mean	490	80.3	10.4	4.6	4.7
	Median	74.8	83.5	10.6	4.4	.8
	Maximum	4,600	100.0	28.8	11.5	76.0
	Standard deviation	1,000	18.5	6.9	2.7	14.8

[1] The full IDEM site number has a prefix of INRB04, for example INRB04-701.

[2] Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 11. Location and ecoregion designations of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
803	395422087202501	JIM BRANCH 900 FT DS OF N500W NR KINGMAN IN	IX	72	39.90611	-87.34028
804	391036087193501	W FK BUSSERON CK 4320 FT DS OF SR48 NR HYMERA IN	IX	72	39.17667	-87.32639
805	394017087302701	BROUILLETS CK 3760 FT US OF SR163 AT BLANFORD IN	VI	54	39.67139	-87.50750
807	401447086335301	LYE CK 1870 FT US OF 350W NR FRANKFORT IN	VI	55	40.24639	-86.56472
808	385709087190101	MARLA CK 500 FT US OF CR 500E NR CARLISLE IN	IX	72	38.95250	-87.31694
810	400204087175301	PRAIRIE CK 1000 FT US OF S170W NR YEDDO IN	VI	55	40.03444	-87.29806
811	403707087014901	BIG PINE CK 315 FT US USHWY 231 NR OTTERBEIN IN	VI	54	40.61861	-87.03028
812	380500087555301	HAWTHORNE CK 2170 FT DS OLD SAND RD AT NEW HARMONY	IX	72	38.08333	-87.93139
813	393532087103601	N FK SULPHER CK 320FT DS N ROCKRUNCHURCHRD DIAMOND	IX	72	39.59222	-87.17667
814	392415087260301	HONEY CK 1 MI DS OF RIGNEY DR NR TERRE HAUTE IN	IX	72	39.40417	-87.43417
815	400753086324501	SPRING CK 6000 FT DS NORTH RD AT GARDEN PARK IN	VI	55	40.13139	-86.54583
817	395117086531201	RACCOON CK 2900 FT US OF USHWY 231 AT RACCOON IN	VI	55	39.85472	-86.88667
819	395506087143101	W PRONG GREEN CK 1030 FT DS USHWY41 NR KINGMAN IN	VI	55	39.91833	-87.24194
820	375936087434901	S FK BIG CK 1500FT US WILDEMAN RD AT ST PHILLIP IN	IX	72	37.99333	-87.73028
821	394256087260001	UNNAMED TRIB 600 FT US OF E1150S NR CLINTON IN	VI	54	39.71556	-87.43333
822	400258086542101	SUGAR CK 500 FT US LAYFAYETTE AV AT CRAWFORDSVILLE	VI	55	40.04944	-86.90583
823	403034086504401	BURNETT CK 160 FT US NORTHEAST RD AT BATTLE GROUND	VI	55	40.50944	-86.84556
824	383357087361701	SWAN POND D 790FT DS S6THSTRD NR STFRANCISVILLE IL	IX	72	38.56583	-87.60472
825	393411087143101	N FK SULPHER CK 450 FT US N BALDWIN ST AT FONTANET	IX	72	39.56972	-87.24194

Appendix 11. Location and ecoregion designations of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
826	402248087290801	JORDAN CK 4125 FT DS OF N800W NR TAB IN	VI	54	40.38000	-87.48556
827	401533086201701	SCOTT WINCOOP D 230 FT DS 900E NR HILLISBURG IN	VI	55	40.25917	-86.33806
828	384046087322101	WABASH R 1400 FT DS OF USHWY50BUS AT VINCENNES IN	IX	72	38.67944	-87.53917
829	393931087174801	ROCK RUN 1900 FT DS OF S325W NR ROSEDALE IN	IX	72	39.65861	-87.29667
830	391444087185101	BUSSERON CK 600 FT US CR 1100N NR FARMERSBURG IN	IX	72	39.24556	-87.31417
832	381003087510301	UNNAMED TRIB 2900FT US NEWHARMONYRDSTEWARTSVILLE	IX	72	38.16750	-87.85083
833	400340086523301	LITTLE SUGAR CK 875 FT DS N175E AT CRAWFORDSVILLE	VI	55	40.06111	-86.87583
834	402122087190901	BIG PINE CK 2300 FT DS OF W300N NR CARBONDALE IN	VI	55	40.35611	-87.31917
835	394417087224101	WABASH R 3.85 MI DS OF USHWY36 NR MONTEZUMA IN	IX	72	39.73806	-87.37806
836	375434088010601	WABASH R 2.72 MI DS OF SR62 NR MT VERNON IN	IX	72	37.90944	-88.01833
837	393703087225001	WABASH R 10.2 MI US OF SR63 NR CLINTON IN	IX	72	39.61750	-87.38056
838	400850086474801	LYE CK 2000 FT US OF CR 700 NR DARLINGTON IN	VI	55	40.14722	-86.79667
839	402354086535901	UNNAMED TRIB 1550 FT DS USHWY 231 AT LAFAYETTE IN	VI	55	40.39833	-86.79667
841	394855087025501	S FK LITTLE RACCOON CK 200FT DS N1000E NR MILLIGAN	VI	55	39.81528	-87.04861
842	400252087255101	WABASH R 830 FT DS OF SR32 AT PERRYSVILLE IN	IX	72	40.04778	-87.43083
843	403351087084501	LITTLE PINE CK 3000 FT US OF CR 300S NR OXFORD IN	VI	54	40.56417	-87.14583
844	385114087320601	WABASH R 13.6 MI US OF USHWY50 NR RUSSELLVILLE IN	IX	72	38.85389	-87.53500
845	393948087045101	ROCKY FORK CK 125FT DS GREENCASTLE RD NR MANSFIELD	IX	72	39.66333	-87.08083
846	391647087363201	WABASH R 21.2 MI DS OF I-70 AT DARWIN IL	IX	72	39.27972	-87.60889

Appendix 11. Location and ecoregion designations of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
847	401042086245501	MUD CK 670 FT DS OF N 136TH ST NR KIRKLIN IN	VI	55	40.17833	-86.41528
848	380835087552901	WABASH R 6850 FT US OF SR14 AT NEW HARMONY IN	IX	72	38.14306	-87.92472
849	395618087020101	INDIAN CK 280 FT DS OF 700W NR BROWNS VALLEY IN	VI	55	39.93833	-87.03361
850	400946087080001	TURKEY RUN 1450 FT DS OF N700E AT MELLOTT IN	VI	55	40.16278	-87.13333
851	395838086534401	OFFIELD CK 2480 FT US USHWY 231 NR CRAWFORDSVILLE	VI	55	39.97722	-86.89556
852	400044087301201	COAL BRANCH 1125 FT DS OF W900N NR EUGENE IN	IX	72	40.01222	-87.50333

[1] The full IDEM site number has a prefix of INRB04, for example INRB04-801.

[2] U.S. Environmental Protection Agency, 1998a.

[3] U.S. Environmental Prote

Appendix 12. Basin characteristics of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana].

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
803	JIM BRANCH 900 FT DS OF N500W NR KINGMAN IN	5.8	72.2	24.3	3.4	0.2
804	W FK BUSSERON CK 4320 FT DS OF SR48 NR HYMERA IN	39.3	60.4	30.2	8.0	1.5
805	BROUILLETS CK 3760 FT US OF SR163 AT BLANFORD IN	692	92.9	4.7	1.8	.6
807	LYE CK 1870 FT US OF 350W NR FRANKFORT IN	19.6	99.8	.1	.1	0
808	MARLA CK 500 FT US OF CR 500E NR CARLISLE IN	6.0	64.5	35.3	.2	0
810	PRAIRIE CK 1000 FT US OF S170W NR YEDDO IN	34.8	92.1	5.6	2.3	0
811	BIG PINE CK 315 FT US USHWY 231 NR OTTERBEIN IN	5.2	99.6	.3	.1	0
812	HAWTHORNE CK 2170 FT DS OLD SAND RD AT NEW HARMONY	3.7	90.7	8.3	.7	.3
813	N FK SULPHER CK 320FT DS N ROCKRUNCHURCHRD DIAMOND	43.1	51.1	44.9	3.5	.4
814	HONEY CK 1 MI DS OF RIGNEY DR NR TERRE HAUTE IN	186	58.2	28.1	10.3	3.3
815	SPRING CK 6000 FT DS NORTH RD AT GARDEN PARK IN	30.7	97.9	1.0	.6	.6
817	RACCOON CK 2900 FT US OF USHWY 231 AT RACCOON IN	323	96.9	1.9	.4	.9
819	W PRONG GREEN CK 1030 FT DS USHWY41 NR KINGMAN IN	6.8	63.5	30.1	6.4	0
820	S FK BIG CK 1500FT US WILDEMAN RD AT ST PHILLIP IN	48.8	70.1	23.1	1.6	5.2
821	UNNAMED TRIB 600 FT US OF E1150S NR CLINTON IN	1.1	73.8	24.9	1.1	.2
822	SUGAR CK 500 FT US LAYFAYETTE AV AT CRAWFORDSVILLE	1,330	95.9	1.6	1.0	1.5
823	BURNETT CK 160 FT US NORTHEAST RD AT BATTLE GROUND	133	87.3	7.7	2.7	2.4
824	SWAN POND D 790FT DS S6THSTRD NR STFRANCISVILLE IL	58.0	83.7	3.1	2.7	10.4
825	N FK SULPHER CK 450 FT US N BALDWIN ST AT FONTANET	87.0	50.1	45.6	3.9	.4

Appendix 12. Basin characteristics of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana].

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
826	JORDAN CK 4125 FT DS OF N800W NR TAB IN	68.1	99.1	.5	.3	.0
827	SCOTT WINCOOP D 230 FT DS 900E NR HILLISBURG IN	11.7	99.1	.2	0	.7
828	WABASH R 1400 FT DS OF USHWY50BUS AT VINCENNES IN	35,700	84.9	9.7	3.5	1.9
829	ROCK RUN 1900 FT DS OF S325W NR ROSEDALE IN	40.6	54.3	38.2	5.8	1.7
830	BUSSERON CK 600 FT US CR 1100N NR FARMERSBURG IN	24.2	80.2	17.7	1.6	.4
832	UNNAMED TRIB 2900FT US NEWHARMONYRDSTEWARTSVILLE	11.0	89.2	10.4	.2	.2
833	LITTLE SUGAR CK 875 FT DS N175E AT CRAWFORDSVILLE	237	96.6	1.9	0.9	0.6
834	BIG PINE CK 2300 FT DS OF W300N NR CARBONDALE IN	782	93.2	4.6	1.7	.5
835	WABASH R 3.85 MI DS OF USHWY36 NR MONTEZUMA IN	30,300	87.2	8.2	2.8	1.8
836	WABASH R 2.72 MI DS OF SR62 NR MT VERNON IN	76,800	78.2	15.9	3.2	2.7
837	WABASH R 10.2 MI US OF SR63 NR CLINTON IN	30,500	87.1	8.2	2.9	1.8
838	LYE CK 2000 FT US OF CR 700 NR DARLINGTON IN	191	98.6	.5	.7	.2
839	UNNAMED TRIB 1550 FT DS USHWY 231 AT LAFAYETTE IN	11.2	20.2	7.0	3.4	69.3
841	S FK LITTLE RACCOON CK 200FT DS N1000E NR MILLIGAN	46.1	93.0	5.2	.8	1.0
842	WABASH R 830 FT DS OF SR32 AT PERRYSVILLE IN	21,500	88.1	7.2	2.9	1.9
843	LITTLE PINE CK 3000 FT US OF CR 300S NR OXFORD IN	39.3	99.0	.6	.4	0
844	WABASH R 13.6 MI US OF USHWY50 NR RUSSELLVILLE IN	35,200	84.9	9.7	3.5	1.9
845	ROCKY FORK CK 125FT DS GREENCASTLE RD NR MANSFIELD	54.9	54.9	44.5	.6	0
846	WABASH R 21.2 MI DS OF I-70 AT DARWIN IL	33,100	85.8	9.1	3.1	1.9

Appendix 12. Basin characteristics of the 44 algal-biomass sampling sites in the Lower Wabash River Basin, Indiana, June through October 2004.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana].

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
847	MUD CK 670 FT DS OF N 136TH ST NR KIRKLIN IN	67.7	98.0	1.1	.7	.1
848	WABASH R 6850 FT US OF SR14 AT NEW HARMONY IN	75,800	78.2	16.0	3.2	2.7
849	INDIAN CK 280 FT DS OF 700W NR BROWNS VALLEY IN	58.7	91.3	8.4	.3	0
850	TURKEY RUN 1450 FT DS OF N700E AT MELLOTT IN	29.5	96.7	1.9	1.0	.4
851	OFFIELD CK 2480 FT US USHWY 231 NR CRAWFORDSVILLE	20.1	95.2	4.6	.2	0
852	COAL BRANCH 1125 FT DS OF W900N NR EUGENE IN	37.7	86.7	9.8	3.1	.3
	Minimum	1.1	20.2	.1	0	0
	Mean	7,810	82.3	12.8	2.2	2.7
	Median	51.9	87.3	8.2	1.7	.6
	Maximum	76,800	99.8	45.6	10.3	69.3
	Standard deviation	18,600	17.7	13.5	2.2	10.4

[1] The full IDEM site number has a prefix of INRB04, for example INRB04-801.

[2] Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 13. Location and ecoregion designations of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
001	413440085131801	UNNAMED TRIB 1500FT US CR 425 S AT STROH IN	VII	56	41.57778	-85.22167
003	412715086020901	BERLIN COURT DITCH 2000FT DS CR 52 AT NAPPANEE IN	VII	56	41.45417	-86.03583
004	404711084573601	BLUHM DITCH 930 FT DS CR 300 N AT DECATUR IN	VI	55	40.78639	-84.96000
005	413739084493001	W BR FISH CK 1050 FT DS OF USHWY 20 AT METZ IN	VII	56	41.62750	-84.82500
007	411922085283701	CARROL CREEK 300 FT DS SR 33 AT WOLF LAKE IN	VII	56	41.32278	-85.47694
008	405643085050601	ST MARYS RIVER 3200FT DS HOAGLAND ROAD AT POE IN	VI	55	40.94528	-85.08500
009	411545084562601	ST JOSEPH RIVER 800 FT US CUBA RD NR GRABILL IN	VI	55	41.26250	-84.94056
011	412501085521701	TURKEY CREEK 2700 FT DS CR 1250 N NR MILFORD IN	VII	56	41.41694	-85.87139
014	413404087112601	WILLOW CREEK 3800 FT US MULBERRY AV AT PORTAGE IN	VI	54	41.56778	-87.19056
016	411059084521001	BLACK CK 20 FT DS SCHAEFFER ROAD NEAR HARLAN IN	VI	57	41.18306	-84.86944
018	413836085385001	LITTLE ELKHART R 200FT US CR 1150 W NR MIDDLEBURY	VII	56	41.64333	-85.64722
019	412614085203201	GRETZINGER D 1250FT US CR 600 N NR KENDALLVILLE IN	VII	56	41.43722	-85.34222
023	412805085355901	ELKHART RIVER 3900 FT DS SR 5 AT LIGONIER IN	VII	56	41.46806	-85.59972
024	405814084512701	FLATROCK CREEK 2100FT DS CR 101 AT MONROEVILLE IN	VI	56	40.97056	-84.85750
026	413856086032001	BAUGO CREEK 4100 FT US ASH ROAD AT OSCEOLA IN	VII	56	41.64889	-86.05556
027	412407085540401	OMAR-NEFF DITCH 2500FT DS CR 320 W NR HASTINGS IN	VII	56	41.40194	-85.90111
028	411529085075201	CEDAR CK 3000 FT US COLDWATER RD NR HUNTERTOWN IN	VI	55	41.25806	-85.13111
029	414137085182601	PIGEON RIVER 2400 FT US CR 600 EAST NEAR MONGO IN	VII	56	41.69361	-85.30722
030	412750087140001	DEEP RIVER 3600FT DS RANDOLPH ST AT DEEP RIVER IN	VI	54	41.46389	-87.23333

Appendix 13. Location and ecoregion designations of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
034	413501085463801	ROCK RUN CREEK 2600 FT US CR 34 NEAR GOSHEN IN	VII	56	41.58361	-85.77722
036	404111084595701	FUCH DITCH 4000 FT US CR 400 S NR BERNE IN	VI	55	40.68639	-84.99917
038	413440086081301	GRIMES DITCH 250FT DS ELM ROAD NEAR MISHAWAKA IN	VII	56	41.57778	-86.13694
039	413125085404001	STONY CREEK 1750 FT US CR 42 AT MILLERSBURG IN	VII	56	41.52361	-85.67778
041	412847084581701	UNNAMED TRIB 1 MI US SR 427 NR TAYLOR CORNER IN	VII	56	41.47972	-84.97139
042	414143085584801	CHRISTIANA CREEK 1300FT US N MAIN ST AT ELKHART IN	VII	56	41.69528	-85.98000
044	410613085094701	LOWTHER NEUHAUS D 400FT DS GOSHEN RD AT FORT WAYNE	VI	55	41.10361	-85.16306
045	414257085253901	PIGEON RIVER 1600 FEET DS SR 9 AT HOWE IN	VII	56	41.71583	-85.42750
047	414224086461401	E BR TRAIL CK 1830FT US CR400 W AT SPRINGFIELD IN	VII	56	41.70667	-86.77056
050	414439085450001	UNNAMED TRIB 1800 FT DS CR 4 AT VISTULA IN	VII	56	41.74417	-85.75000
051	412851085081501	UNNAMED TRIB 1700 FT DS CR 12 AT FAIRFIELD CENTER	VII	56	41.48083	-85.13750
052	414046086493201	UNNAMED TRIB 20FT US I-94 AT ORCHARD HIGHLANDS IN	VII	56	41.67944	-86.82556
053	414426085332901	PIGEON RIVER 400 FT DS N CR 675 WEST AT SCOTT IN	VII	56	41.74056	-85.55806
056	413939086080901	ELLER DITCH 600 FT US SR 933 AT MISHAWAKA IN	VII	56	41.66083	-86.13583
057	413040085585801	DAVIDHIZER DITCH 20 FT DS CR 7 NEAR SOUTHWEST IN	VII	56	41.51111	-85.98278
059	411439084582801	ST JOSEPH RIVER 830 FT DS VANZILA RD AT HURSH IN	VI	55	41.24417	-84.97444
060	414259085443301	LITTLE ELKHART R 1.2MI DS CR37 AT BONNEYVLLE MILLS	VII	56	41.71639	-85.74250
061	412718085502501	KIEFFER D 20FT US OLD STATE RD NR MILFORD JUNCTION	VII	56	41.45500	-85.84028
062	410442085051201	MAUMEE R 220 FT DS OF COLISEUM BLVD AT FT WAYNE IN	VI	55	41.07833	-85.08667

Appendix 13. Location and ecoregion designations of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
065	412537085392101	CROMWELL D 600FT DS CR1000 E NR ENCHANTED HLLS IN	VII	56	41.42694	-85.65583
066	405341085002701	ST MARYS RIVER 20FT DS CR 350 W NR MIDDLETOWN IN	VI	55	40.89472	-85.00750
068	414215085525201	ST JOSEPH RIVER 2300 FT US CR 17 AT ELKHART IN	VII	56	41.70417	-85.88111
069	411556085081301	LITTLE CEDAR CK 1520 FT DS SR 327 NR HUNTERTOWN IN	VI	55	41.26556	-85.13694

[1] The full IDEM site number has a prefix of INRB05, for example INRB05-001.

[2] U.S. Environmental Protection Agency, 1998a.

[3] U.S. Environmental Protection Agency, 2003.

Appendix 14. Basin characteristics of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2] Agriculture	Forest	Urban	Other
001	UNNAMED TRIB 1500FT US CR 425 S AT STROH IN	45.3	73.4	14.0	12.1	0.5
003	BERLIN COURT DITCH 2000FT DS CR 52 AT NAPPANEE IN	3.4	93.0	4.3	2.7	0
004	BLUHM DITCH 930 FT DS CR 300 N AT DECATUR IN	13.3	96.5	3.4	.1	0
005	W BR FISH CK 1050 FT DS OF USHWY 20 AT METZ IN	27.8	65.6	28.0	5.5	.9
007	CARROL CREEK 300 FT DS SR 33 AT WOLF LAKE IN	45.0	79.1	9.8	10.2	1.0
008	ST MARYS RIVER 3200FT DS HOAGLAND ROAD AT POE IN	1,790	91.9	6.1	.5	1.4
009	ST JOSEPH RIVER 800 FT US CUBA RD NR GRABILL IN	1,880	79.9	14.6	4.5	1.0
011	TURKEY CREEK 2700 FT DS CR 1250 N NR MILFORD IN	220	73.4	9.6	14.0	2.9
014	WILLOW CREEK 3800 FT US MULBERRY AV AT PORTAGE IN	14.2	62.8	9.9	2.0	25.2
016	BLACK CK 20 FT DS SCHAEFFER ROAD NEAR HARLAN IN	32.1	93.5	3.5	.4	2.6
018	LITTLE ELKHART R 200FT US CR 1150 W NR MIDDLEBURY	154	93.0	4.9	1.4	.7
019	GRETZINGER D 1250FT US CR 600 N NR KENDALLVILLE IN	15.8	85.6	7.6	6.3	.5
023	ELKHART RIVER 3900 FT DS SR 5 AT LIGONIER IN	752	77.4	10.3	10.2	2.0
024	FLATROCK CREEK 2100FT DS CR 101 AT MONROEVILLE IN	19.5	96.5	3.0	.1	.4
026	BAUGO CREEK 4100 FT US ASH ROAD AT OSCEOLA IN	198	91.6	5.3	1.7	1.4
027	OMAR-NEFF DITCH 2500FT DS CR 320 W NR HASTINGS IN	22.3	97.9	1.7	.4	0
028	CEDAR CK 3000 FT US COLDWATER RD NR HUNTERTOWN IN	407	85.8	8.4	3.1	2.7
029	PIGEON RIVER 2400 FT US CR 600 EAST NEAR MONGO IN	571	78.5	12.3	8.0	1.2
030	DEEP RIVER 3600FT DS RANDOLPH ST AT DEEP RIVER IN	157	65.8	14.7	9.4	10.2

Appendix 14. Basin characteristics of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
034	ROCK RUN CREEK 2600 FT US CR 34 NEAR GOSHEN IN	28.6	92.9	6.3	.6	.2
036	FUCH DITCH 4000 FT US CR 400 S NR BERNE IN	1.8	98.0	1.9	.1	0
038	GRIMES DITCH 250FT DS ELM ROAD NEAR MISHAWAKA IN	23.8	93.0	5.5	1.4	.2
039	STONY CREEK 1750 FT US CR 42 AT MILLERSBURG IN	40.9	91.3	5.5	3.1	.1
041	UNNAMED TRIB 1 MI US SR 427 NR TAYLOR CORNER IN	.8	92.6	7.2	.2	0
042	CHRISTIANA CREEK 1300FT US N MAIN ST AT ELKHART IN	304	61.9	21.8	14.4	1.9
044	LOWTHER NEUHAUS D 400FT DS GOSHEN RD AT FORT WAYNE	12.3	58.1	12.6	2.7	26.5
045	PIGEON RIVER 1600 FEET DS SR 9 AT HOWE IN	735	78.3	12.4	8.1	1.2
047	E BR TRAIL CK 1830FT US CR400 W AT SPRINGFIELD IN	13.3	30.9	50.5	15.6	3.0
050	UNNAMED TRIB 1800 FT DS CR 4 AT VISTULA IN	5.3	69.1	22.4	5.6	2.9
051	UNNAMED TRIB 1700 FT DS CR 12 AT FAIRFIELD CENTER	11.8	89.8	8.6	1.6	0
052	UNNAMED TRIB 20FT US I-94 AT ORCHARD HIGHLANDS IN	1.4	11.5	59.0	13.4	16.2
053	PIGEON RIVER 400 FT DS N CR 675 WEST AT SCOTT IN	871	79.3	11.8	7.8	1.1
056	ELLER DITCH 600 FT US SR 933 AT MISHAWAKA IN	19.2	84.7	8.0	1.8	5.4
057	DAVIDHIZER DITCH 20 FT DS CR 7 NEAR SOUTHWEST IN	3.5	97.9	1.7	.4	0
059	ST JOSEPH RIVER 830 FT DS VANZILA RD AT HURSH IN	1,900	80.0	14.6	4.5	.9
060	LITTLE ELKHART R 1.2MI DS CR37 AT BONNEYVLLE MILLS	312	90.4	6.2	2.2	1.3
061	KIEFFER D 20FT US OLD STATE RD NR MILFORD JUNCTION	12.2	89.7	7.8	2.3	.2
062	MAUMEE R 220 FT DS OF COLISEUM BLVD AT FT WAYNE IN	4,880	83.4	10.1	2.8	3.6

Appendix 14. Basin characteristics of the 42 algal-biomass sampling sites in the Great Lakes Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
065	CROMWELL D 600FT DS CR1000 E NR ENCHANTED HLLS IN	9.8	91.4	6.0	.6	2.0
066	ST MARYS RIVER 20FT DS CR 350 W NR MIDDLETOWN IN	1,660	91.8	6.2	.5	1.5
068	ST JOSEPH RIVER 2300 FT US CR 17 AT ELKHART IN	6,470	72.7	16.7	9.2	1.5
069	LITTLE CEDAR CK 1520 FT DS SR 327 NR HUNTERTOWN IN	187	86.1	8.4	3.9	1.7
	Minimum	.8	11.5	1.7	.1	0
	Mean	568	80.9	11.5	4.7	3.0
	Median	36.5	85.7	8.4	2.8	1.2
	Maximum	6,470	98.0	59.0	15.6	26.5
	Standard deviation	1,290	17.5	11.3	4.6	5.9

[1] The full IDEM site number has a prefix of INRB05, for example INRB05-001.

[2] Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 15. Location and ecoregion designations of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
102	381232087323201	HURRICANE CK 2300 FT DS OF CR1025 NR HAUBSTADT IN	IX	72	38.20889	-87.54222
103	382108086164601	BLUE R 230 FT DS OF SR 64 AT MILLTOWN IN	IX	71	38.35222	-86.27944
104	383339085454001	MILLER FK 1680FT US HEBRON CHURCH RD AT HENRYVILLE	VI	55	38.56083	-85.76111
106	382806085470801	UNNAMED TRIB 200FT US EBENEZERCHURCH RD NR MEMPHIS	VI	55	38.46833	-85.78556
109	375731086420401	UNNAMED TRIB 950 FT DS OF ASTER RD NR TELL CITY IN	IX	71	37.95861	-86.70111
110	382151085561201	INDIAN CK 875 FT DS OF NAVILLETON RD AT GALENA IN	IX	71	38.36417	-85.93667
111	380537086290701	LITTLE OIL CK 975 FT DS OF PARKS RD NR MAGNET IN	IX	71	38.09361	-86.48528
112	390432085070401	SOUTH HOGAN CK 6100 FT DS OF SR 101 NR MILAN IN	IX	71	39.07556	-85.11778
113	380309085594301	MOSQUITO CK 1.2MI DS BUENA VISTA RD NR BUENA VISTA	IX	71	38.05250	-85.99528
115	380814087241101	PIGEON CK 2550 FT DS OF N 750 RD NR ELBERFELD IN	IX	72	38.13722	-87.40306
116	391155084542401	BRUSHY FK 1230FT US SAWDON RIDGE RD NR GUILFORD IN	IX	71	39.19861	-84.90667
119	381121086184001	BLUE R 0.6MI DS OLD FOREST RD SW NR LEAVENWORTH IN	IX	71	38.18917	-86.31111
121	381345086072001	INDIAN CK 8730 FT US OF SR337 AT CORYDON IN	IX	71	38.22917	-86.12222
122	384615085243501	DEANS BR 1050 FT US OF SR 1 AT NORTH MADISON IN	VI	55	38.77083	-85.40972
124	390511085032701	ALLEN BR 4450FT US OF IRELAND RD NR MOORES HILL IN	VI	55	39.08639	-85.05750
125	380620087041401	LITTLE PIGEON CK 0.2MI US PIGEON SWITCH GENTRYVLLE	IX	72	38.10556	-87.07056
126	383221085352801	FOURTEENMILE CK 3140FT US ROGERS RUN NR NEW MARKET	VI	55	38.53917	-85.59111
127	380926086344501	OIL CK 5580 DS OF BRANCHVILLE RD AT BRANCHVILLE IN	IX	71	38.15722	-86.57917
128	385822085024401	HAYES BR 1620 FT DS W LAUGHERY CK RD NR MILTON IN	IX	71	38.97278	-85.04556

Appendix 15. Location and ecoregion designations of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
132	391015084523101	SALT FK 7380 FT US OF SR 1 NR LAWRENCEBURG IN	IX	71	39.17083	-84.87528
133	380115086542901	UNNAMED TRIB 730 FT US OF SR 245 NR NEWTONVILLE IN	IX	72	38.02083	-86.90806
136	390707084521701	TANNERS CK 6300 FT US SCHENLEY PL AT GREENDALE IN	IX	71	39.11861	-84.87139
137	381429086472501	CYCLONE BR 2 MI US OF SCHLACHTER RD FERDINAND IN	IX	71	38.24139	-86.79028
141	380313087075701	LITTLE PIGEON CK 4550FT US E525 RD NR TENNYSON IN	IX	72	38.05361	-87.13250
142	382349085433601	SILVER CK 5850FT DS GREENLEAF DR AT SELLERSBURG IN	VI	55	38.39694	-85.72667
145	382309086145001	BLUE R 2 MI US OF E TOTTEN FORD RD NR MILLTOWN IN	IX	71	38.38583	-86.24722
148	390550085144001	LAUGHERY CK 4.3 MI US E PERRY ST NR VERSAILLES IN	VI	55	39.09722	-85.24444
150	382620086032101	BEAR CK 730FT US E MARTINSBURG FIRE RD MARTINSBURG	IX	71	38.43889	-86.05583
153	381333086164201	BLUE R 3.64 MI DS OF SR 462 NR LEAVENWORTH IN	IX	71	38.22583	-86.27833
156	382852085421201	SUGAR RUN 760 FT DS OF SR 160 NR CHARLESTOWN IN	VI	55	38.48111	-85.70333
157	381947086283401	LITTLE BLUE R 4200FT DS OF SPEARS ST AT ENGLISH IN	IX	71	38.32972	-86.47611
158	385130085152601	INDIAN KENTUCK CK 8070 FT DS OF SR 62 NR CANAAN IN	IX	71	38.85833	-85.25722
159	380443086464901	ANDERSON R 1500FT US N AVERY RIDGE RD NR HUFFMAN	IX	71	38.07861	-86.78028
162	385955084565501	LAUGHERY CK 4900 FT DS OF COLE LANE AT HARTFORD IN	IX	71	38.99861	-84.94861
164	383640085324401	UNNAMED TRIB 2100FT US SR 362 NR NEW WASHINGTON IN	VI	55	38.61111	-85.54556
167	381044086374601	WINDING BR 3630 FT US OF CR46 NR APALONA IN	IX	71	38.17889	-86.62944
172	384635085044401	INDIAN CK 9200 FT US OF KNOX FORD RD NR VEVAY IN	IX	71	38.77639	-85.07889
179	382341086150801	BLUE R 4.1MI US OF E TOTTEN FORD RD NR MILLTOWN IN	IX	71	38.39472	-86.25222

Appendix 15. Location and ecoregion designations of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; USEPA, U.S. Environmental Protection Agency; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station ID	USGS station name	USEPA Aggregate Nutrient Ecoregion[2]	Level III Ecoregion[3]	Latitude (decimal degrees)	Longitude (decimal degrees)
184	381302087204401	UNNAMED TRIB 250 FT US OF CR 950S NR LYNNVILLE IN	IX	72	38.21722	-87.34556
185	381705086163001	BLUE R 1.35 MI US OF CR 30 NR MILLTOWN IN	IX	71	38.28472	-86.27500
191	375931086440301	BRUSHY FK 4780 FT US OF CR 11 NR TELL CITY IN	IX	71	37.99194	-86.73417
193	381745086311701	OTTER CK 660FT US OF W OLD FELKER RD NR MIFFLIN IN	IX	71	38.29583	-86.52139
195	380749086040201	BUCK CK 275FT US BUCK CK VALLEY RD NEW MIDDLETOWN	IX	71	38.13028	-86.06722

[1] The full IDEM site number has a prefix of INRB05, for example INRB05-101.

[2] U.S. Environmental Protection Agency, 1998a.

[3] U.S. Environmental Protection Agency, 2003.

Appendix 16. Basin characteristics of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
102	HURRICANE CK 2300 FT DS OF CR1025 NR HAUBSTADT IN	35.5	93.3	5.0	0.6	1.2
103	BLUE R 230 FT DS OF SR 64 AT MILLTOWN IN	916	68.3	30.5	.3	.9
104	MILLER FK 1680FT US HEBRON CHURCH RD AT HENRYVILLE	10.1	25.2	71.9	.9	2.1
106	UNNAMED TRIB 200FT US EBENEZERCHURCH RD NR MEMPHIS	2.9	66.8	32.5	.2	.5
109	UNNAMED TRIB 950 FT DS OF ASTER RD NR TELL CITY IN	4.3	28.8	70.8	.1	.3
110	INDIAN CK 875 FT DS OF NAVILLETON RD AT GALENA IN	42.2	63.0	35.2	.2	1.7
111	LITTLE OIL CK 975 FT DS OF PARKS RD NR MAGNET IN	23.1	18.2	81.8	0	0
112	SOUTH HOGAN CK 6100 FT DS OF SR 101 NR MILAN IN	53.1	69.7	26.7	.5	3.1
113	MOSQUITO CK 1.2MI DS BUENA VISTA RD NR BUENA VISTA	12.5	16.7	83.3	0	0
115	PIGEON CK 2550 FT DS OF N 750 RD NR ELBERFELD IN	516	80.8	12.9	4.9	1.3
116	BRUSHY FK 1230FT US SAWDON RIDGE RD NR GUILFORD IN	13.3	71.8	27.5	.1	.6
119	BLUE R 0.6MI DS OLD FOREST RD SW NR LEAVENWORTH IN	1,290	62.3	36.5	.3	.8
121	INDIAN CK 8730 FT US OF SR337 AT CORYDON IN	394	64.6	31.9	.3	3.2
122	DEANS BR 1050 FT US OF SR 1 AT NORTH MADISON IN	1.1	11.3	6.6	.1	82.0
124	ALLEN BR 4450FT US OF IRELAND RD NR MOORES HILL IN	2.3	66.2	33.7	0	0
125	LITTLE PIGEON CK 0.2MI US PIGEON SWITCH GENTRYVLLE	268	71.2	26.4	1.7	.8
126	FOURTEENMILE CK 3140FT US ROGERS RUN NR NEW MARKET	135	77.4	21.3	.8	.5
127	OIL CK 5580 DS OF BRANCHVILLE RD AT BRANCHVILLE IN	46.3	30.3	69.5	.0	.2
128	HAYES BR 1620 FT DS W LAUGHERY CK RD NR MILTON IN	51.9	47.5	50.5	.6	1.4

Appendix 16. Basin characteristics of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
132	SALT FK 7380 FT US OF SR 1 NR LAWRENCEBURG IN	28.1	49.1	41.8	.3	8.8
133	UNNAMED TRIB 730 FT US OF SR 245 NR NEWTONVILLE IN	2.1	80.1	17.0	2.9	0
136	TANNERS CK 6300 FT US SCHENLEY PL AT GREENDALE IN	268	60.1	37.5	.4	2.0
137	CYCLONE BR 2 MI US OF SCHLACHTER RD FERDINAND IN	2.3	39.8	60.2	0	0
141	LITTLE PIGEON CK 4550FT US E525 RD NR TENNYSON IN	489	67.5	29.5	2.4	.6
142	SILVER CK 5850FT DS GREENLEAF DR AT SELLERSBURG IN	439	45.9	50.0	1.9	2.3
145	BLUE R 2 MI US OF E TOTTEN FORD RD NR MILLTOWN IN	872	69.1	29.7	.3	.9
148	LAUGHERY CK 4.3 MI US E PERRY ST NR VERSAILLES IN	394	71.3	26.0	.8	2.0
150	BEAR CK 730FT US E MARTINSBURG FIRE RD MARTINSBURG	20.4	67.0	32.7	0	.4
153	BLUE R 3.64 MI DS OF SR 462 NR LEAVENWORTH IN	1,270	63.2	35.7	.3	.8
156	SUGAR RUN 760 FT DS OF SR 160 NR CHARLESTOWN IN	17.5	45.2	51.7	1.8	1.3
157	LITTLE BLUE R 4200FT DS OF SPEARS ST AT ENGLISH IN	70.2	36.0	62.2	1.1	.6
158	INDIAN KENTUCK CK 8070 FT DS OF SR 62 NR CANAAN IN	123	51.4	48.1	.3	.1
159	ANDERSON R 1500FT US N AVERY RIDGE RD NR HUFFMAN	322	45.1	54.4	.3	.3
162	LAUGHERY CK 4900 FT DS OF COLE LANE AT HARTFORD IN	856	60.3	37.6	.8	1.3
164	UNNAMED TRIB 2100FT US SR 362 NR NEW WASHINGTON IN	1.4	77.8	21.6	.6	0
167	WINDING BR 3630 FT US OF CR46 NR APALONA IN	9.3	13.4	79.0	6.6	1.0
172	INDIAN CK 9200 FT US OF KNOX FORD RD NR VEVAY IN	113	48.9	50.5	.4	.2
179	BLUE R 4.1MI US OF E TOTTEN FORD RD NR MILLTOWN IN	869	69.2	29.5	.3	.9

Appendix 16. Basin characteristics of the 43 algal-biomass sampling sites in the Ohio River Tributaries, Indiana, May through October 2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; ID, identification number; km^2, square kilometer; FT, feet; US, upstream; INDPLS, Indianapolis; CR, County Road; SR, State Route; DS, downstream; CK, Creek.; FK, Fork; DCH, Ditch; NR, near; AV, Avenue; ST, Street; N, North; S, South; E, East; W, West; IN, Indiana]

Short IDEM site number[1]	USGS station name	Drainage area (km^2)	Land use (percent)[2]			
			Agriculture	Forest	Urban	Other
184	UNNAMED TRIB 250 FT US OF CR 950S NR LYNNVILLE IN	.5	96.8	3.0	.2	.0
185	BLUE R 1.35 MI US OF CR 30 NR MILLTOWN IN	1,110	63.8	35.0	.3	.9
191	BRUSHY FK 4780 FT US OF CR 11 NR TELL CITY IN	2.8	51.7	48.3	0	.0
193	OTTER CK 660FT US OF W OLD FELKER RD NR MIFFLIN IN	27.0	26.5	73.4	0	.0
195	BUCK CK 275FT US BUCK CK VALLEY RD NEW MIDDLETOWN	96.8	64.1	35.2	.6	.1
	Minimum	.5	11.3	3.0	0	.0
	Mean	274	55.8	40.6	.8	2.8
	Median	53.1	63.0	35.2	.3	.6
	Maximum	1,290	96.8	83.3	6.6	82.0
	Standard deviation	378	20.8	20.4	1.3	12.2

[1] The full IDEM site number has a prefix of INRB05, for example INRB05-102.

[2] Land-use percentages were determined by the U.S. Geological Survey using the National Land Cover Dataset (U.S. Geological Survey, 2000).

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
West Fork White	301	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	301	2	7/18/01	2	Summer	Epipsammic	205.29	83.3	22.47	4.209	1.6	0.005	1.605	0.38
West Fork White	301	2	9/12/01	3	Fall	Epipsammic	1.00	191.9	7.45	2.198	1	0.012	1.012	0.36
West Fork White	302	3	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	302	3	7/25/01	2	Summer	Epilithic	16.88	12.6	6.40	4.965	1.2	0.43	1.63	0.18
West Fork White	302	3	9/19/01	3	Fall	Epilithic	1.26	13.5	2.68	2.452	0.87	0.57	1.44	0.32
West Fork White	303	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	303	1	7/11/01	2	Summer	Epilithic	72.70	34.8	2.14	1.994	0.51	3.1	3.61	0.064
West Fork White	303	1	9/5/01	3	Fall	Epilithic	10.97	15.5	0.58	0.667	0.67	1.7	2.37	0.04
West Fork White	304	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	304	1	7/11/01	2	Summer	Epilithic	374.80	41.3	1.36	0.692	0.51	4.9	5.41	0.077
West Fork White	304	1	9/4/01	3	Fall	Epilithic	40.08	17.2	1.12	0.607	0.62	0.31	0.93	0.081
West Fork White	305	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	305	1	7/17/01	2	Summer	Epipsammic	379.38	178.5	1.13	0.555	0.27	0.022	0.292	0.015
West Fork White	305	1	9/11/01	3	Fall	Epipsammic	14.99	192.9	1.00	0.235	0.29	0.013	0.303	0.042
West Fork White	306	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	306	2	7/11/01	2	Summer	Epilithic	91.56	24.4	4.48	1.217	0.64	2.1	2.74	0.12
West Fork White	306	2	9/5/01	3	Fall	Epilithic	12.90	15.2	4.79	1.018	0.56	0.25	0.81	0.084
West Fork White	311	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	311	1	7/25/01	2	Summer	Epilithic	42.51	31.2	2.99	0.578	0.6	6.7	7.3	0.039
West Fork White	311	1	9/19/01	3	Fall	Epilithic	69.85	24.7	2.61	0.969	0.95	4.6	5.55	0.18
West Fork White	313	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	313	2	7/18/01	2	Summer	Epilithic	88.28	10.7	2.70	0.826	2.1	7.7	9.8	2.7
West Fork White	313	2	9/11/01	3	Fall	Epipsammic	14.09	47.0	2.75	0.371	0.99	1	1.99	0.84
West Fork White	314	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	314	2	7/11/01	2	Summer	Epilithic	2.71	7.3	8.31	1.186	0.81	0.8	1.61	0.1
West Fork White	314	2	9/4/01	3	Fall	Epilithic	180.19	64.5	3.13	0.618	0.39	0.055	0.445	0.068
West Fork White	316	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	316	1	7/16/01	2	Summer	Epilithic	167.36	45.2	9.23	2.237	1.1	0.73	1.83	0.12
West Fork White	316	1	9/17/01	3	Fall	Epipsammic	11.75	52.5	0.70	1.101	1	0.093	1.093	0.22

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
West Fork White	318	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	318	2	7/9/01	2	Summer	Epilithic	17.33	16.7	9.91	2.232	1.2	0.36	1.56	0.21
West Fork White	318	2	9/4/01	3	Fall	Epilithic	3.90	15.1	3.74	0.672	0.4	0.17	0.57	0.039
West Fork White	319	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	319	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	319	1	9/19/01	3	Fall	Epipsammic	34.12	209.3	1.86	2.404	1.1	2.4	3.5	0.17
West Fork White	320	4	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	320	4	7/23/01	2	Summer	Epilithic	12.70	15.8	11.95	2.435	0.89	1.6	2.49	0.094
West Fork White	320	4	9/17/01	3	Fall	Epilithic	1.97	13.7	2.56	1.345	0.38	1.8	2.18	0.11
West Fork White	321	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	321	1	7/18/01	2	Summer	Epilithic	14.19	19.9	5.87	4.424	0.72	1.2	1.92	0.11
West Fork White	321	1	9/11/01	3	Fall	Epilithic	4.48	9.9	0.22	0.712	0.36	0.85	1.21	0.11
West Fork White	322	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	322	2	7/10/01	2	Summer	Epilithic	88.03	38.1	7.58	1.951	1	2.4	3.4	0.16
West Fork White	322	2	9/5/01	3	Fall	Epilithic	16.44	18.7	2.05	0.683	0.59	1.1	1.69	0.15
West Fork White	323	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	323	1	7/24/01	2	Summer	Epilithic	10.54	25.9	1.16	0.329	0.92	0.63	1.55	0.14
West Fork White	323	1	9/18/01	3	Fall	Epilithic	6.05	26.2	0.24	0.582	0.49	* *	* *	0.1
West Fork White	324	3	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	324	3	7/16/01	2	Summer	Epilithic	75.55	50.0	2.70	0.456	0.62	2.4	3.02	0.056
West Fork White	324	3	9/13/01	3	Fall	Epilithic	10.82	18.6	0.46	0.585	0.05	1.6	1.65	0.14
West Fork White	327	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	327	2	7/24/01	2	Summer	Epilithic	56.04	29.6	1.54	1.612	0.62	2.2	2.82	0.057
West Fork White	327	2	9/18/01	3	Fall	Epilithic	14.80	26.5	0.84	0.365	0.32	2	2.32	0.063
West Fork White	330	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	330	2	7/10/01	2	Summer	Epilithic	36.53	19.6	7.29	1.057	0.65	1.2	1.85	0.087
West Fork White	330	2	9/5/01	3	Fall	Epilithic	2.44	14.2	1.93	0.502	0.42	0.12	0.54	0.049
West Fork White	331	4	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	331	4	7/25/01	2	Summer	Epilithic	58.75	31.0	8.13	3.306	1.8	4.7	6.5	0.037
West Fork White	331	4	9/19/01	3	Fall	Epilithic	8.34	20.9	4.05	2.136	1.3	2.4	3.7	0.071

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
West Fork White	332	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	332	1	7/19/01	2	Summer	Epilithic	34.92	17.8	4.99	1.238	4.4	1.2	5.6	0.22
West Fork White	332	1	9/13/01	3	Fall	Epilithic	2.07	12.0	4.36	1.488	0.7	3.9	4.6	0.19
West Fork White	335	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	335	2	7/24/01	2	Summer	Epilithic	14.05	14.6	1.20	1.086	0.54	0.4	0.94	0.055
West Fork White	335	2	9/18/01	3	Fall	Epilithic	4.32	18.8	0.86	0.389	0.25	0.3	0.55	0.053
West Fork White	336	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	336	2	7/17/01	2	Summer	Epilithic	67.25	46.0	2.60	0.592	0.26	0.37	0.63	0.041
West Fork White	336	2	9/12/01	3	Fall	Epilithic	7.08	11.1	1.98	0.836	0.3	0.45	0.75	0.055
West Fork White	337	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	337	1	7/17/01	2	Summer	* *	* *	* *	2.40	4.613	0.25	0.012	0.262	0.015
West Fork White	337	1	9/12/01	3	Fall	Epipsammic	2.00	117.7	0.38	0.895	0.37	0.014	0.384	0.015
West Fork White	338	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	338	2	7/10/01	2	Summer	Epilithic	67.13	28.0	11.96	1.358	1.2	2	3.2	0.27
West Fork White	338	2	9/6/01	3	Fall	Epilithic	4.64	18.2	0.59	0.975	0.49	1.4	1.89	0.3
West Fork White	339	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	339	1	7/25/01	2	Summer	* *	* *	* *	1.07	2.303	0.97	8.7	9.67	0.13
West Fork White	339	1	9/19/01	3	Fall	Epipsammic	37.69	244.9	0.60	1.287	0.74	8.1	8.84	0.18
West Fork White	340	3	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	340	3	7/19/01	2	Summer	Epilithic	36.18	28.8	4.57	1.085	0.58	1.1	1.68	0.11
West Fork White	340	3	9/13/01	3	Fall	Epidendric	1.95	45.8	0.90	0.891	0.62	2.7	3.32	0.14
West Fork White	341	3	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	341	3	7/18/01	2	Summer	* *	* *	* *	23.83	3.562	1.4	1.1	2.5	0.4
West Fork White	341	3	9/12/01	3	Fall	Epipsammic	9.86	35.9	7.74	1.901	0.83	1.5	2.33	0.3
West Fork White	342	4	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	342	4	7/23/01	2	Summer	Epilithic	30.97	28.3	3.28	1.666	1.2	5.2	6.4	0.15
West Fork White	342	4	9/19/01	3	Fall	Epilithic	37.25	17.8	6.19	1.742	1	1.7	2.7	0.28
West Fork White	343	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	343	2	7/9/01	2	Summer	Epilithic	37.70	11.4	11.67	2.842	1.6	0.89	2.49	0.32
West Fork White	343	2	9/4/01	3	Fall	Epilithic	13.28	58.7	7.01	0.699	0.54	0.13	0.67	0.04

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
West Fork White	344	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	344	2	7/17/01	2	Summer	Epilithic	20.02	23.3	3.24	1.066	0.95	0.56	1.51	0.13
West Fork White	344	2	9/11/01	3	Fall	Epilithic	1.22	28.8	3.48	1.404	0.98	0.91	1.89	0.25
West Fork White	346	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	346	1	7/10/01	2	Summer	Epilithic	71.70	26.1	1.90	1.191	0.55	3.8	4.35	0.074
West Fork White	346	1	9/5/01	3	Fall	Epidendric	4.62	15.7	1.25	0.532	0.62	0.44	1.06	0.12
West Fork White	347	2	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	347	2	7/24/01	2	Summer	Epilithic	176.44	43.4	56.10	6.007	1.3	1	2.3	0.21
West Fork White	347	2	9/18/01	3	Fall	Epilithic	21.09	36.8	1.28	1.319	0.4	0.24	0.64	0.12
West Fork White	348	1	- -	1	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
West Fork White	348	1	7/23/01	2	Summer	Epilithic	23.40	23.4	4.68	3.412	4.4	0.63	5.03	0.14
West Fork White	348	1	9/17/01	3	Fall	Epilithic	5.23	18.9	2.96	0.672	0.22	0.39	0.61	0.032
Whitewater	401	2	5/21/02	1	Spring	Epilithic	62.97	14.9	0.98	0.46	0.12	3.8	3.92	0.093
Whitewater	401	2	7/1/02	2	Summer	Epilithic	40.49	10.6	2.78	1.134	0.37	2.3	2.67	0.038
Whitewater	401	2	9/3/02	3	Fall	Epilithic	47.87	21.1	0.09	0.496	* *	2.1	* *	0.015
Whitewater	402	2	6/12/02	1	Summer	Epilithic	37.87	17.4	1.31	0.415	0.23	9	9.23	0.053
Whitewater	402	2	7/15/02	2	Summer	Epilithic	28.38	14.0	1.19	0.978	0.74	4.6	5.34	0.1
Whitewater	402	2	9/11/02	3	Fall	Epilithic	35.05	8.3	0.74	0.378	0.24	7.7	7.94	0.081
Whitewater	403	4	6/20/02	1	Summer	Epilithic	53.66	13.5	2.14	0.714	0.55	4.1	4.65	0.098
Whitewater	403	4	7/24/02	2	Summer	Epilithic	61.96	13.9	3.91	1.911	0.6	1.7	2.3	0.1
Whitewater	403	4	9/11/02	3	Fall	Epilithic	355.14	28.2	5.54	0.798	0.86	3.2	4.06	0.14
Whitewater	404	2	6/10/02	1	Summer	Epilithic	36.11	7.5	1.52	0.724	0.59	4.8	5.39	0.077
Whitewater	404	2	7/10/02	2	Summer	Epilithic	43.81	15.2	11.36	0.925	0.77	0.13	0.9	0.049
Whitewater	404	2	9/17/02	3	Fall	Epilithic	12.30	7.1	24.36	2.01	1.3	0.013	1.313	0.12
Whitewater	407	1	6/4/02	1	Summer	Epilithic	47.98	8.7	2.68	0.773	0.25	1.5	1.75	0.015
Whitewater	407	1	7/9/02	2	Summer	Epilithic	15.72	10.6	1.14	0.513	0.28	1.6	1.88	0.015
Whitewater	407	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	408	2	5/22/02	1	Spring	Epilithic	416.87	48.6	1.11	0.451	0.28	3.6	3.88	0.051
Whitewater	408	2	7/2/02	2	Summer	Epilithic	54.27	7.4	2.88	0.4	0.43	3.3	3.73	0.06
Whitewater	408	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Whitewater	409	2	5/28/02	1	Spring	Epilithic	9.60	14.5	4.22	0.422	0.72	4.3	5.02	0.032
Whitewater	409	2	7/1/02	2	Summer	Epilithic	7.92	6.0	4.85	0.997	0.84	2.6	3.44	0.043
Whitewater	409	2	9/3/02	3	Fall	Epilithic	262.60	29.6	0.86	0.733	0.57	1.5	2.07	0.015
Whitewater	410	3	6/11/02	1	Summer	Epilithic	126.15	14.7	2.47	1.147	0.51	5.9	6.41	0.043
Whitewater	410	3	7/16/02	2	Summer	Epilithic	99.84	28.6	7.43	0.625	0.47	0.046	0.516	0.078
Whitewater	410	3	9/17/02	3	Fall	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	411	1	6/4/02	1	Summer	Epilithic	50.46	13.5	2.29	0.247	0.3	3.6	3.9	0.015
Whitewater	411	1	7/9/02	2	Summer	Epilithic	63.26	15.1	4.41	0.358	0.33	3	3.33	0.015
Whitewater	411	1	9/16/02	3	Fall	Epilithic	313.99	18.3	6.37	0.471	0.3	1.2	1.5	0.015
Whitewater	412	2	6/5/02	1	Summer	Epilithic	81.24	9.3	4.34	0.339	0.35	1.1	1.45	0.015
Whitewater	412	2	8/8/02	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	412	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	413	3	5/21/02	1	Spring	Epilithic	51.76	12.7	0.91	0.742	0.34	6.1	6.44	0.044
Whitewater	413	3	7/1/02	2	Summer	Epilithic	84.20	19.2	3.74	1.25	0.49	3.8	4.29	0.04
Whitewater	413	3	9/3/02	3	Fall	Epilithic	183.49	17.2	1.23	1.767	0.53	2.8	3.33	0.03
Whitewater	415	1	6/11/02	1	Summer	Epilithic	42.63	8.3	3.06	0.414	0.58	5.7	6.28	0.037
Whitewater	415	1	7/16/02	2	Summer	Epilithic	63.32	18.2	2.22	1.508	0.69	3.9	4.59	0.036
Whitewater	415	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	416	2	5/29/02	1	Spring	Epilithic	182.02	21.7	4.55	2.277	0.44	4.2	4.64	0.097
Whitewater	416	2	7/2/02	2	Summer	Epilithic	35.05	8.6	2.01	0.72	0.57	2.6	3.17	0.053
Whitewater	416	2	9/4/02	3	Fall	Epilithic	49.84	12.0	1.37	0.532	* *	0.82	* *	0.015
Whitewater	417	2	5/29/02	1	Spring	Epilithic	151.16	21.8	4.21	0.706	0.49	3.4	3.89	0.062
Whitewater	417	2	7/8/02	2	Summer	Epilithic	113.82	29.7	1.96	0.646	0.31	1.4	1.71	0.033
Whitewater	417	2	9/12/02	3	Fall	Epilithic	210.37	21.4	0.73	0.138	0.26	1.1	1.36	0.033
Whitewater	419	4	6/19/02	1	Summer	Epilithic	102.93	26.4	5.56	1.088	0.44	3.3	3.74	0.062
Whitewater	419	4	7/23/02	2	Summer	Epilithic	32.92	9.7	4.00	0.588	0.48	2.8	3.28	0.062
Whitewater	419	4	9/25/02	3	Fall	Epilithic	365.53	22.1	2.45	0.336	0.26	2.9	3.16	0.044
Whitewater	420	4	6/19/02	1	Summer	Epidendric	81.39	71.8	2.85	0.596	0.44	4.8	5.24	0.05
Whitewater	420	4	7/23/02	2	Summer	Epidendric	31.05	75.8	2.86	0.594	0.47	2.5	2.97	0.033
Whitewater	420	4	9/24/02	3	Fall	Epilithic	74.88	13.8	1.90	0.461	0.39	2.2	2.59	0.015

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Whitewater	421	1	5/28/02	1	Spring	Epilithic	287.93	40.9	2.38	* *	0.59	1.6	2.19	0.064
Whitewater	421	1	7/1/02	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	421	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	422	4	6/19/02	1	Summer	Epidendric	97.57	93.1	2.39	1.142	0.18	4.4	4.58	0.057
Whitewater	422	4	7/23/02	2	Summer	Epidendric	85.85	131.7	3.53	0.746	0.55	2.4	2.95	0.033
Whitewater	422	4	9/24/02	3	Fall	Epidendric	89.33	69.9	0.91	0.868	0.41	2.1	2.51	0.032
Whitewater	423	3	6/11/02	1	Summer	Epilithic	133.67	21.8	0.85	0.374	0.05	13	13.05	0.048
Whitewater	423	3	7/15/02	2	Summer	Epilithic	61.73	18.3	3.54	1.122	0.7	2.7	3.4	0.075
Whitewater	423	3	9/11/02	3	Fall	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	425	1	5/29/02	1	Spring	Epilithic	4.15	3.6	7.55	0.799	0.59	4.4	4.99	0.1
Whitewater	425	1	7/8/02	2	Summer	Epilithic	1.62	4.7	5.80	1.224	0.6	0.6	1.2	0.15
Whitewater	425	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	427	4	6/18/02	1	Summer	Epidendric	86.59	282.9	3.35	1.188	0.41	6.2	6.61	0.045
Whitewater	427	4	7/22/02	2	Summer	Epidendric	51.39	95.1	1.62	0.893	0.61	2.4	3.01	0.052
Whitewater	427	4	9/23/02	3	Fall	Epidendric	331.83	55.2	1.80	0.293	0.39	2.5	2.89	0.015
Whitewater	428	1	5/29/02	1	Spring	Epilithic	70.91	12.6	5.09	1.583	0.52	2.9	3.42	0.13
Whitewater	428	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	428	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	429	3	6/4/02	1	Summer	Epilithic	124.81	12.2	5.84	0.736	0.47	3.5	3.97	0.033
Whitewater	429	3	7/9/02	2	Summer	Epilithic	33.65	16.9	3.56	0.392	0.46	3.1	3.56	0.071
Whitewater	429	3	9/10/02	3	Fall	Epilithic	119.79	25.1	2.88	0.405	0.52	2.7	3.22	0.08
Whitewater	430	2	6/10/02	1	Summer	Epilithic	25.06	5.7	1.91	0.838	0.83	3.1	3.93	0.098
Whitewater	430	2	7/10/02	2	Summer	Epilithic	2.25	25.9	2.25	0.508	0.6	0.12	0.72	0.048
Whitewater	430	2	9/17/02	3	Fall	Epilithic	11.19	6.6	7.41	1.476	0.82	0.08	0.9	0.11
Whitewater	431	2	6/11/02	1	Summer	Epilithic	120.19	13.9	1.45	0.363	0.23	11	11.23	0.059
Whitewater	431	2	7/15/02	2	Summer	Epilithic	35.39	12.4	3.49	0.528	0.79	3.5	4.29	0.084
Whitewater	431	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	432	3	5/28/02	1	Spring	Epilithic	70.32	11.3	4.56	1.559	0.72	4.1	4.82	0.09
Whitewater	432	3	7/2/02	2	Summer	Epilithic	90.25	13.1	1.52	0.341	0.45	2	2.45	0.031
Whitewater	432	3	9/4/02	3	Fall	Epilithic	160.82	15.2	0.81	0.512	* *	1.6	* *	0.015

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Whitewater	433	3	5/30/02	1	Spring	Epilithic	136.77	12.8	3.51	0.392	0.36	7.1	7.46	0.039
Whitewater	433	3	7/8/02	2	Summer	Epilithic	24.27	10.7	0.80	0.343	0.54	2.2	2.74	0.039
Whitewater	433	3	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	434	3	5/29/02	1	Spring	Epilithic	93.97	9.6	3.41	0.506	- -	- -	- -	- -
Whitewater	434	3	7/9/02	2	Summer	Epilithic	45.41	17.0	1.30	0.325	0.52	1.9	2.42	0.046
Whitewater	434	3	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	435	1	6/5/02	1	Summer	Epilithic	127.41	22.1	2.94	0.39	0.61	3.3	3.91	0.035
Whitewater	435	1	7/10/02	2	Summer	Epilithic	63.39	20.7	9.99	0.503	0.46	3	3.46	0.049
Whitewater	435	1	9/24/02	3	Fall	Epidendric	72.49	33.5	1.30	0.679	0.53	1.9	2.43	0.032
Whitewater	436	1	6/10/02	1	Summer	Epilithic	40.82	11.3	2.10	0.312	0.05	11	11.05	0.015
Whitewater	436	1	7/10/02	2	Summer	Epilithic	7.52	9.2	1.57	0.814	0.64	6.4	7.04	0.05
Whitewater	436	1	9/17/02	3	Fall	Epilithic	6.39	8.9	17.10	4.829	2.5	0.062	2.562	0.2
Whitewater	437	4	6/24/02	1	Summer	Epilithic	45.36	12.2	7.06	0.825	0.58	3.6	4.18	0.046
Whitewater	437	4	7/22/02	2	Summer	Epilithic	56.28	15.5	2.44	0.791	0.4	3.1	3.5	0.048
Whitewater	437	4	9/10/02	3	Fall	Epilithic	211.77	20.4	1.69	0.3	0.4	3.2	3.6	0.059
Whitewater	438	4	6/19/02	1	Summer	Epidendric	65.83	79.9	2.90	0.9	0.44	4.8	5.24	0.053
Whitewater	438	4	7/23/02	2	Summer	Epidendric	56.36	51.9	3.84	0.625	0.53	2.5	3.03	0.015
Whitewater	438	4	9/25/02	3	Fall	Epidendric	103.99	25.7	0.99	0.353	- -	- -	- -	- -
Whitewater	439	4	6/19/02	1	Summer	Epidendric	90.00	124.7	2.55	1.541	0.45	5.4	5.85	0.049
Whitewater	439	4	7/23/02	2	Summer	Epidendric	32.52	71.3	3.32	0.945	0.05	2.7	2.75	0.015
Whitewater	439	4	9/24/02	3	Fall	Epilithic	149.59	27.9	1.07	0.743	0.37	2.4	2.77	0.015
Whitewater	440	1	5/22/02	1	Spring	Epilithic	91.93	19.4	2.49	0.947	0.46	4.2	4.66	0.031
Whitewater	440	1	7/2/02	2	Summer	Epilithic	39.44	16.7	0.42	0.311	0.52	4.2	4.72	0.054
Whitewater	440	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	441	3	5/22/02	1	Spring	Epilithic	49.52	13.7	1.46	1.255	0.34	5.2	5.54	0.077
Whitewater	441	3	7/2/02	2	Summer	Epilithic	38.21	5.5	2.99	0.526	0.45	3	3.45	0.059
Whitewater	441	3	9/4/02	3	Fall	Epilithic	317.61	24.0	3.69	0.642	* *	2	* *	0.015
Whitewater	442	1	6/11/02	1	Summer	Epilithic	21.34	5.2	0.93	0.255	0.25	7.8	8.05	0.05
Whitewater	442	1	7/16/02	2	Summer	Epilithic	86.81	19.0	5.45	1.78	0.61	1.2	1.81	0.086
Whitewater	442	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Whitewater	443	4	6/18/02	1	Summer	Epidendric	53.98	67.8	3.76	0.547	0.38	5.2	5.58	0.04
Whitewater	443	4	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	443	4	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Whitewater	445	2	6/4/02	1	Summer	Epilithic	110.32	28.2	3.23	0.336	0.45	6	6.45	0.015
Whitewater	445	2	7/9/02	2	Summer	Epilithic	53.84	17.7	3.04	0.347	0.6	3.9	4.5	0.033
Whitewater	445	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
East Fork White	501	3	5/21/2002	1	Spring	Epilithic	87.65	21.4	1.75	0.857	0.39	1	1.39	0.058
East Fork White	501	3	7/1/2002	2	Summer	Epilithic	45.97	18.7	3.53	1.248	0.62	1.7	2.32	0.048
East Fork White	501	3	9/2/2002	3	Fall	Epilithic	28.36	15.1	1.23	0.987	- -	- -	- -	- -
East Fork White	502	4	5/28/2002	1	Spring	Epilithic	39.62	9.0	6.07	1.082	0.55	5	5.55	0.22
East Fork White	502	4	7/9/2002	2	Summer	Epilithic	20.08	12.2	21.05	1.87	1.1	0.38	1.48	0.19
East Fork White	502	4	9/10/2002	3	Fall	Epilithic	124.38	18.3	3.89	0.538	0.65	0.073	0.723	0.099
East Fork White	503	3	6/3/2002	1	Summer	Epilithic	37.16	8.5	2.65	1.238	1	9.1	10.1	0.2
East Fork White	503	3	7/8/2002	2	Summer	Epilithic	31.93	13.3	8.25	0.843	0.73	4.3	5.03	0.07
East Fork White	503	3	9/9/2002	3	Fall	Epilithic	153.46	12.3	2.69	0.754	0.64	0.055	0.695	0.075
East Fork White	504	7	6/19/2002	1	Summer	Epidendric	103.00	146.7	13.95	3.531	1	4.8	5.8	0.28
East Fork White	504	7	7/23/2002	2	Summer	Epidendric	54.76	129.8	20.77	3.122	1.1	2.5	3.6	0.21
East Fork White	504	7	9/24/2002	3	Fall	Epidendric	0.94	59.1	20.75	2.311	0.76	1.6	2.36	0.12
East Fork White	505	3	5/29/2002	1	Spring	Epilithic	74.62	15.6	12.37	1.443	0.68	6	6.68	0.12
East Fork White	505	3	7/11/2002	2	Summer	Epilithic	64.98	33.5	4.56	0.77	0.64	2.7	3.34	0.076
East Fork White	505	3	9/9/2002	3	Fall	Epilithic	40.79	18.0	5.19	0.321	0.68	0.076	0.756	0.056
East Fork White	506	3	6/12/2002	1	Summer	Epidendric	6.05	77.7	0.64	1.167	* *	0.22	* *	0.062
East Fork White	506	3	7/17/2002	2	Summer	Epidendric	71.05	96.4	22.19	1.907	0.62	0.06	0.68	0.079
East Fork White	506	3	9/18/2002	3	Fall	Epidendric	168.25	126.6	2.09	1.599	1.4	0.005	1.405	0.06
East Fork White	508	3	6/26/2002	1	Summer	Epidendric	2.59	140.0	7.28	1.016	0.79	0.64	1.43	0.14
East Fork White	508	3	7/30/2002	2	Summer	Epidendric	34.28	144.1	9.74	1.65	0.76	0.4	1.16	0.088
East Fork White	508	3	9/18/2002	3	Fall	Epilithic	11.61	14.8	5.35	0.783	1.3	0.85	2.15	0.13
East Fork White	509	3	5/21/2002	1	Spring	Epilithic	13.80	23.9	2.70	1.347	0.7	1.6	2.3	0.14
East Fork White	509	3	7/1/2002	2	Summer	Epilithic	87.24	18.9	4.69	1.801	0.97	4.5	5.47	0.17
East Fork White	509	3	9/2/2002	3	Fall	Epilithic	114.01	21.9	2.97	0.982	- -	- -	- -	- -

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
East Fork White	510	4	6/27/2002	1	Summer	Epilithic	72.07	12.5	7.89	0.951	0.54	3.5	4.04	0.067
East Fork White	510	4	7/29/2002	2	Summer	Epilithic	63.55	22.9	4.23	0.971	0.46	2.5	2.96	0.07
East Fork White	510	4	9/16/2002	3	Fall	Epilithic	216.42	21.0	6.43	1.164	0.69	1.2	1.89	0.015
East Fork White	511	4	6/13/2002	1	Summer	Epilithic	7.69	10.5	6.39	2.989	1.1	1.6	2.7	0.18
East Fork White	511	4	7/16/2002	2	Summer	Epilithic	5.12	12.0	37.90	3.426	1	0.27	1.27	0.11
East Fork White	511	4	9/17/2002	3	Fall	Epilithic	28.65	16.2	1.61	0.423	0.6	0.031	0.631	0.054
East Fork White	512	7	6/18/2002	1	Summer	Epidendric	2.25	123.1	10.14	1.911	1.2	3.2	4.4	0.29
East Fork White	512	7	7/22/2002	2	Summer	Epidendric	79.57	106.3	66.13	5.645	1.4	0.94	2.34	0.13
East Fork White	512	7	9/23/2002	3	Fall	Epidendric	13.36	39.4	33.11	3.804	0.62	0.82	1.44	0.057
East Fork White	513	3	5/22/2002	1	Spring	Epilithic	68.61	15.4	2.09	1.13	0.77	2.3	3.07	0.13
East Fork White	513	3	7/9/2002	2	Summer	Epilithic	14.62	14.0	4.68	1.048	0.69	7	7.69	0.21
East Fork White	513	3	9/9/2002	3	Fall	Epilithic	52.46	16.9	1.98	0.776	0.05	15	15.05	0.13
East Fork White	515	2	6/5/2002	1	Summer	Epilithic	28.77	7.1	1.76	0.257	* *	0.64	* *	0.015
East Fork White	515	2	7/16/2002	2	Summer	Epilithic	23.99	9.3	13.46	1.453	0.65	0.3	0.95	0.034
East Fork White	515	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
East Fork White	516	2	6/12/2002	1	Summer	Epidendric	28.60	112.2	0.67	0.65	* *	0.41	* *	0.047
East Fork White	516	2	7/17/2002	2	Summer	Epilithic	12.12	8.8	0.91	0.383	0.51	0.072	0.582	0.039
East Fork White	516	2	9/18/2002	3	Fall	Epidendric	17.61	59.7	4.89	0.944	0.92	0.013	0.933	0.082
East Fork White	518	2	5/28/2002	1	Spring	Epilithic	116.01	23.9	3.79	0.661	0.47	6.4	6.87	0.13
East Fork White	518	2	7/9/2002	2	Summer	Epilithic	65.01	27.3	12.59	1.83	0.8	* *	* *	0.067
East Fork White	518	2	9/10/2002	3	Fall	Epilithic	18.63	18.4	6.06	1.796	1.2	0.005	1.205	0.076
East Fork White	519	1	5/28/2002	1	Spring	Epilithic	3.84	5.9	1.45	* *	0.52	0.81	1.33	0.061
East Fork White	519	1	7/9/2002	2	Summer	Epilithic	87.24	18.9	3.42	0.534	0.43	0.13	0.56	0.051
East Fork White	519	1	9/10/2002	3	Fall	Epilithic	12.23	6.1	4.01	0.722	0.4	0.085	0.485	0.046
East Fork White	521	2	5/22/2002	1	Spring	Epilithic	11.27	5.4	3.88	0.696	0.22	2.3	2.52	0.083
East Fork White	521	2	7/2/2002	2	Summer	Epilithic	43.83	10.0	5.77	0.915	0.57	5.4	5.97	0.096
East Fork White	521	2	9/4/2002	3	Fall	Epilithic	876.16	21.9	5.32	1.413	0.63	1.4	2.03	0.072
East Fork White	522	3	6/5/2002	1	Summer	Epilithic	49.87	11.5	10.07	0.853	* *	0.54	* *	0.05
East Fork White	522	3	7/17/2002	2	Summer	Epilithic	44.83	36.4	6.32	0.828	0.85	0.25	1.1	0.059
East Fork White	522	3	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
East Fork White	523	3	6/4/2002	1	Summer	Epilithic	47.22	14.9	1.60	0.41	* *	1.2	* *	0.071
East Fork White	523	3	7/10/2002	2	Summer	Epilithic	18.60	7.7	7.67	0.913	0.9	1.1	2	0.21
East Fork White	523	3	9/11/2002	3	Fall	Epilithic	62.21	14.9	1.35	0.528	- -	- -	- -	- -
East Fork White	524	7	6/18/2002	1	Summer	Epidendric	33.34	179.5	8.37	2.443	0.83	2.3	3.13	0.22
East Fork White	524	7	7/24/2002	2	Summer	Epidendric	51.27	139.4	27.20	3.556	0.75	0.89	1.64	0.086
East Fork White	524	7	9/25/2002	3	Fall	Epilithic	105.06	90.2	16.17	3.048	0.68	0.6	1.28	0.071
East Fork White	525	4	7/8/2002	1	Summer	Epilithic	57.66	20.7	4.00	1.842	0.33	3.7	4.03	0.15
East Fork White	525	4	8/19/2002	2	Summer	Epilithic	238.43	13.6	3.08	1.252	0.23	3.7	3.93	0.2
East Fork White	525	4	9/16/2002	3	Fall	Epilithic	403.56	33.3	2.44	0.713	0.61	3.2	3.81	0.15
East Fork White	526	7	6/18/2002	1	Summer	Epidendric	17.20	94.5	6.97	1.393	0.93	1.9	2.83	0.22
East Fork White	526	7	7/22/2002	2	Summer	Epidendric	12.71	117.9	15.03	6.067	1.1	0.79	1.89	0.1
East Fork White	526	7	9/23/2002	3	Fall	Epidendric	47.99	43.5	40.45	5.803	1	0.74	1.74	0.11
East Fork White	527	3	6/4/2002	1	Summer	Epilithic	13.03	7.8	2.96	0.922	* *	1	* *	0.084
East Fork White	527	3	7/10/2002	2	Summer	Epilithic	7.33	5.7	5.17	1.12	0.82	0.55	1.37	0.091
East Fork White	527	3	9/11/2002	3	Fall	Epilithic	20.65	11.8	2.71	1.008	0.58	0.14	0.72	0.037
East Fork White	528	2	6/12/2002	1	Summer	Epilithic	2.83	7.0	4.04	2.301	4.4	7.5	11.9	2.5
East Fork White	528	2	7/17/2002	2	Summer	Epilithic	26.22	13.0	2.02	0.462	0.65	4.1	4.75	0.044
East Fork White	528	2	9/18/2002	3	Fall	Epilithic	27.53	13.6	0.16	0.313	0.71	3	3.71	0.044
East Fork White	530	5	6/19/2002	1	Summer	Epidendric	1.94	245.4	0.95	1.163	0.86	1.1	1.96	0.19
East Fork White	530	5	7/23/2002	2	Summer	Epidendric	1.85	91.4	0.61	1.147	1	1.6	2.6	0.17
East Fork White	530	5	9/24/2002	3	Fall	Epidendric	50.84	66.8	0.38	0.534	0.66	0.62	1.28	0.1
East Fork White	531	3	6/11/2002	1	Summer	Epidendric	30.77	165.3	3.48	1.026	* *	0.3	* *	0.059
East Fork White	531	3	7/18/2002	2	Summer	Epidendric	143.75	171.0	3.34	1.394	0.57	* *	* *	0.054
East Fork White	531	3	9/17/2002	3	Fall	Epipsammic	44.03	227.6	9.21	2.817	1	0.005	1.005	0.087
East Fork White	532	7	6/26/2002	1	Summer	Epidendric	54.60	68.9	15.40	0.915	0.74	1.2	1.94	0.079
East Fork White	532	7	7/30/2002	2	Summer	Epilithic	48.44	21.0	30.13	3.083	1	1.5	2.5	0.13
East Fork White	532	7	9/25/2002	3	Fall	Epilithic	58.49	15.1	22.71	1.824	0.75	0.72	1.47	0.076
East Fork White	533	3	5/23/2002	1	Spring	Epilithic	47.03	11.5	1.22	0.834	0.54	2.6	3.14	0.1
East Fork White	533	3	7/2/2002	2	Summer	Epilithic	45.60	10.4	1.80	1.38	0.67	2.7	3.37	0.12
East Fork White	533	3	9/4/2002	3	Fall	Epilithic	35.64	10.9	3.76	1.27	0.65	0.76	1.41	0.11

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
East Fork White	534	3	6/4/2002	1	Summer	Epilithic	56.71	15.1	34.44	2.15	1.2	2	3.2	0.1
East Fork White	534	3	7/16/2002	2	Summer	Epilithic	79.26	15.5	8.94	1.465	0.75	0.34	1.09	0.06
East Fork White	534	3	9/17/2002	3	Fall	Epilithic	249.37	18.5	10.47	1.992	0.87	0.08	0.95	0.064
East Fork White	535	1	5/22/2002	1	Spring	Epilithic	72.66	18.9	5.41	0.882	0.05	6.8	6.85	0.066
East Fork White	535	1	7/2/2002	2	Summer	Epilithic	64.30	16.6	2.21	0.38	0.5	4.8	5.3	0.037
East Fork White	535	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
East Fork White	536	5	6/19/2002	1	Summer	Epidendric	88.17	94.3	1.06	1.188	0.87	1.2	2.07	0.22
East Fork White	536	5	7/23/2002	2	Summer	Epidendric	96.33	107.4	1.04	0.991	1	1.9	2.9	0.14
East Fork White	536	5	9/24/2002	3	Fall	Epidendric	4.12	36.1	1.47	1.099	0.63	0.53	1.16	0.1
East Fork White	537	3	5/22/2002	1	Spring	Epilithic	4.38	5.2	0.58	0.619	0.31	2.1	2.41	0.1
East Fork White	537	3	7/2/2002	2	Summer	Epilithic	13.33	13.1	4.73	1.714	0.83	4.8	5.63	0.13
East Fork White	537	3	9/4/2002	3	Fall	Epilithic	167.15	18.6	61.44	3.828	0.7	2.5	3.2	0.19
East Fork White	539	3	6/4/2002	1	Summer	Epilithic	59.52	14.3	4.04	0.663	* *	0.79	* *	0.05
East Fork White	539	3	7/10/2002	2	Summer	Epilithic	27.94	13.5	3.28	0.681	0.64	0.25	0.89	0.04
East Fork White	539	3	9/10/2002	3	Fall	Epilithic	32.81	11.8	0.59	0.311	0.56	0.084	0.644	0.044
East Fork White	542	4	6/20/2002	1	Summer	Epidendric	11.60	164.5	6.01	2.79	0.64	4.1	4.74	0.22
East Fork White	542	4	7/29/2002	2	Summer	Epidendric	24.71	344.6	2.38	1.013	0.48	4.1	4.58	0.18
East Fork White	542	4	9/26/2002	3	Fall	Epidendric	1187.56	96.1	1.82	0.813	0.61	3.6	4.21	0.16
East Fork White	543	4	6/5/2002	1	Summer	Epidendric	21.11	111.1	5.96	0.769	1.6	1.1	2.7	0.12
East Fork White	543	4	7/10/2002	2	Summer	Epipsammic	7.93	30.9	3.17	1.31	1.3	0.5	1.8	0.16
East Fork White	543	4	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
East Fork White	544	3	6/26/2002	1	Summer	Epilithic	65.76	16.7	0.44	0.241	0.05	6.5	6.55	0.074
East Fork White	544	3	7/30/2002	2	Summer	Epilithic	80.58	20.0	0.81	0.591	0.51	5	5.51	0.097
East Fork White	544	3	9/18/2002	3	Fall	Epilithic	111.32	24.6	1.52	0.722	0.5	2.3	2.8	0.015
East Fork White	545	4	7/8/2002	1	Summer	Epilithic	19.71	10.2	0.88	0.828	0.55	2.3	2.85	0.092
East Fork White	545	4	8/19/2002	2	Summer	Epilithic	73.62	7.1	0.35	0.636	0.28	1.5	1.78	0.077
East Fork White	545	4	9/16/2002	3	Fall	Epilithic	206.09	25.6	3.60	0.753	0.5	1.2	1.7	0.059
East Fork White	551	2	5/23/2002	1	Spring	Epidendric	474.60	200.3	1.21	* *	0.46	1.5	1.96	0.091
East Fork White	551	2	7/2/2002	2	Summer	Epilithic	70.99	11.1	2.13	1.765	1	3.6	4.6	0.11
East Fork White	551	2	9/4/2002	3	Fall	Epipsammic	67.42	62.9	8.28	1.157	0.72	0.055	0.775	0.092

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Upper Wabash	601	3	6/3/2003	1	Summer	Epilithic	140.02	23.7	10.23	0.818	* *	5	* *	0.04
Upper Wabash	601	3	7/28/2003	2	Summer	Epilithic	32.57	18.6	1.38	0.509	0.62	3.8	4.42	0.11
Upper Wabash	601	3	9/11/2003	3	Fall	Epilithic	26.12	16.3	1.67	0.352	0.65	2.4	3.05	0.085
Upper Wabash	602	2	5/27/2003	1	Spring	Epilithic	127.85	28.1	0.96	0.377	0.32	4.1	4.42	0.05
Upper Wabash	602	2	7/22/2003	2	Summer	Epilithic	18.29	8.0	0.68	0.657	0.68	1.8	2.48	0.1
Upper Wabash	602	2	9/8/2003	3	Fall	Epilithic	36.80	20.4	0.15	0.416	0.65	1.4	2.05	0.082
Upper Wabash	603	1	6/10/2003	1	Summer	Epipsammic	20.40	73.0	0.94	0.792	0.91	1.3	2.21	0.085
Upper Wabash	603	1	8/7/2003	2	Summer	Epipsammic	11.22	119.1	0.40	0.407	0.75	1.7	2.45	0.068
Upper Wabash	603	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Upper Wabash	604	3	5/28/2003	1	Spring	Epilithic	43.92	21.8	6.59	1.352	0.83	3.7	4.53	0.081
Upper Wabash	604	3	7/24/2003	2	Summer	Epilithic	88.30	27.2	11.83	1.526	0.84	1.9	2.74	0.21
Upper Wabash	604	3	9/15/2003	3	Fall	Epilithic	46.37	19.4	6.10	0.867	0.77	1.1	1.87	0.097
Upper Wabash	605	3	6/10/2003	1	Summer	Epilithic	100.73	81.2	0.78	0.479	0.73	3.4	4.13	0.015
Upper Wabash	605	3	8/7/2003	2	Summer	Epilithic	40.02	24.8	1.68	0.478	1.3	4.6	5.9	0.071
Upper Wabash	605	3	9/17/2003	3	Fall	Epilithic	62.84	22.8	1.05	0.288	0.84	0.88	1.72	0.015
Upper Wabash	606	1	5/22/2003	1	Spring	Epilithic	72.41	31.1	0.74	0.594	0.37	14	14.37	0.065
Upper Wabash	606	1	7/29/2003	2	Summer	Epilithic	60.04	22.3	1.87	0.452	0.97	4.3	5.27	0.21
Upper Wabash	606	1	9/10/2003	3	Fall	Epilithic	45.94	24.1	1.15	0.368	0.78	2.4	3.18	0.13
Upper Wabash	607	4	6/11/2003	1	Summer	Epilithic	156.86	42.3	9.72	1.008	0.71	6.4	7.11	0.34
Upper Wabash	607	4	8/6/2003	2	Summer	Epilithic	58.62	21.6	7.32	0.887	0.85	4	4.85	0.4
Upper Wabash	607	4	9/18/2003	3	Fall	Epilithic	43.81	15.9	4.65	0.471	0.73	3.1	3.83	0.31
Upper Wabash	608	3	6/9/2003	1	Summer	Epilithic	140.69	55.4	2.06	0.621	0.83	2.8	3.63	0.015
Upper Wabash	608	3	7/30/2003	2	Summer	Epidendric	5.80	20.3	2.49	1.51	1.2	4.5	5.7	0.075
Upper Wabash	608	3	9/9/2003	3	Fall	Epilithic	41.18	27.3	2.02	0.601	1	2	3	0.045
Upper Wabash	609	1	6/11/2003	1	Summer	Epidendric	50.18	35.3	2.11	0.371	0.24	6.8	7.04	0.015
Upper Wabash	609	1	8/6/2003	2	Summer	Epidendric	3.17	36.3	1.30	0.379	0.5	4	4.5	0.015
Upper Wabash	609	1	9/17/2003	3	Fall	Epipsammic	34.74	116.7	1.46	0.604	0.38	3.3	3.68	0.057
Upper Wabash	610	2	6/4/2003	1	Summer	Epilithic	156.62	51.4	1.14	0.386	0.91	1.3	2.21	0.015
Upper Wabash	610	2	8/12/2003	2	Summer	Epilithic	80.24	44.2	0.64	0.464	0.83	1.2	2.03	0.064
Upper Wabash	610	2	9/16/2003	3	Fall	Epilithic	106.85	28.6	0.89	0.356	0.91	0.69	1.6	0.076

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Upper Wabash	611	1	6/3/2003	1	Summer	Epilithic	106.92	26.6	0.79	0.442	* *	6.5	* *	0.043
Upper Wabash	611	1	7/28/2003	2	Summer	Epilithic	14.86	7.3	0.57	0.308	0.43	6	6.43	0.11
Upper Wabash	611	1	9/10/2003	3	Fall	Epilithic	33.76	21.1	0.13	0.268	0.53	4.3	4.83	0.071
Upper Wabash	612	1	5/29/2003	1	Spring	Epilithic	3.50	22.9	9.29	1.24	0.39	8.7	9.09	0.049
Upper Wabash	612	1	7/23/2003	2	Summer	Epilithic	69.81	19.9	3.38	0.746	0.76	5.8	6.56	0.085
Upper Wabash	612	1	9/8/2003	3	Fall	Epilithic	57.51	25.0	2.11	0.817	0.65	1.8	2.45	0.071
Upper Wabash	613	4	6/11/2003	1	Summer	Epilithic	143.51	66.9	2.59	0.613	0.48	2.8	3.28	0.078
Upper Wabash	613	4	8/7/2003	2	Summer	Epilithic	49.90	21.3	2.51	0.611	0.76	3.5	4.26	0.11
Upper Wabash	613	4	9/17/2003	3	Fall	Epilithic	94.62	20.4	2.22	0.482	0.57	2.4	2.97	0.051
Upper Wabash	614	2	5/29/2003	1	Spring	Epilithic	97.42	30.5	2.02	1.087	1	7.8	8.8	0.17
Upper Wabash	614	2	7/23/2003	2	Summer	Epidendric	6.37	11.9	2.41	1.805	1.6	6	7.6	0.26
Upper Wabash	614	2	9/9/2003	3	Fall	Epilithic	57.32	38.4	1.73	1.018	1.1	1.4	2.5	0.17
Upper Wabash	615	4	6/11/2003	1	Summer	Epilithic	38.77	15.3	2.86	0.616	0.39	2.8	3.19	0.068
Upper Wabash	615	4	8/6/2003	2	Summer	Epilithic	25.68	20.3	2.94	0.566	0.82	3.7	4.52	0.11
Upper Wabash	615	4	9/17/2003	3	Fall	Epilithic	32.97	13.2	3.06	0.453	0.43	2.5	2.93	0.036
Upper Wabash	616	2	6/5/2003	1	Summer	Epidendric	149.00	57.4	3.62	0.72	0.42	2.2	2.62	0.015
Upper Wabash	616	2	7/29/2003	2	Summer	Epipsammic	30.42	366.5	0.85	0.641	0.38	1.8	2.18	0.015
Upper Wabash	616	2	9/9/2003	3	Fall	Epidendric	17.43	13.8	2.65	2.068	0.63	0.61	1.24	0.058
Upper Wabash	617	2	6/3/2003	1	Summer	Epilithic	133.06	44.8	21.60	2.208	1.2	3.4	4.6	0.072
Upper Wabash	617	2	7/28/2003	2	Summer	Epilithic	158.35	48.5	12.53	2.509	0.91	2.8	3.71	0.086
Upper Wabash	617	2	9/11/2003	3	Fall	Epilithic	107.47	23.7	42.23	2.661	1.3	1.7	3	0.12
Upper Wabash	618	1	5/22/2003	1	Spring	Epidendric	3.35	10.0	0.63	0.409	1.3	8.9	10.2	0.11
Upper Wabash	618	1	7/29/2003	2	Summer	Epidendric	1.12	23.8	0.55	3.194	24	4.5	28.5	2.6
Upper Wabash	618	1	9/10/2003	3	Fall	Epidendric	2.69	11.2	2.01	22.309	23	3.7	26.7	2
Upper Wabash	619	1	5/22/2003	1	Spring	Epilithic	38.88	11.8	13.40	1.642	0.23	3.3	3.53	0.043
Upper Wabash	619	1	7/29/2003	2	Summer	Epilithic	7.03	7.3	0.80	0.184	0.37	2	2.37	0.1
Upper Wabash	619	1	9/10/2003	3	Fall	Epilithic	22.65	12.0	1.01	0.478	0.4	0.27	0.67	0.075
Upper Wabash	621	3	6/9/2003	1	Summer	Epipsammic	22.35	65.0	2.41	0.618	0.94	1.7	2.64	0.049
Upper Wabash	621	3	7/30/2003	2	Summer	Epipsammic	0.48	39.2	0.77	0.889	1.2	3	4.2	0.11
Upper Wabash	621	3	9/10/2003	3	Fall	Epipsammic	4.69	45.2	0.45	0.412	0.67	1.4	2.07	0.076

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Upper Wabash	622	2	6/4/2003	1	Summer	Epilithic	150.70	33.4	1.80	0.785	1.8	6.3	8.1	1.1
Upper Wabash	622	2	8/12/2003	2	Summer	Epilithic	78.92	46.3	1.44	0.568	2.2	3.6	5.8	1.7
Upper Wabash	622	2	9/16/2003	3	Fall	Epilithic	48.92	23.4	4.04	0.915	1.7	1.8	3.5	0.6
Upper Wabash	623	3	6/11/2003	1	Summer	Epilithic	147.17	44.1	12.08	2.849	1.1	4.2	5.3	0.24
Upper Wabash	623	3	8/6/2003	2	Summer	Epilithic	78.93	26.2	2.14	0.557	0.62	2.8	3.42	0.072
Upper Wabash	623	3	9/17/2003	3	Fall	Epilithic	68.16	16.0	2.39	0.395	0.47	2	2.47	0.065
Upper Wabash	624	4	6/4/2003	1	Summer	Epilithic	17.78	17.6	1.55	0.504	0.92	0.39	1.31	0.015
Upper Wabash	624	4	8/11/2003	2	Summer	Epilithic	2.12	13.6	2.47	1.068	0.78	0.048	0.828	0.041
Upper Wabash	624	4	9/16/2003	3	Fall	Epilithic	3.47	7.4	0.77	0.434	0.76	0.05	0.81	0.015
Upper Wabash	625	7	6/24/2003	1	Summer	Epidendric	24.30	30.4	69.80	4.02	2.2	6.7	8.9	0.23
Upper Wabash	625	7	8/14/2003	2	Summer	Epidendric	5.89	11.7	1.59	2.163	1	1.5	2.5	0.32
Upper Wabash	625	7	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Upper Wabash	626	3	5/28/2003	1	Spring	Epilithic	63.49	28.2	10.74	1.16	0.45	3.7	4.15	0.055
Upper Wabash	626	3	7/24/2003	2	Summer	Epilithic	16.69	8.1	2.78	1.201	1.1	4.3	5.4	0.15
Upper Wabash	626	3	9/16/2003	3	Fall	Epilithic	95.48	34.7	2.94	0.557	0.46	0.73	1.19	0.066
Upper Wabash	627	3	6/3/2003	1	Summer	Epidendric	18.47	20.5	7.13	1.063	* *	10	* *	0.043
Upper Wabash	627	3	7/24/2003	2	Summer	Epidendric	5.08	23.8	1.77	1.013	0.91	8	8.91	0.13
Upper Wabash	627	3	9/18/2003	3	Fall	Epidendric	13.32	16.3	3.97	0.587	0.88	3.8	4.68	0.042
Upper Wabash	628	3	6/10/2003	1	Summer	Epilithic	330.68	49.6	0.97	0.718	0.64	2	2.64	0.015
Upper Wabash	628	3	7/30/2003	2	Summer	Epilithic	44.01	28.8	0.67	0.488	0.86	3.8	4.66	0.057
Upper Wabash	628	3	9/9/2003	3	Fall	Epilithic	48.81	28.0	0.34	0.455	0.57	1.6	2.17	0.015
Upper Wabash	629	2	6/10/2003	1	Summer	Epilithic	17.48	17.1	0.45	0.58	0.12	2.9	3.02	0.041
Upper Wabash	629	2	8/11/2003	2	Summer	Epilithic	1.70	20.1	0.71	2.363	0.55	3.1	3.65	0.2
Upper Wabash	629	2	9/17/2003	3	Fall	Epilithic	3.28	8.9	0.37	0.126	0.33	3.1	3.43	0.015
Upper Wabash	630	1	5/28/2003	1	Spring	Epilithic	26.02	16.0	2.81	0.828	0.6	6.3	6.9	0.07
Upper Wabash	630	1	8/12/2003	2	Summer	Epilithic	2.43	8.8	0.48	0.344	0.6	1.1	1.7	0.064
Upper Wabash	630	1	9/15/2003	3	Fall	Epilithic	9.10	15.5	0.54	0.599	0.8	0.31	1.11	0.06
Upper Wabash	631	2	5/27/2003	1	Spring	Epilithic	207.03	60.8	3.01	0.705	0.82	8	8.82	0.46
Upper Wabash	631	2	7/22/2003	2	Summer	Epilithic	40.52	18.2	2.60	0.754	0.94	4.5	5.44	0.35
Upper Wabash	631	2	9/8/2003	3	Fall	Epilithic	89.19	28.3	1.29	0.682	1.3	2.4	3.7	0.39

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

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Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Upper Wabash	632	1	6/4/2003	1	Summer	Epidendric	32.22	26.1	3.76	0.953	0.95	9	9.95	0.041
Upper Wabash	632	1	7/29/2003	2	Summer	Epipsammic	51.24	271.9	2.66	0.633	2.4	6.6	9	0.089
Upper Wabash	632	1	9/9/2003	3	Fall	Epidendric	10.26	21.3	0.34	0.552	2.5	5	7.5	0.082
Upper Wabash	633	2	5/28/2003	1	Spring	Epilithic	142.71	55.7	3.60	0.787	0.62	9.7	10.32	0.061
Upper Wabash	633	2	7/24/2003	2	Summer	Epilithic	74.80	31.2	0.43	0.441	0.64	6	6.64	0.079
Upper Wabash	633	2	9/15/2003	3	Fall	Epilithic	174.95	32.5	2.19	0.387	0.7	2.5	3.2	0.069
Upper Wabash	634	1	5/27/2003	1	Spring	Epilithic	113.62	25.9	2.69	0.498	0.69	2.2	2.89	0.056
Upper Wabash	634	1	7/22/2003	2	Summer	Epidendric	2.64	11.6	0.40	0.46	0.69	1.4	2.09	0.12
Upper Wabash	634	1	9/8/2003	3	Fall	Epilithic	3.46	10.5	0.28	0.473	0.72	1.1	1.82	0.11
Upper Wabash	635	1	6/10/2003	1	Summer	Epidendric	109.89	26.8	1.21	0.539	0.63	3.2	3.83	0.073
Upper Wabash	635	1	8/7/2003	2	Summer	Epidendric	3.53	22.3	11.35	1.865	2.4	2.5	4.9	0.22
Upper Wabash	635	1	9/16/2003	3	Fall	Epidendric	6.68	10.9	0.28	0.426	0.56	0.58	1.14	0.19
Upper Wabash	636	3	5/28/2003	1	Spring	Epilithic	34.58	17.9	1.77	0.706	1	3.1	4.1	0.073
Upper Wabash	636	3	8/12/2003	2	Summer	Epilithic	60.04	49.3	0.52	0.959	1.1	1.2	2.3	0.26
Upper Wabash	636	3	9/15/2003	3	Fall	Epilithic	123.93	27.3	1.59	0.583	0.86	0.38	1.24	0.13
Upper Wabash	637	1	6/9/2003	1	Summer	Epidendric	13.58	36.1	23.59	17.083	0.49	2.7	3.19	0.015
Upper Wabash	637	1	7/30/2003	2	Summer	Epidendric	42.65	32.2	6.24	1.344	1.2	2.9	4.1	0.071
Upper Wabash	637	1	9/10/2003	3	Fall	Epidendric	12.98	27.4	1.37	0.605	0.84	1.5	2.34	0.015
Upper Wabash	638	3	6/4/2003	1	Summer	Epilithic	70.93	16.3	2.40	0.756	0.92	1.8	2.72	0.054
Upper Wabash	638	3	8/12/2003	2	Summer	Epilithic	53.75	21.6	4.55	0.534	1	0.92	1.92	0.11
Upper Wabash	638	3	9/16/2003	3	Fall	Epilithic	31.46	14.9	11.27	1.085	0.92	0.24	1.16	0.096
Upper Wabash	639	5	6/24/2003	1	Summer	Epidendric	32.59	16.0	15.31	1.769	0.93	5.2	6.13	0.098
Upper Wabash	639	5	8/11/2003	2	Summer	Epidendric	24.34	17.3	5.19	1.283	0.56	1.9	2.46	0.12
Upper Wabash	639	5	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	701	5	7/28/2004	1	Summer	Epidendric	12.26	20.7	2.37	1.74	0.368	1.16	1.528	0.045
Kankakee	701	5	9/7/2004	2	Fall	Epidendric	6.98	14.1	4.08	2.321	1.09	1.19	2.28	0.093
Kankakee	701	5	10/14/2004	3	Fall	Epidendric	3.31	27.3	2.24	1.114	0.25	1.3	1.55	0.05
Kankakee	702	1	7/7/2004	1	Summer	Epipsammic	26.00	109.1	1.52	0.747	1.02	1.62	2.64	0.119
Kankakee	702	1	8/11/2004	2	Summer	Epipsammic	53.98	67.1	26.24	1.293	0.787	0.412	1.199	0.091
Kankakee	702	1	9/22/2004	3	Fall	Epipsammic	46.24	84.2	1.44	0.415	0.6	0.6	1.2	0.16

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Kankakee	703	1	7/1/2004	1	Summer	Epilithic	539.58	181.1	1.39	0.663	0.741	0.353	1.094	0.052
Kankakee	703	1	8/10/2004	2	Summer	Epilithic	144.49	330.3	0.57	1.018	0.633	0.126	0.759	0.053
Kankakee	703	1	9/23/2004	3	Fall	Epilithic	16.35	128.1	0.56	0.4	0.25	0.3	0.55	0.09
Kankakee	705	2	6/30/2004	1	Summer	- -	* *	* *	1.04	0.821	0.819	0.934	1.753	0.049
Kankakee	705	2	8/10/2004	2	Summer	Epidendric	3.77	18.6	4.18	2.054	0.7	0.977	1.677	0.052
Kankakee	705	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	706	5	7/28/2004	1	Summer	Epidendric	14.23	11.2	2.69	1.967	0.698	1.16	1.858	0.049
Kankakee	706	5	9/7/2004	2	Fall	Epidendric	27.54	24.6	3.23	2.354	0.784	1.25	2.034	0.077
Kankakee	706	5	10/14/2004	3	Fall	Epidendric	14.06	14.3	1.70	1.15	0.25	1.3	1.55	0.025
Kankakee	707	4	7/7/2004	1	Summer	Epilithic	48.58	135.4	1.83	0.671	* *	0.349	* *	0.05
Kankakee	707	4	8/16/2004	2	Summer	Epilithic	4.97	101.5	1.47	0.766	0.253	0.347	0.6	0.015
Kankakee	707	4	9/21/2004	3	Fall	Epilithic	17.96	122.1	2.46	0.462	0.25	0.3	0.55	0.08
Kankakee	708	5	7/1/2004	1	Summer	Epipsammic	9.97	292.8	5.01	2.101	1.44	5.62	7.06	0.115
Kankakee	708	5	8/9/2004	2	Summer	Epipsammic	28.79	144.0	7.21	2.827	1.25	2.82	4.07	0.127
Kankakee	708	5	10/12/2004	3	Fall	Epipsammic	21.20	262.4	1.44	1.785	0.6	2.1	2.7	0.025
Kankakee	709	2	7/1/2004	1	Summer	Epipsammic	12.10	52.7	0.41	0.668	1.03	0.373	1.403	0.104
Kankakee	709	2	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	709	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	710	3	7/13/2004	1	Summer	Epipsammic	42.25	107.3	3.61	1.553	1.18	3.45	4.63	0.152
Kankakee	710	3	8/17/2004	2	Summer	Epipsammic	140.62	126.3	2.68	0.955	0.923	2.22	3.143	0.15
Kankakee	710	3	10/14/2004	3	Fall	Epipsammic	250.70	87.6	6.28	0.973	0.6	2.5	3.1	0.1
Kankakee	711	4	6/30/2004	1	Summer	Epipsammic	15.12	38.4	9.39	2.345	0.897	2.45	3.347	0.143
Kankakee	711	4	8/4/2004	2	Summer	Epipsammic	101.64	69.1	11.49	1.805	0.805	1.89	2.695	0.192
Kankakee	711	4	9/20/2004	3	Fall	Epipsammic	2.79	113.8	2.71	0.641	0.25	1.3	1.55	0.17
Kankakee	712	2	6/22/2004	1	Summer	Epilithic	7.89	31.2	1.18	0.507	* *	7.88	* *	0.086
Kankakee	712	2	8/2/2004	2	Summer	Epilithic	124.83	193.1	2.36	0.554	* *	2.95	* *	0.015
Kankakee	712	2	9/15/2004	3	Fall	Epilithic	181.78	150.2	2.83	0.664	0.25	5.1	5.35	0.015
Kankakee	713	3	6/29/2004	1	Summer	Epilithic	349.69	330.7	3.87	0.798	1.18	10.3	11.48	0.033
Kankakee	713	3	8/3/2004	2	Summer	Epilithic	451.73	325.8	1.28	0.28	0.677	0.661	1.338	0.059
Kankakee	713	3	9/13/2004	3	Fall	Epilithic	58.85	124.1	0.95	0.946	0.7	5.4	6.1	0.045

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

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Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Kankakee	714	2	7/14/2004	1	Summer	Epipsammic	206.96	331.3	0.75	0.389	* *	0.0229	* *	0.037
Kankakee	714	2	8/18/2004	2	Summer	Epipsammic	304.07	377.2	8.85	1.329	0.394	0.0269	0.4209	0.015
Kankakee	714	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	715	1	7/6/2004	1	Summer	Epilithic	217.91	165.2	3.25	0.758	1.7	1.61	3.31	0.157
Kankakee	715	1	8/10/2004	2	Summer	Epilithic	215.78	209.5	0.99	1.078	0.717	0.215	0.932	0.094
Kankakee	715	1	9/22/2004	3	Fall	Epilithic	23.77	176.2	0.95	0.652	0.8	0.2	1	0.21
Kankakee	716	1	6/23/2004	1	Summer	Epilithic	132.37	63.5	1.90	0.351	* *	15.3	* *	0.015
Kankakee	716	1	9/2/2004	2	Fall	Epilithic	32.10	197.6	0.73	0.286	0.125	7.79	7.915	0.129
Kankakee	716	1	10/12/2004	3	Fall	Epilithic	168.22	168.2	1.26	0.493	0.25	7.6	7.85	0.025
Kankakee	717	5	7/6/2004	1	Summer	Epidendric	28.27	10.0	8.67	2.2	0.894	1.29	2.184	0.079
Kankakee	717	5	9/8/2004	2	Fall	Epidendric	1.70	12.1	3.09	2.733	1.13	1.93	3.06	0.112
Kankakee	717	5	10/13/2004	3	Fall	Epidendric	43.37	28.2	1.73	0.748	0.25	1.3	1.55	0.025
Kankakee	718	2	7/12/2004	1	Summer	Epipsammic	41.43	67.4	9.08	2.059	0.87	0.398	1.268	0.042
Kankakee	718	2	8/16/2004	2	Summer	Epipsammic	49.10	133.0	12.80	2.107	0.634	0.332	0.966	0.051
Kankakee	718	2	10/13/2004	3	Fall	Epipsammic	258.31	280.3	2.03	0.993	0.25	0.4	0.65	0.025
Kankakee	719	5	7/7/2004	1	Summer	Epidendric	11.96	11.6	17.93	1.976	0.832	0.988	1.82	0.068
Kankakee	719	5	9/8/2004	2	Fall	Epidendric	12.03	17.0	3.67	2.715	1.09	1.56	2.65	0.104
Kankakee	719	5	10/12/2004	3	Fall	Epidendric	9.90	22.0	1.41	0.795	0.25	0.9	1.15	0.025
Kankakee	720	1	6/22/2004	1	Summer	Epilithic	123.92	85.6	1.66	0.349	0.25	13.2	13.45	0.041
Kankakee	720	1	8/2/2004	2	Summer	Epilithic	37.03	107.6	3.50	0.661	* *	1.35	* *	0.036
Kankakee	720	1	9/15/2004	3	Fall	Epilithic	92.11	138.1	1.35	0.479	0.25	6.2	6.45	0.015
Kankakee	723	3	7/7/2004	1	Summer	Epipsammic	52.23	322.3	2.31	0.509	* *	0.0303	* *	0.041
Kankakee	723	3	8/11/2004	2	Summer	Epipsammic	69.90	311.0	4.05	0.588	0.202	0.0256	0.2276	0.015
Kankakee	723	3	9/22/2004	3	Fall	Epipsammic	36.22	158.4	8.36	1.289	0.25	0.05	0.3	0.08
Kankakee	724	5	7/27/2004	1	Summer	Epidendric	20.32	28.9	3.61	1.861	1.02	1.05	2.07	0.121
Kankakee	724	5	9/9/2004	2	Fall	Epidendric	4.47	11.5	3.12	1.522	1.25	3.39	4.64	0.186
Kankakee	724	5	10/12/2004	3	Fall	Epidendric	37.94	39.7	1.83	1.4	0.25	1.9	2.15	0.025
Kankakee	725	5	7/7/2004	1	Summer	Epidendric	11.33	11.0	11.16	2.56	0.944	1.24	2.184	0.133
Kankakee	725	5	9/8/2004	2	Fall	Epidendric	1.45	7.8	3.53	2.982	1.38	1.83	3.21	0.121
Kankakee	725	5	10/13/2004	3	Fall	Epidendric	21.77	14.0	1.33	0.823	0.25	1.1	1.35	0.025

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Kankakee	726	1	7/8/2004	1	Summer	Epipsammic	47.92	100.6	2.74	0.466	1.53	0.305	1.835	0.338
Kankakee	726	1	8/17/2004	2	Summer	Epipsammic	20.10	233.3	58.98	5.85	1.71	0.205	1.915	0.391
Kankakee	726	1	10/14/2004	3	Fall	Epipsammic	25.33	209.6	250.89	15.845	6.15	0.05	6.2	0.36
Kankakee	727	2	6/23/2004	1	Summer	Epipsammic	8.94	139.0	2.23	0.06	1.19	9.49	10.68	0.079
Kankakee	727	2	8/9/2004	2	Summer	Epipsammic	37.47	204.4	3.70	0.627	1.07	2.2	3.27	0.101
Kankakee	727	2	9/15/2004	3	Fall	Epipsammic	12.57	119.0	0.73	0.571	0.6	4.1	4.7	0.048
Kankakee	728	1	6/22/2004	1	Summer	Epilithic	93.27	74.9	0.33	0.06	0.05	11.5	11.55	0.032
Kankakee	728	1	8/2/2004	2	Summer	Epilithic	314.88	261.6	3.24	0.497	0.05	9.17	9.22	0.015
Kankakee	728	1	9/15/2004	3	Fall	Epilithic	144.19	144.1	1.93	0.291	0.25	11	11.25	0.015
Kankakee	729	4	6/29/2004	1	Summer	Epilithic	95.59	124.7	3.02	1.056	1.3	4.43	5.73	0.066
Kankakee	729	4	8/3/2004	2	Summer	Epilithic	470.10	626.9	1.38	0.596	* *	0.602	* *	0.06
Kankakee	729	4	9/13/2004	3	Fall	Epilithic	14.31	144.1	2.09	1.865	0.8	3.6	4.4	0.082
Kankakee	730	1	7/8/2004	1	Summer	Epipsammic	34.28	188.8	1.07	0.886	1.31	2.31	3.62	0.499
Kankakee	730	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	730	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	731	2	7/7/2004	1	Summer	Epipsammic	52.31	238.2	4.97	0.777	1.38	1.83	3.21	0.22
Kankakee	731	2	8/11/2004	2	Summer	Epipsammic	28.74	216.7	4.91	1.596	1.19	0.0175	1.2075	0.409
Kankakee	731	2	9/22/2004	3	Fall	Epipsammic	61.87	208.8	9.98	7.666	1.32	0.05	1.37	0.32
Kankakee	732	2	6/28/2004	1	Summer	Epipsammic	81.83	36.4	1.17	0.126	* *	10.3	* *	0.015
Kankakee	732	2	8/3/2004	2	Summer	Epipsammic	61.38	66.2	0.38	0.314	* *	0.125	* *	0.034
Kankakee	732	2	9/14/2004	3	Fall	Epipsammic	69.20	57.6	1.12	0.268	0.25	5	5.25	0.015
Kankakee	733	5	7/6/2004	1	Summer	Epidendric	8.90	9.5	7.97	2.018	0.945	1.43	2.375	0.08
Kankakee	733	5	9/8/2004	2	Fall	Epidendric	19.57	14.7	3.39	3.36	1.12	1.91	3.03	0.128
Kankakee	733	5	10/13/2004	3	Fall	Epidendric	96.58	49.9	1.57	0.71	0.25	1.3	1.55	0.025
Kankakee	734	3	7/12/2004	1	Summer	Epidendric	351.11	158.5	3.48	1.268	1.05	10.2	11.25	0.126
Kankakee	734	3	8/17/2004	2	Summer	Epilithic	564.53	275.6	2.59	0.791	0.514	2.39	2.904	0.101
Kankakee	734	3	10/13/2004	3	Fall	Epilithic	248.58	184.2	2.97	0.495	0.25	2.6	2.85	0.07
Kankakee	735	3	6/30/2004	1	Summer	Epipsammic	81.19	585.5	4.65	0.858	0.703	1.33	2.033	0.03
Kankakee	735	3	8/4/2004	2	Summer	Epipsammic	24.02	233.2	3.46	1.158	* *	0.169	* *	0.044
Kankakee	735	3	9/23/2004	3	Fall	Epipsammic	48.30	73.3	1.93	0.75	0.25	0.2	0.45	0.06

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

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Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Kankakee	736	4	7/13/2004	1	Summer	Epidendric	1000.74	515.3	14.11	2.679	1.04	1.04	2.08	0.069
Kankakee	736	4	9/2/2004	2	Fall	Epilithic	55.41	192.2	26.40	3.27	1.29	1.12	2.41	0.099
Kankakee	736	4	10/14/2004	3	Fall	Epilithic	203.62	184.2	8.87	1.046	0.25	1.1	1.35	0.025
Kankakee	737	4	7/8/2004	1	Summer	Epipsammic	48.32	185.9	1.79	0.746	* *	0.335	* *	0.015
Kankakee	737	4	8/16/2004	2	Summer	Epipsammic	64.82	178.0	1.42	0.678	0.203	0.331	0.534	0.015
Kankakee	737	4	9/21/2004	3	Fall	Epipsammic	47.74	354.1	2.21	0.632	0.25	0.3	0.55	0.08
Kankakee	738	2	7/8/2004	1	Summer	- -	* *	* *	4.05	1.294	* *	1.28	* *	0.054
Kankakee	738	2	8/12/2004	2	Summer	Epipsammic	64.64	111.3	1.05	0.519	0.368	1.39	1.758	0.05
Kankakee	738	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	739	3	7/8/2004	1	Summer	Epilithic	633.50	366.2	1.64	0.432	* *	0.681	* *	0.058
Kankakee	739	3	8/12/2004	2	Summer	Epilithic	1.91	373.7	0.44	0.361	0.341	0.985	1.326	0.032
Kankakee	739	3	9/21/2004	3	Fall	Epilithic	173.77	194.2	1.38	0.565	0.25	1	1.25	0.06
Kankakee	741	1	6/30/2004	1	Summer	Epidendric	18.15	21.1	32.34	5.319	1.09	0.453	1.543	0.067
Kankakee	741	1	8/10/2004	2	Summer	Epidendric	5.25	12.8	22.53	1.937	0.626	0.0369	0.6629	0.042
Kankakee	741	1	10/13/2004	3	Fall	Epidendric	7.61	7.7	14.09	2.038	0.25	0.5	0.75	0.07
Kankakee	742	3	7/13/2004	1	Summer	Epipsammic	5.89	35.2	2.60	1.286	1.1	9.2	10.3	0.11
Kankakee	742	3	8/17/2004	2	Summer	Epipsammic	31.32	141.8	3.34	1.149	0.972	2.54	3.512	0.09
Kankakee	742	3	10/13/2004	3	Fall	Epipsammic	41.13	200.3	1.62	0.798	0.6	2.9	3.5	0.025
Kankakee	743	3	6/23/2004	1	Summer	Epilithic	37.22	50.1	3.64	1.63	0.925	6.83	7.755	0.138
Kankakee	743	3	8/9/2004	2	Summer	Epilithic	273.88	287.4	1.85	1.089	0.965	1.83	2.795	0.079
Kankakee	743	3	9/16/2004	3	Fall	Epilithic	106.30	154.2	3.90	2.349	0.25	2.3	2.55	0.072
Kankakee	744	2	6/28/2004	1	Summer	Epilithic	394.81	134.1	2.44	0.249	* *	19.5	* *	0.152
Kankakee	744	2	8/2/2004	2	Summer	Epilithic	200.83	251.4	3.97	0.541	* *	7.14	* *	1.01
Kankakee	744	2	9/14/2004	3	Fall	Epilithic	300.64	172.2	1.65	0.391	0.25	7.8	8.05	0.33
Kankakee	745	4	6/29/2004	1	Summer	Epidendric	24.88	29.9	1.78	0.511	0.91	4.63	5.54	0.036
Kankakee	745	4	8/3/2004	2	Summer	Epidendric	56.25	52.3	2.37	0.596	0.629	0.198	0.827	0.069
Kankakee	745	4	9/14/2004	3	Fall	Epilithic	92.96	164.1	1.14	1.073	0.25	3.6	3.85	0.07
Kankakee	748	4	6/28/2004	1	Summer	Epipsammic	47.43	57.7	1.65	0.249	0.742	7.72	8.462	0.037
Kankakee	748	4	8/3/2004	2	Summer	Epipsammic	192.66	111.1	1.85	0.4	0.531	0.151	0.682	0.043
Kankakee	748	4	9/14/2004	3	Fall	Epipsammic	71.17	171.9	1.19	0.526	0.25	3.7	3.95	0.048

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Kankakee	752	1	7/6/2004	1	Summer	Epipsammic	19.84	238.4	3.88	3.69	1.21	0.239	1.449	0.097
Kankakee	752	1	8/11/2004	2	Summer	Epipsammic	27.61	172.6	16.86	15.706	2.22	0.0103	2.2303	0.286
Kankakee	752	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	753	1	6/29/2004	1	Summer	Epipsammic	80.30	156.4	1.89	0.719	* *	14.4	* *	0.056
Kankakee	753	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	753	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Kankakee	754	3	7/13/2004	1	Summer	Epipsammic	145.29	152.4	21.50	1.572	1.16	0.743	1.903	0.064
Kankakee	754	3	8/18/2004	2	Summer	Epipsammic	85.60	194.6	20.31	3.919	1.21	0.785	1.995	0.111
Kankakee	754	3	10/14/04	3	Fall	Epipsammic	108.16	227.2	11.29	0.865	0.25	0.8	1.05	0.025
Lower Wabash	803	1	6/29/2004	1	Summer	Epipsammic	8.75	9.6	1.52	0.207	0.688	1.6	2.288	0.015
Lower Wabash	803	1	8/2/2004	2	Summer	Epipsammic	106.64	70.3	0.94	0.206	0.153	0.0599	0.2129	0.015
Lower Wabash	803	1	9/15/2004	3	Fall	Epipsammic	9.56	56.4	0.48	0.342	0.125	0.05	0.175	0.015
Lower Wabash	804	1	7/19/2004	1	Summer	Epipsammic	12.38	125.8	3.12	0.917	0.807	0.362	1.169	0.105
Lower Wabash	804	1	8/31/2004	2	Summer	Epipsammic	87.16	148.8	1.05	0.579	0.638	0.352	0.99	0.13
Lower Wabash	804	1	10/4/2004	3	Fall	Epipsammic	14.99	87.8	1.09	0.44	0.25	0.3	0.55	0.06
Lower Wabash	805	5	6/29/2004	1	Summer	Epipsammic	0.41	12.8	3.79	0.385	0.256	13.4	13.656	0.031
Lower Wabash	805	5	8/3/2004	2	Summer	Epipsammic	64.37	96.6	7.03	1.27	0.356	0.647	1.003	0.036
Lower Wabash	805	5	9/22/2004	3	Fall	Epipsammic	60.61	102.8	3.19	0.52	0.25	0.4	0.65	0.015
Lower Wabash	807	2	6/22/2004	1	Summer	Epipsammic	33.22	156.9	1.67	0.47	0.285	24.2	24.485	0.103
Lower Wabash	807	2	7/27/2004	2	Summer	Epipsammic	64.07	207.0	0.98	0.748	0.588	2.31	2.898	0.083
Lower Wabash	807	2	9/14/2004	3	Fall	Epipsammic	153.76	136.2	10.56	2.091	0.25	0.2	0.45	0.417
Lower Wabash	808	1	7/20/2004	1	Summer	Epilithic	1.63	136.8	0.40	0.637	0.483	0.0369	0.5199	0.033
Lower Wabash	808	1	8/31/2004	2	Summer	Epilithic	34.84	213.6	0.72	0.537	0.25	0.0267	0.2767	0.039
Lower Wabash	808	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	810	2	6/28/2004	1	Summer	Epilithic	618.02	132.1	3.66	0.727	* *	0.744	* *	0.093
Lower Wabash	810	2	8/2/2004	2	Summer	Epilithic	213.77	117.7	4.32	0.784	0.714	0.218	0.932	0.046
Lower Wabash	810	2	9/14/2004	3	Fall	Epilithic	174.23	240.3	2.84	0.686	0.304	0.05	0.354	0.057
Lower Wabash	811	1	6/23/2004	1	Summer	Epipsammic	72.04	139.2	18.73	1.102	0.847	11.9	12.747	0.05
Lower Wabash	811	1	7/27/2004	2	Summer	Epipsammic	66.47	233.9	1.75	0.485	0.494	0.252	0.746	0.057
Lower Wabash	811	1	9/14/2004	3	Fall	Epipsammic	57.22	210.6	1.07	0.308	0.503	2.1	2.603	0.044

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

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Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Lower Wabash	812	1	7/21/2004	1	Summer	Epilithic	14.36	198.1	2.22	0.736	0.279	0.529	0.808	0.074
Lower Wabash	812	1	9/1/2004	2	Fall	Epilithic	5.56	170.8	6.36	0.768	0.687	0.43	1.117	0.116
Lower Wabash	812	1	10/5/2004	3	Fall	Epilithic	35.43	132.1	0.82	0.384	0.25	0.05	0.3	0.07
Lower Wabash	813	3	6/30/2004	1	Summer	Epipsammic	72.40	39.0	1.43	0.24	0.384	0.108	0.492	0.031
Lower Wabash	813	3	8/4/2004	2	Summer	Epipsammic	57.46	65.1	9.55	0.767	0.309	0.3	0.609	0.015
Lower Wabash	813	3	9/22/2004	3	Fall	Epipsammic	49.99	91.3	0.74	0.426	0.25	0.05	0.3	0.015
Lower Wabash	814	3	7/20/2004	1	Summer	Epipsammic	88.11	152.8	1.29	1.022	0.619	0.387	1.006	0.152
Lower Wabash	814	3	8/30/2004	2	Summer	Epipsammic	92.87	167.7	1.27	0.698	0.643	0.424	1.067	0.2
Lower Wabash	814	3	10/4/2004	3	Fall	Epipsammic	19.38	58.3	2.71	0.984	0.6	0.05	0.65	0.24
Lower Wabash	815	2	6/22/2004	1	Summer	Epilithic	64.10	74.4	2.03	0.563	0.681	6.82	7.501	0.076
Lower Wabash	815	2	7/26/2004	2	Summer	Epilithic	156.72	256.2	2.15	0.482	0.586	0.298	0.884	0.042
Lower Wabash	815	2	9/13/2004	3	Fall	Epilithic	77.39	200.2	0.92	0.464	0.25	0.05	0.3	0.095
Lower Wabash	817	3	7/14/2004	1	Summer	Epilithic	635.40	320.2	5.96	1.628	* *	2.64	* *	0.123
Lower Wabash	817	3	8/17/2004	2	Summer	Epilithic	765.97	317.7	14.95	2.193	0.534	0.254	0.788	0.033
Lower Wabash	817	3	9/21/2004	3	Fall	Epilithic	901.91	464.5	4.40	1.067	0.25	0.3	0.55	0.048
Lower Wabash	819	2	6/29/2004	1	Summer	Epilithic	111.85	77.3	0.95	0.198	0.336	0.753	1.089	0.033
Lower Wabash	819	2	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	819	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	820	2	7/21/2004	1	Summer	Epilithic	9.79	121.1	4.70	0.523	0.584	0.616	1.2	0.045
Lower Wabash	820	2	9/1/2004	2	Fall	Epilithic	24.89	168.1	1.10	0.352	0.248	0.294	0.542	0.055
Lower Wabash	820	2	10/5/2004	3	Fall	Epilithic	19.65	120.1	0.57	0.186	0.25	0.05	0.3	0.025
Lower Wabash	821	1	6/29/2004	1	Summer	Epilithic	98.21	168.5	9.58	0.328	0.732	1.04	1.772	0.055
Lower Wabash	821	1	8/3/2004	2	Summer	Epilithic	61.06	95.2	1.57	0.905	1.85	0.123	1.973	0.054
Lower Wabash	821	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	822	5	6/24/2004	1	Summer	Epilithic	210.30	137.8	2.23	0.425	0.541	7.42	7.961	0.061
Lower Wabash	822	5	7/28/2004	2	Summer	Epilithic	335.09	348.2	2.71	0.719	0.365	0.978	1.343	0.046
Lower Wabash	822	5	9/16/2004	3	Fall	Epilithic	256.27	213.5	3.42	0.732	0.25	0.5	0.75	0.063
Lower Wabash	823	3	6/23/2004	1	Summer	Epilithic	25.41	42.4	5.52	0.784	1.04	10.3	11.34	0.129
Lower Wabash	823	3	7/27/2004	2	Summer	Epilithic	98.41	210.9	1.10	0.223	0.05	3.27	3.32	0.018
Lower Wabash	823	3	9/14/2004	3	Fall	Epilithic	572.94	320.3	1.44	0.244	0.125	3.3	3.425	0.015

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Lower Wabash	824	1	7/20/2004	1	Summer	Epipsammic	7.57	201.1	2.28	1.101	0.37	2.11	2.48	0.056
Lower Wabash	824	1	8/31/2004	2	Summer	* *	* *	* *	0.66	0.399	0.555	2.63	3.185	0.062
Lower Wabash	824	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	825	3	7/1/2004	1	Summer	Epipsammic	38.49	48.1	1.31	0.283	0.374	0.177	0.551	0.015
Lower Wabash	825	3	8/4/2004	2	Summer	Epipsammic	257.80	82.4	10.74	1.011	0.265	0.249	0.514	0.015
Lower Wabash	825	3	9/23/2004	3	Fall	Epipsammic	82.84	78.9	1.01	0.469	0.25	0.1	0.35	0.015
Lower Wabash	826	3	7/14/2004	1	Summer	Epilithic	227.18	235.7	1.03	0.413	* *	18	* *	0.051
Lower Wabash	826	3	8/16/2004	2	Summer	Epilithic	536.47	328.3	0.77	0.391	0.517	2.89	3.407	0.034
Lower Wabash	826	3	9/21/2004	3	Fall	Epilithic	881.60	250.9	0.89	0.303	0.25	4	4.25	0.015
Lower Wabash	827	1	6/21/2004	1	Summer	Epipsammic	75.62	91.3	3.47	0.532	0.551	13.9	14.451	0.05
Lower Wabash	827	1	7/26/2004	2	Summer	Epipsammic	66.98	205.5	34.72	2.753	1.18	0.965	2.145	0.129
Lower Wabash	827	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	828	7	7/21/2004	1	Summer	Epidendric	0.84	7.3	71.12	6.891	1.43	3.68	5.11	0.095
Lower Wabash	828	7	8/24/2004	2	Summer	Epidendric	2.32	12.3	99.17	8.531	1.8	0.688	2.488	0.142
Lower Wabash	828	7	10/5/2004	3	Fall	Epidendric	28.89	23.8	72.53	9.082	0.25	0.6	0.85	0.025
Lower Wabash	829	3	6/30/2004	1	Summer	Epipsammic	11.54	35.7	1.89	0.353	0.415	0.564	0.979	0.015
Lower Wabash	829	3	8/4/2004	2	Summer	Epipsammic	33.83	80.3	7.52	1.271	0.389	0.0395	0.4285	0.045
Lower Wabash	829	3	9/22/2004	3	Fall	Epipsammic	102.08	82.8	2.93	2.366	0.25	0.05	0.3	0.039
Lower Wabash	830	2	7/19/2004	1	Summer	Epipsammic	26.34	81.5	14.34	1.464	1.19	0.11	1.3	0.17
Lower Wabash	830	2	8/30/2004	2	Summer	Epipsammic	27.04	63.4	0.81	0.572	0.405	0.0786	0.4836	0.075
Lower Wabash	830	2	10/4/2004	3	Fall	Epipsammic	31.85	105.5	1.04	0.642	0.25	0.05	0.3	0.06
Lower Wabash	832	1	7/21/2004	1	Summer	Epipsammic	11.05	47.4	0.81	0.372	0.508	2.44	2.948	0.113
Lower Wabash	832	1	9/1/2004	2	Fall	Epipsammic	2.86	60.4	1.01	0.535	0.238	2.67	2.908	0.119
Lower Wabash	832	1	10/5/2004	3	Fall	Epipsammic	17.18	70.2	1.44	0.73	0.25	0.05	0.3	0.11
Lower Wabash	833	4	7/1/2004	1	Summer	Epilithic	479.53	232.8	7.11	0.56	0.318	7.25	7.568	0.037
Lower Wabash	833	4	8/2/2004	2	Summer	Epilithic	848.41	415.5	2.82	0.535	0.301	2.27	2.571	0.053
Lower Wabash	833	4	9/16/2004	3	Fall	Epilithic	652.85	320.3	2.52	0.373	0.25	0.6	0.85	0.036
Lower Wabash	834	4	7/13/2004	1	Summer	Epilithic	97.66	170.5	6.44	1.455	* *	6.9	* *	0.098
Lower Wabash	834	4	8/16/2004	2	Summer	Epilithic	443.46	312.3	2.45	0.678	0.399	1.36	1.759	0.04
Lower Wabash	834	4	9/20/2004	3	Fall	Epilithic	476.20	248.3	2.31	0.517	0.25	1.8	2.05	0.015

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

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Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Lower Wabash	835	8	7/19/2004	1	Summer	Epidendric	7.63	22.2	114.22	7.563	1.73	4.95	6.68	0.097
Lower Wabash	835	8	8/23/2004	2	Summer	Epidendric	2.97	12.3	64.65	4.535	1.37	1.26	2.63	0.161
Lower Wabash	835	8	10/4/2004	3	Fall	Epidendric	15.87	29.9	137.91	8.667	0.6	0.9	1.5	0.025
Lower Wabash	836	8	7/22/2004	1	Summer	Epidendric	3.26	8.3	102.01	5.685	1.61	2.29	3.9	0.112
Lower Wabash	836	8	8/25/2004	2	Summer	Epidendric	2.05	17.0	140.28	8.55	1.6	0.0632	1.6632	0.107
Lower Wabash	836	8	10/6/2004	3	Fall	Epidendric	7.31	17.3	111.46	7.029	0.25	0.05	0.3	0.025
Lower Wabash	837	8	7/19/2004	1	Summer	Epidendric	3.48	10.6	146.23	6.731	2.23	2.36	4.59	0.099
Lower Wabash	837	8	8/23/2004	2	Summer	Epidendric	7.48	11.7	63.67	6.945	1.55	1.2	2.75	0.157
Lower Wabash	837	8	10/4/2004	3	Fall	Epidendric	23.89	28.2	145.06	8.119	0.25	0.9	1.15	0.025
Lower Wabash	838	3	6/24/2004	1	Summer	Epidendric	8.13	12.6	1.41	1.191	0.05	9.1	9.15	0.078
Lower Wabash	838	3	7/28/2004	2	Summer	Epidendric	3.68	16.5	0.77	0.917	0.349	0.251	0.6	0.094
Lower Wabash	838	3	9/16/2004	3	Fall	Epidendric	4.18	11.9	1.32	1.087	0.25	0.1	0.35	0.135
Lower Wabash	839	1	6/23/2004	1	Summer	Epilithic	1.09	30.4	0.03	0.06	0.136	0.504	0.64	0.035
Lower Wabash	839	1	7/27/2004	2	Summer	Epilithic	9.40	127.0	0.25	0.06	0.05	0.59	0.64	0.021
Lower Wabash	839	1	9/13/2004	3	Fall	Epilithic	75.63	136.1	0.54	0.06	0.125	0.5	0.625	0.015
Lower Wabash	841	2	7/15/2004	1	Summer	Epipsammic	1.96	40.4	48.87	3.434	1.94	3.07	5.01	0.097
Lower Wabash	841	2	8/17/2004	2	Summer	Epipsammic	43.71	85.9	2.17	0.565	0.337	0.549	0.886	0.061
Lower Wabash	841	2	9/21/2004	3	Fall	Epipsammic	34.09	93.8	1.00	0.424	0.25	0.2	0.45	0.053
Lower Wabash	842	7	7/20/2004	1	Summer	Epidendric	0.90	5.3	145.00	7.123	1.89	3.49	5.38	0.102
Lower Wabash	842	7	8/23/2004	2	Summer	Epidendric	7.82	12.4	41.70	4.486	1.48	1.69	3.17	0.175
Lower Wabash	842	7	10/4/2004	3	Fall	Epidendric	7.62	21.1	86.87	4.63	0.7	1.3	2	0.025
Lower Wabash	843	2	7/15/2004	1	Summer	Epilithic	168.57	187.1	2.77	0.511	0.05	9.17	9.22	0.048
Lower Wabash	843	2	8/17/2004	2	Summer	Epilithic	689.54	411.1	0.98	0.387	0.258	0.0521	0.3101	0.015
Lower Wabash	843	2	9/20/2004	3	Fall	Epilithic	768.26	274.9	1.60	0.358	0.25	4	4.25	0.015
Lower Wabash	844	7	7/21/2004	1	Summer	Epidendric	2.79	11.1	68.81	6.896	1.73	4.6	6.33	0.109
Lower Wabash	844	7	8/24/2004	2	Summer	Epidendric	2.66	12.2	83.22	8.96	1.12	0.803	1.923	0.131
Lower Wabash	844	7	10/5/2004	3	Fall	Epidendric	27.45	34.0	116.78	9.22	0.25	0.6	0.85	0.025
Lower Wabash	845	3	6/30/2004	1	Summer	Epilithic	131.86	282.3	3.18	0.536	0.311	0.194	0.505	0.015
Lower Wabash	845	3	8/4/2004	2	Summer	Epilithic	148.91	220.1	3.00	1.497	0.271	0.162	0.433	0.049
Lower Wabash	845	3	10/6/2004	3	Fall	Epilithic	52.48	117.7	0.54	0.254	0.25	0.05	0.3	0.025

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Lower Wabash	846	7	7/20/2004	1	Summer	Epidendric	0.94	6.7	118.77	7.097	1.68	4.27	5.95	0.087
Lower Wabash	846	7	8/24/2004	2	Summer	Epidendric	5.70	13.0	60.38	5.506	1.48	1.13	2.61	0.123
Lower Wabash	846	7	10/5/2004	3	Fall	Epidendric	13.85	23.2	144.23	7.922	0.25	0.7	0.95	0.025
Lower Wabash	847	3	6/21/2004	1	Summer	Epilithic	304.18	321.3	1.70	0.312	0.701	8.13	8.831	0.075
Lower Wabash	847	3	7/26/2004	2	Summer	Epilithic	1553.74	696.7	7.38	0.794	0.58	0.197	0.777	0.081
Lower Wabash	847	3	9/13/2004	3	Fall	Epilithic	146.71	296.3	4.57	1.251	0.25	0.05	0.3	0.148
Lower Wabash	848	8	7/21/2004	1	Summer	Epidendric	7.83	10.7	93.26	6.179	1.21	1.43	2.64	0.107
Lower Wabash	848	8	8/25/2004	2	Summer	Epidendric	1.66	26.7	165.99	10.492	1.89	0.0886	1.9786	0.087
Lower Wabash	848	8	10/6/2004	3	Fall	Epidendric	11.33	26.5	116.61	8.419	0.25	0.05	0.3	0.025
Lower Wabash	849	2	7/14/2004	1	Summer	Epilithic	120.35	175.0	4.00	0.331	0.05	5.48	5.53	0.057
Lower Wabash	849	2	8/17/2004	2	Summer	Epilithic	294.43	176.1	1.27	0.297	0.327	0.117	0.444	0.033
Lower Wabash	849	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Lower Wabash	850	2	6/24/2004	1	Summer	Epipsammic	195.15	174.6	1.98	0.451	* *	5.19	* *	0.045
Lower Wabash	850	2	7/28/2004	2	Summer	Epipsammic	27.59	172.8	1.00	0.418	0.263	1.41	1.673	0.033
Lower Wabash	850	2	9/15/2004	3	Fall	Epipsammic	46.70	136.7	8.63	6.905	0.25	0.3	0.55	0.053
Lower Wabash	851	1	6/24/2004	1	Summer	Epipsammic	34.37	52.6	1.34	0.175	* *	7.61	* *	0.037
Lower Wabash	851	1	7/28/2004	2	Summer	Epipsammic	212.43	143.2	4.28	0.426	0.344	0.477	0.821	0.048
Lower Wabash	851	1	9/15/2004	3	Fall	Epipsammic	144.55	113.3	4.48	0.481	0.25	0.6	0.85	0.078
Lower Wabash	852	2	6/28/2004	1	Summer	Epilithic	164.89	44.3	9.53	0.505	1.02	5.75	6.77	0.047
Lower Wabash	852	2	8/3/2004	2	Summer	Epilithic	71.27	69.2	2.02	0.546	0.177	0.364	0.541	0.053
Lower Wabash	852	2	9/14/2004	3	Fall	Epilithic	210.31	189.5	1.68	0.381	0.25	0.2	0.45	0.037
Great Lakes	001	2	5/31/2005	1	Spring	Epipsammic	56.44	302.0	8.26	1.731	0.25	0.8	1.05	0.025
Great Lakes	001	2	7/14/2005	2	Summer	Epipsammic	32.78	287.0	6.16	1.178	0.5	0.05	0.55	0.12
Great Lakes	001	2	10/4/2005	3	Fall	Epipsammic	26.50	402.3	17.73	2.322	0.25	0.05	0.3	0.12
Great Lakes	003	1	5/23/2005	1	Spring	Epipsammic	152.83	60.8	4.55	1.528	1.3	0.49	1.79	0.3
Great Lakes	003	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	003	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	004	1	6/14/2005	1	Summer	Epipsammic	31.51	326.4	1.26	0.657	1	16	17	0.18
Great Lakes	004	1	7/18/2005	2	Summer	Epipsammic	27.09	235.1	14.46	1.873	* *	0.05	* *	0.1
Great Lakes	004	1	10/3/2005	3	Fall	Epipsammic	73.14	292.9	8.75	1.746	0.25	0.05	0.3	0.08

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Great Lakes	005	2	5/31/2005	1	Spring	Epipsammic	65.41	148.3	0.75	0.731	0.25	0.29	0.54	0.1
Great Lakes	005	2	7/13/2005	2	Summer	Epipsammic	8.45	58.9	2.26	1.847	0.5	0.5	1	0.1
Great Lakes	005	2	9/8/2005	3	Fall	Epipsammic	62.67	215.4	1.69	0.438	0.25	2.5	2.75	0.025
Great Lakes	007	3	6/1/2005	1	Summer	Epipsammic	33.18	262.0	1.94	0.706	0.7	1.4	2.1	0.11
Great Lakes	007	3	7/13/2005	2	Summer	Epipsammic	70.55	314.9	4.16	0.764	0.5	1	1.5	0.15
Great Lakes	007	3	10/4/2005	3	Fall	Epipsammic	99.94	282.0	2.09	0.338	0.25	0.19	0.44	0.06
Great Lakes	008	5	6/8/2005	1	Summer	Epipsammic	48.89	76.4	119.99	8.936	0.25	0.05	0.3	0.39
Great Lakes	008	5	7/19/2005	2	Summer	Epipsammic	24.72	79.9	102.91	7.814	* *	0.66	* *	0.4
Great Lakes	008	5	9/6/2005	3	Fall	Epipsammic	28.89	149.7	16.08	2.487	0.9	4.7	5.6	0.47
Great Lakes	009	5	6/7/2005	1	Summer	Epidendric	27.29	11.6	54.41	3.2	0.25	0.49	0.74	0.16
Great Lakes	009	5	8/10/2005	2	Summer	Epidendric	9.73	22.9	64.18	4.518	0.6	0.05	0.65	0.23
Great Lakes	009	5	10/18/2005	3	Fall	Epidendric	21.42	14.7	8.73	0.955	0.5	0.4	0.9	0.13
Great Lakes	011	4	5/24/2005	1	Spring	Epipsammic	65.46	103.8	4.91	1.419	0.25	0.99	1.24	0.1
Great Lakes	011	4	7/12/2005	2	Summer	Epipsammic	261.34	148.3	4.77	0.523	0.5	1.1	1.6	0.12
Great Lakes	011	4	9/8/2005	3	Fall	Epipsammic	188.27	139.7	1.20	0.305	0.25	2.3	2.55	0.25
Great Lakes	014	2	5/17/2005	1	Spring	Epipsammic	168.69	144.7	1.99	0.585	0.25	1.3	1.55	0.05
Great Lakes	014	2	7/6/2005	2	Summer	Epipsammic	20.04	242.6	0.93	0.894	0.25	0.05	0.3	0.21
Great Lakes	014	2	9/6/2005	3	Fall	Epipsammic	11.62	72.9	0.65	0.343	0.25	0.14	0.39	0.025
Great Lakes	016	3	6/15/2005	1	Summer	Epipsammic	88.83	102.3	1.84	0.551	0.7	5.8	6.5	0.15
Great Lakes	016	3	7/19/2005	2	Summer	Epipsammic	31.12	82.4	3.71	2.569	* *	2.2	* *	0.76
Great Lakes	016	3	9/7/2005	3	Fall	Epipsammic	139.81	104.0	1.05	0.525	0.25	0.05	0.3	0.16
Great Lakes	018	4	5/25/2005	1	Spring	Epipsammic	77.80	130.7	1.76	0.886	0.25	2.5	2.75	0.08
Great Lakes	018	4	7/11/2005	2	Summer	Epipsammic	61.08	131.8	10.91	1.148	0.5	1.7	2.2	0.1
Great Lakes	018	4	10/5/2005	3	Fall	Epipsammic	35.59	200.1	2.29	0.594	0.25	1.8	2.05	0.1
Great Lakes	019	2	6/1/2005	1	Summer	Epilithic	169.94	181.5	1.50	0.34	0.6	4.7	5.3	0.025
Great Lakes	019	2	7/13/2005	2	Summer	Epilithic	37.70	205.5	0.53	0.635	0.5	2.9	3.4	0.2
Great Lakes	019	2	10/17/2005	3	Fall	Epilithic	6.70	136.1	0.83	1.794	0.8	0.05	0.85	0.44
Great Lakes	023	5	5/25/2005	1	Spring	Epipsammic	84.14	220.6	5.69	2.268	0.25	0.87	1.12	0.14
Great Lakes	023	5	7/13/2005	2	Summer	Epipsammic	38.92	167.2	3.16	1.171	0.5	0.4	0.9	0.12
Great Lakes	023	5	10/5/2005	3	Fall	Epipsammic	17.82	128.8	1.63	1.159	0.25	1.6	1.85	0.1

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Great Lakes	024	2	6/14/2005	1	Summer	Epilithic	104.66	170.9	1.14	0.794	0.6	4.4	5	0.16
Great Lakes	024	2	7/19/2005	2	Summer	Epilithic	153.78	202.9	2.31	0.633	* *	0.05	* *	0.06
Great Lakes	024	2	9/7/2005	3	Fall	Epilithic	134.11	202.9	8.97	0.879	0.25	4.4	4.65	0.1
Great Lakes	026	4	5/18/2005	1	Spring	Epilithic	663.05	266.9	3.89	0.544	0.25	2.4	2.65	0.11
Great Lakes	026	4	7/7/2005	2	Summer	Epilithic	729.02	275.0	13.04	1.041	0.25	2.2	2.45	0.16
Great Lakes	026	4	9/7/2005	3	Fall	Epilithic	765.58	248.2	3.29	0.395	0.25	2.4	2.65	0.08
Great Lakes	027	2	5/24/2005	1	Spring	Epipsammic	23.57	151.2	2.34	0.881	0.25	0.96	1.21	0.09
Great Lakes	027	2	7/12/2005	2	Summer	Epipsammic	6.95	387.3	23.79	5.384	0.5	0.05	0.55	0.09
Great Lakes	027	2	9/8/2005	3	Fall	Epipsammic	8.92	252.6	2.12	1.761	0.25	0.05	0.3	0.24
Great Lakes	028	4	6/2/2005	1	Summer	Epipsammic	140.99	178.2	4.13	1.385	0.25	2.1	2.35	0.14
Great Lakes	028	4	7/20/2005	2	Summer	Epipsammic	33.23	93.3	10.96	2.15	* *	2.4	* *	0.16
Great Lakes	028	4	9/7/2005	3	Fall	Epipsammic	103.22	159.7	1.44	0.449	0.6	0.39	0.99	0.15
Great Lakes	029	4	6/13/2005	1	Summer	Epidendric	18.55	17.1	3.20	1.412	0.25	1.2	1.45	0.07
Great Lakes	029	4	8/9/2005	2	Summer	Epidendric	28.87	27.2	2.84	0.815	1	0.7	1.7	0.05
Great Lakes	029	4	10/6/2005	3	Fall	Epidendric	32.41	35.9	2.26	0.999	0.25	0.57	0.82	0.09
Great Lakes	030	3	5/16/2005	1	Spring	Epipsammic	195.63	191.6	1.42	0.665	0.25	1.8	2.05	0.28
Great Lakes	030	3	7/6/2005	2	Summer	Epipsammic	27.04	135.3	1.04	1.007	0.6	3.7	4.3	0.48
Great Lakes	030	3	9/6/2005	3	Fall	Epipsammic	40.94	115.3	0.76	0.359	0.25	4.2	4.45	0.49
Great Lakes	034	3	5/24/2005	1	Spring	Epilithic	390.77	245.5	2.67	0.474	0.25	9.2	9.45	0.08
Great Lakes	034	3	7/11/2005	2	Summer	Epilithic	1012.61	365.7	160.53	5.065	1.7	7.1	8.8	0.09
Great Lakes	034	3	9/8/2005	3	Fall	Epilithic	240.80	224.2	2.07	0.437	0.5	7.6	8.1	0.025
Great Lakes	036	1	6/14/2005	1	Summer	Epilithic	32.59	181.5	0.83	0.441	0.25	9.4	9.65	0.13
Great Lakes	036	1	7/18/2005	2	Summer	Epilithic	65.28	165.4	36.03	1.72	* *	1.4	* *	0.26
Great Lakes	036	1	10/3/2005	3	Fall	Epilithic	53.78	189.5	24.16	7.945	4.1	0.57	4.67	0.91
Great Lakes	038	3	5/19/2005	1	Spring	Epipsammic	34.05	365.4	10.37	4.992	0.873	0.4	1.273	0.33
Great Lakes	038	3	7/7/2005	2	Summer	Epipsammic	5.85	263.0	1.60	1.046	1.1	0.05	1.15	0.5
Great Lakes	038	3	9/7/2005	3	Fall	Epipsammic	16.75	265.5	15.68	7.947	1.3	0.05	1.35	0.43
Great Lakes	039	3	5/25/2005	1	Spring	Epilithic	136.87	197.5	0.92	0.338	0.7	5.2	5.9	0.07
Great Lakes	039	3	7/12/2005	2	Summer	Epilithic	398.85	288.3	1.56	0.405	0.5	4.1	4.6	0.09
Great Lakes	039	3	10/5/2005	3	Fall	Epilithic	102.74	149.5	0.91	0.444	0.25	4.6	4.85	0.09

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Great Lakes	041	1	6/1/2005	1	Summer	Epipsammic	357.76	171.7	3.58	0.536	1.3	4.9	6.2	0.13
Great Lakes	041	1	7/20/2005	2	Summer	Epipsammic	35.50	241.6	1.78	1.12	* *	5.6	* *	0.2
Great Lakes	041	1	9/8/2005	3	Fall	Epipsammic	49.80	190.5	2.17	2.635	0.6	2.9	3.5	0.36
Great Lakes	042	3	5/18/2005	1	Spring	Epipsammic	100.15	167.7	1.74	0.632	0.25	1.4	1.65	0.025
Great Lakes	042	3	7/21/2005	2	Summer	Epipsammic	75.78	150.2	3.14	3.069	* *	0.69	* *	0.025
Great Lakes	042	3	9/7/2005	3	Fall	Epipsammic	47.60	128.8	1.14	0.616	0.25	0.97	1.22	0.025
Great Lakes	044	2	6/7/2005	1	Summer	Epipsammic	25.98	136.7	5.05	1.347	1.4	0.05	1.45	0.12
Great Lakes	044	2	7/19/2005	2	Summer	Epipsammic	28.75	143.7	5.67	2.696	* *	1.4	* *	0.12
Great Lakes	044	2	9/7/2005	3	Fall	Epipsammic	36.51	126.4	5.52	1.102	0.25	0.17	0.42	0.09
Great Lakes	045	4	6/13/2005	1	Summer	Epipsammic	27.64	60.4	2.99	1.209	0.25	1.2	1.45	0.09
Great Lakes	045	4	8/9/2005	2	Summer	Epipsammic	17.07	98.4	1.46	0.374	0.25	0.76	1.01	0.025
Great Lakes	045	4	10/6/2005	3	Fall	Epipsammic	30.23	445.7	0.73	0.32	0.25	0.82	1.07	0.05
Great Lakes	047	2	5/17/2005	1	Spring	Epipsammic	60.63	138.7	2.40	1.944	0.25	0.4	0.65	0.12
Great Lakes	047	2	7/7/2005	2	Summer	Epipsammic	8.83	126.8	0.82	2.693	0.25	0.34	0.59	0.1
Great Lakes	047	2	9/7/2005	3	Fall	Epipsammic	30.84	138.7	1.05	0.83	0.25	0.33	0.58	0.09
Great Lakes	050	1	5/18/2005	1	Spring	Epidendric	2.34	6.3	2.82	4.02	0.25	0.05	0.3	0.12
Great Lakes	050	1	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	050	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	051	1	6/1/2005	1	Summer	Epilithic	523.10	333.8	2.06	0.915	0.25	4.9	5.15	0.06
Great Lakes	051	1	7/20/2005	2	Summer	Epilithic	38.89	160.2	7.68	1.063	* *	1.6	* *	0.11
Great Lakes	051	1	10/4/2005	3	Fall	Epilithic	59.44	157.5	1.38	0.358	0.25	2.1	2.35	0.07
Great Lakes	052	1	5/17/2005	1	Spring	Epipsammic	20.44	194.6	0.48	0.45	0.25	0.05	0.3	0.08
Great Lakes	052	1	7/6/2005	2	Summer	Epipsammic	88.32	314.9	1.64	0.752	0.25	0.05	0.3	0.09
Great Lakes	052	1	9/6/2005	3	Fall	Epipsammic	28.67	149.7	0.76	0.593	0.7	0.05	0.75	0.025
Great Lakes	053	4	6/14/2005	1	Summer	Epipsammic	83.03	258.5	3.21	1.252	0.25	1.3	1.55	0.08
Great Lakes	053	4	8/9/2005	2	Summer	Epipsammic	60.78	248.5	3.20	0.512	0.25	0.78	1.03	0.025
Great Lakes	053	4	10/6/2005	3	Fall	Epipsammic	196.31	64.4	0.62	0.285	0.25	0.82	1.07	0.07
Great Lakes	056	2	5/18/2005	1	Spring	Epilithic	15.73	138.8	1.25	0.557	0.25	1.7	1.95	0.08
Great Lakes	056	2	7/11/2005	2	Summer	Epilithic	128.84	197.5	0.60	0.429	0.5	1.5	2	0.025
Great Lakes	056	2	9/7/2005	3	Fall	Epilithic	85.03	200.2	0.70	0.355	0.25	1.3	1.55	0.025

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Great Lakes	057	1	5/23/2005	1	Spring	Epipsammic	214.51	174.2	16.75	2.444	4.7	7	11.7	1.3
Great Lakes	057	1	7/12/2005	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	057	1	10/6/2005	3	Fall	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	059	5	6/7/2005	1	Summer	Epidendric	17.11	10.9	57.78	6.106	0.25	0.22	0.47	0.1
Great Lakes	059	5	8/10/2005	2	Summer	Epidendric	90.43	35.8	28.64	2.879	0.9	0.05	0.95	0.15
Great Lakes	059	5	10/18/2005	3	Fall	Epidendric	92.43	17.9	16.41	1.583	0.8	0.4	1.2	0.14
Great Lakes	060	4	5/26/2005	1	Spring	Epipsammic	23.26	97.3	2.29	0.872	0.25	2.5	2.75	0.12
Great Lakes	060	4	8/8/2005	2	Summer	Epipsammic	48.19	314.9	1.04	0.545	0.25	2.3	2.55	0.06
Great Lakes	060	4	10/5/2005	3	Fall	Epipsammic	22.36	208.1	0.91	0.431	0.25	2.2	2.45	0.11
Great Lakes	061	2	5/24/2005	1	Spring	Epipsammic	111.03	129.8	0.95	0.578	0.25	2.5	2.75	0.11
Great Lakes	061	2	7/12/2005	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	061	2	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Great Lakes	062	2	6/8/2005	1	Summer	Epidendric	49.18	36.4	65.14	5.544	0.6	2.3	2.9	0.27
Great Lakes	062	2	8/10/2005	2	Summer	Epidendric	17.36	29.1	33.09	2.673	1.8	3.3	5.1	0.4
Great Lakes	062	2	10/18/2005	3	Fall	Epidendric	26.14	12.5	16.47	1.777	1.9	4.5	6.4	0.27
Great Lakes	065	1	5/25/2005	1	Spring	Epipsammic	220.30	175.2	1.91	0.495	0.25	16	16.25	0.55
Great Lakes	065	1	7/13/2005	2	Summer	Epipsammic	51.72	234.6	0.48	0.458	0.5	24	24.5	1.1
Great Lakes	065	1	10/4/2005	3	Fall	Epipsammic	40.23	233.1	0.41	0.304	0.25	24	24.25	0.32
Great Lakes	066	5	6/8/2005	1	Summer	Epipsammic	70.40	259.0	146.23	8.336	0.25	0.05	0.3	0.47
Great Lakes	066	5	7/19/2005	2	Summer	Epipsammic	79.51	159.8	73.48	7.21	* *	0.57	* *	0.48
Great Lakes	066	5	9/6/2005	3	Fall	Epipsammic	91.69	366.8	15.82	6.13	1.3	0.1	1.4	0.38
Great Lakes	068	5	6/9/2005	1	Summer	Epidendric	38.11	16.7	2.91	0.479	0.25	1.4	1.65	0.025
Great Lakes	068	5	8/9/2005	2	Summer	Epidendric	19.28	18.7	1.80	0.523	0.25	4.5	4.75	0.025
Great Lakes	068	5	10/19/2005	3	Fall	Epidendric	30.84	30.9	0.94	0.33	5.3	1.5	6.8	0.07
Great Lakes	069	3	6/2/2005	1	Summer	Epipsammic	49.10	90.3	2.12	0.805	0.25	0.66	0.91	0.1
Great Lakes	069	3	7/20/2005	2	Summer	Epipsammic	8.43	60.9	9.22	2.796	* *	4.7	* *	0.15
Great Lakes	069	3	10/3/2005	3	Fall	Epipsammic	36.59	78.9	2.31	0.901	0.25	0.59	0.84	0.05
Ohio River	102	2	5/16/2005	1	Spring	Epipsammic	40.18	131.3	2.20	0.583	1.5	12	13.5	0.2
Ohio River	102	2	7/5/2005	2	Summer	Epipsammic	69.99	200.7	11.15	2.822	* *	2	* *	0.59
Ohio River	102	2	9/12/2005	3	Fall	Epipsammic	37.65	143.8	10.94	0.772	0.63	0.18	0.81	0.17

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m^2, milligrams per square meter; g/m^2, grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m^2)	AFDM (g/m^2)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Ohio River	103	4	6/1/2005	1	Summer	Epidendric	5.63	5.1	0.73	0.252	* *	2	* *	0.025
Ohio River	103	4	7/13/2005	2	Summer	Epidendric	12.75	6.6	9.18	0.467	0.55	1.3	1.85	0.025
Ohio River	103	4	10/4/2005	3	Fall	Epidendric	19.32	9.4	0.86	0.279	0.34	0.9	1.24	0.025
Ohio River	104	2	5/31/2005	1	Spring	Epilithic	14.27	154.8	1.78	0.219	* *	0.41	* *	0.025
Ohio River	104	2	7/18/2005	2	Summer	Epilithic	11.26	62.7	5.41	0.554	* *	0.05	* *	0.025
Ohio River	104	2	9/14/2005	3	Fall	Epilithic	6.99	146.8	1.55	0.236	0.43	0.02	0.45	0.025
Ohio River	106	1	5/31/2005	1	Spring	Epilithic	4.47	168.1	1.18	0.256	* *	0.31	* *	0.025
Ohio River	106	1	7/11/2005	2	Summer	Epilithic	8.51	138.8	17.47	1.127	0.76	0.37	1.13	0.07
Ohio River	106	1	9/14/2005	3	Fall	Epilithic	49.45	157.5	19.94	0.625	0.52	0.02	0.54	0.025
Ohio River	109	1	5/19/2005	1	Spring	Epilithic	71.21	160.1	0.86	0.138	0.15	1.3	1.45	0.025
Ohio River	109	1	7/7/2005	2	Summer	Epilithic	8.40	109.4	0.35	0.13	* *	0.17	* *	0.025
Ohio River	109	1	9/14/2005	3	Fall	Epilithic	26.95	81.7	0.37	0.354	0.43	0.37	0.8	0.025
Ohio River	110	2	5/26/2005	1	Spring	Epilithic	36.73	146.8	1.39	0.215	0.15	0.26	0.41	0.025
Ohio River	110	2	7/11/2005	2	Summer	Epilithic	21.65	136.1	9.85	1.169	0.5	0.06	0.56	0.025
Ohio River	110	2	9/13/2005	3	Fall	Epilithic	37.39	72.1	1.46	0.459	0.37	0.02	0.39	0.025
Ohio River	111	2	5/25/2005	1	Spring	Epidendric	5.60	7.5	0.45	0.314	0.15	0.08	0.23	0.025
Ohio River	111	2	7/12/2005	2	Summer	Epidendric	3.07	10.3	3.25	1.001	0.73	0.02	0.75	0.06
Ohio River	111	2	9/14/2005	3	Fall	Epidendric	2.00	3.4	23.14	1.093	1	0.02	1.02	0.025
Ohio River	112	2	6/8/2005	1	Summer	Epilithic	38.19	141.5	1.87	0.336	0.57	0.32	0.89	0.12
Ohio River	112	2	7/20/2005	2	Summer	Epilithic	25.80	85.4	1.11	0.436	* *	0.24	* *	0.21
Ohio River	112	2	10/5/2005	3	Fall	Epilithic	21.11	96.1	0.66	0.27	0.62	0.17	0.79	0.25
Ohio River	113	1	5/24/2005	1	Spring	Epilithic	7.87	138.8	0.56	0.155	0.15	0.99	1.14	0.025
Ohio River	113	1	7/12/2005	2	Summer	Epilithic	56.50	72.1	0.71	0.196	0.45	0.97	1.42	0.025
Ohio River	113	1	10/3/2005	3	Fall	Epilithic	23.73	69.4	0.09	0.138	0.31	0.42	0.73	0.025
Ohio River	115	4	5/17/2005	1	Spring	Epidendric	38.70	28.1	3.89	1.134	0.96	3.8	4.76	0.2
Ohio River	115	4	- -	2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	115	4	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	116	2	6/8/2005	1	Summer	Epilithic	50.74	205.5	0.45	0.06	0.39	0.18	0.57	0.06
Ohio River	116	2	7/21/2005	2	Summer	Epilithic	62.48	82.8	1.05	0.221	* *	0.22	* *	0.09
Ohio River	116	2	10/6/2005	3	Fall	Epilithic	99.02	138.8	0.95	0.332	0.15	0.11	0.26	0.07

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Ohio River	119	4	6/22/2005	1	Summer	Epidendric	26.43	16.0	2.87	0.449	0.15	2.8	2.95	0.07
Ohio River	119	4	8/1/2005	2	Summer	Epidendric	102.35	44.2	6.87	0.677	0.51	1.2	1.71	0.09
Ohio River	119	4	10/11/2005	3	Fall	Epidendric	92.09	28.6	23.66	1.999	* *	0.64	* *	0.06
Ohio River	121	4	5/24/2005	1	Spring	Epilithic	29.79	146.8	1.44	0.421	0.34	1.3	1.64	0.025
Ohio River	121	4	7/12/2005	2	Summer	Epilithic	10.34	65.4	2.29	0.528	0.57	0.52	1.09	0.025
Ohio River	121	4	9/13/2005	3	Fall	Epilithic	19.11	144.2	1.41	0.346	0.54	0.45	0.99	0.025
Ohio River	122	1	6/7/2005	1	Summer	Epilithic	14.54	152.2	0.15	0.145	0.15	0.58	0.73	0.025
Ohio River	122	1	7/19/2005	2	Summer	Epilithic	10.07	69.4	0.40	0.161	* *	0.39	* *	0.07
Ohio River	122	1	9/15/2005	3	Fall	Epilithic	70.19	138.8	0.57	0.173	0.46	0.41	0.87	0.025
Ohio River	124	1	6/8/2005	1	Summer	Epilithic	30.27	152.1	1.66	0.963	0.52	0.25	0.77	0.12
Ohio River	124	1	7/20/2005	2	Summer	Epilithic	14.14	82.8	6.17	1.193	* *	0.18	* *	0.14
Ohio River	124	1	10/5/2005	3	Fall	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	125	4	5/17/2005	1	Spring	Epidendric	2.51	7.2	1.39	0.67	0.92	4.8	5.72	0.09
Ohio River	125	4	7/5/2005	2	Summer	Epidendric	6.14	6.5	3.34	0.835	2.5	0.09	2.59	0.11
Ohio River	125	4	9/13/2005	3	Fall	Epidendric	17.36	12.0	12.70	1.002	1.9	0.1	2	0.17
Ohio River	126	3	6/6/2005	1	Summer	Epilithic	71.37	157.5	1.49	0.332	0.39	1.9	2.29	0.025
Ohio River	126	3	7/19/2005	2	Summer	Epilithic	59.84	170.8	1.12	0.195	* *	0.61	* *	0.07
Ohio River	126	3	9/14/2005	3	Fall	Epilithic	49.29	141.5	2.36	0.688	0.43	1.1	1.53	0.025
Ohio River	127	2	5/25/2005	1	Spring	Epilithic	130.40	192.2	1.37	0.131	0.15	0.3	0.45	0.025
Ohio River	127	2	7/13/2005	2	Summer	Epilithic	16.53	141.5	1.81	0.466	0.45	0.09	0.54	0.025
Ohio River	127	2	9/14/2005	3	Fall	Epilithic	22.42	84.9	1.21	0.418	0.61	0.005	0.615	0.025
Ohio River	128	3	6/7/2005	1	Summer	Epilithic	15.29	133.5	0.52	0.21	0.35	0.07	0.42	0.06
Ohio River	128	3	7/20/2005	2	Summer	Epilithic	25.58	85.4	5.19	0.5	* *	0.1	* *	0.11
Ohio River	128	3	10/5/2005	3	Fall	Epilithic	42.89	138.8	0.55	0.183	0.15	0.11	0.26	0.08
Ohio River	132	2	6/8/2005	1	Summer	Epilithic	65.28	138.8	2.04	0.216	0.43	0.03	0.46	0.09
Ohio River	132	2	7/21/2005	2	Summer	Epilithic	24.53	80.1	1.59	0.363	* *	0.06	* *	0.14
Ohio River	132	2	10/5/2005	3	Fall	Epilithic	92.59	141.4	0.53	0.152	0.31	0.06	0.37	0.13
Ohio River	133	1	5/18/2005	1	Spring	Epilithic	241.84	216.2	3.58	0.288	0.45	0.3	0.75	0.025
Ohio River	133	1	7/5/2005	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	133	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Ohio River	136	4	6/20/2005	1	Summer	Epidendric	66.78	22.7	22.96	2.116	0.56	* *	* *	0.14
Ohio River	136	4	8/2/2005	2	Summer	Epidendric	88.73	49.4	41.19	2.839	0.57	0.005	0.575	0.09
Ohio River	136	4	10/12/2005	3	Fall	Epidendric	13.03	8.7	14.79	0.703	* *	0.13	* *	0.09
Ohio River	137	1	5/24/2005	1	Spring	Epilithic	73.04	157.5	1.01	0.06	0.15	0.48	0.63	0.025
Ohio River	137	1	7/6/2005	2	Summer	Epilithic	24.89	133.5	3.52	0.231	* *	0.46	* *	0.025
Ohio River	137	1	9/15/2005	3	Fall	Epilithic	38.94	88.1	0.92	0.237	0.93	0.36	1.29	0.025
Ohio River	141	4	5/18/2005	1	Spring	Epidendric	41.85	17.3	1.89	1.066	1.3	5.4	6.7	0.15
Ohio River	141	4	7/6/2005	2	Summer	Epidendric	3.66	11.7	30.16	2.267	* *	0.005	* *	0.26
Ohio River	141	4	9/13/2005	3	Fall	Epidendric	16.23	11.0	21.44	1.925	1.5	0.1	1.6	0.17
Ohio River	142	4	6/6/2005	1	Summer	Epidendric	7.40	7.3	1.62	0.373	0.38	0.46	0.84	0.025
Ohio River	142	4	7/19/2005	2	Summer	Epidendric	1.13	6.7	1.90	1.044	* *	0.25	* *	0.21
Ohio River	142	4	9/14/2005	3	Fall	Epilithic	9.52	8.8	0.54	0.411	0.66	0.5	1.16	0.025
Ohio River	145	4	6/1/2005	1	Summer	Epilithic	49.45	152.1	0.97	0.296	* *	2	* *	0.025
Ohio River	145	4	7/14/2005	2	Summer	Epilithic	40.56	128.1	3.10	0.463	0.48	1.5	1.98	0.025
Ohio River	145	4	9/12/2005	3	Fall	Epilithic	40.71	213.5	0.99	0.34	0.66	1.2	1.86	0.06
Ohio River	148	3	6/20/2005	1	Summer	Epidendric	61.74	28.6	27.15	1.577	0.82	4.4	5.22	0.11
Ohio River	148	3	8/3/2005	2	Summer	Epidendric	15.34	16.6	9.85	1.925	2.4	0.005	2.405	0.09
Ohio River	148	3	10/13/2005	3	Fall	Epidendric	83.76	16.4	1.39	0.271	* *	0.38	* *	0.08
Ohio River	150	2	5/31/2005	1	Spring	Epilithic	34.74	146.8	1.81	0.808	* *	1.8	* *	0.025
Ohio River	150	2	7/11/2005	2	Summer	Epilithic	39.08	85.4	0.85	0.218	0.43	2.2	2.63	0.025
Ohio River	150	2	9/13/2005	3	Fall	Epilithic	44.19	157.5	0.26	0.336	0.38	1.9	2.28	0.025
Ohio River	153	4	5/25/2005	1	Spring	Epilithic	50.09	176.2	1.51	0.276	0.34	2.3	2.64	0.06
Ohio River	153	4	7/12/2005	2	Summer	Epilithic	68.56	152.1	5.64	0.478	0.59	1.2	1.79	0.07
Ohio River	153	4	10/4/2005	3	Fall	Epilithic	143.72	152.1	0.58	0.222	0.36	0.86	1.22	0.06
Ohio River	156	1	6/2/2005	1	Summer	Epilithic	170.47	157.5	3.44	0.292	* *	0.72	* *	0.025
Ohio River	156	1	7/18/2005	2	Summer	Epilithic	12.77	65.4	10.82	1.544	* *	0.02	* *	0.07
Ohio River	156	1	9/14/2005	3	Fall	Epilithic	20.14	146.8	7.15	2.091	0.86	0.005	0.865	0.025
Ohio River	157	3	5/23/2005	1	Spring	Epilithic	106.86	173.5	0.52	0.322	0.15	0.33	0.48	0.025
Ohio River	157	3	7/13/2005	2	Summer	Epilithic	31.83	133.5	4.16	0.399	0.46	0.93	1.39	0.1
Ohio River	157	3	10/3/2005	3	Fall	Epilithic	332.04	317.6	1.17	0.737	0.51	0.43	0.94	0.16

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Ohio River	158	3	6/7/2005	1	Summer	Epilithic	54.72	157.5	1.07	0.236	0.15	0.04	0.19	0.025
Ohio River	158	3	7/19/2005	2	Summer	Epilithic	31.94	81.4	2.83	0.482	* *	0.13	* *	0.07
Ohio River	158	3	9/15/2005	3	Fall	Epilithic	15.36	78.8	0.90	0.419	0.58	0.04	0.62	0.025
Ohio River	159	3	5/18/2005	1	Spring	Epidendric	8.49	12.9	1.58	0.475	0.43	5.4	5.83	0.06
Ohio River	159	3	7/6/2005	2	Summer	Epidendric	3.59	6.7	2.70	0.426	* *	1.1	* *	0.06
Ohio River	159	3	9/13/2005	3	Fall	Epidendric	1.95	8.2	1.32	0.707	0.68	0.34	1.02	0.07
Ohio River	162	4	6/21/2005	1	Summer	Epidendric	7.09	7.7	25.40	1.641	0.78	2.8	3.58	0.14
Ohio River	162	4	8/2/2005	2	Summer	Epidendric	30.79	35.5	22.60	2.147	0.86	0.005	0.865	0.08
Ohio River	162	4	10/12/2005	3	Fall	Epidendric	71.13	25.1	40.90	2.103	* *	0.1	* *	0.12
Ohio River	164	1	6/2/2005	1	Summer	Epilithic	158.09	152.2	16.46	0.869	* *	2.4	* *	0.025
Ohio River	164	1	7/19/2005	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	164	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	167	1	5/25/2005	1	Spring	Epilithic	1.88	138.8	0.87	0.21	0.48	0.19	0.67	0.025
Ohio River	167	1	7/6/2005	2	Summer	Epilithic	6.25	149.5	1.18	0.311	* *	0.33	* *	0.025
Ohio River	167	1	9/15/2005	3	Fall	Epilithic	50.96	160.1	1.91	0.343	0.54	0.39	0.93	0.025
Ohio River	172	3	6/7/2005	1	Summer	Epilithic	25.42	154.9	1.38	0.19	0.15	0.005	0.155	0.025
Ohio River	172	3	7/20/2005	2	Summer	Epilithic	28.01	78.7	10.87	0.663	* *	0.17	* *	0.11
Ohio River	172	3	10/5/2005	3	Fall	Epilithic	35.72	136.1	0.84	0.157	0.15	0.005	0.155	0.025
Ohio River	179	4	6/1/2005	1	Summer	Epilithic	68.89	165.5	0.86	0.303	* *	2	* *	0.025
Ohio River	179	4	7/18/2005	2	Summer	Epilithic	16.27	57.4	1.74	0.33	* *	1.6	* *	0.09
Ohio River	179	4	10/4/2005	3	Fall	Epilithic	9.34	52.1	0.82	0.267	0.37	1.2	1.57	0.025
Ohio River	184	1	5/17/2005	1	Spring	Epilithic	17.61	176.2	1.50	1.268	1	5.8	6.8	0.33
Ohio River	184	1	7/5/2005	2	Summer	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	184	1	- -	3	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Ohio River	185	4	6/1/2005	1	Summer	Epidendric	15.78	8.1	1.56	0.332	* *	1.9	* *	0.025
Ohio River	185	4	7/13/2005	2	Summer	Epidendric	9.85	9.7	3.64	0.358	0.48	1.1	1.58	0.025
Ohio River	185	4	9/12/2005	3	Fall	Epidendric	25.19	17.4	0.61	0.203	0.61	0.76	1.37	0.025
Ohio River	191	1	5/19/2005	1	Spring	Epilithic	16.91	168.2	0.54	0.06	0.34	0.65	0.99	0.025
Ohio River	191	1	7/7/2005	2	Summer	Epilithic	5.55	120.1	0.05	0.06	* *	0.23	* *	0.025
Ohio River	191	1	9/14/2005	3	Fall	Epilithic	12.19	59.5	0.11	0.06	0.56	0.18	0.74	0.025

Appendix 17. Algal biomass and nutrient concentrations in Indiana, 2001-2005.—Continued

[IDEM, Indiana Department of Environmental Management; USGS, U.S. Geological Survey; USEPA, U.S. Environmental Protection Agency; CHLa, chlorophyll *a*; AFDM, Ash-Free Dry Mass; POC, particulate organic carbon; TKN, total Kjeldahl nitrogen; TN, total nitrogen; TP, total phosphorus; mg/m², milligrams per square meter; g/m², grams per square meter; µg/L, micrograms per liter; mg/L, milligrams per liter; - -, not collected; * *, not analyzed]

Study basin	IDEM number	Strahler (stream) order	Sample date	USGS/IDEM sample round	USEPA season	Periphyton substrate	Periphyton CHLa (mg/m²)	AFDM (g/m²)	Seston CHLa (µg/L)	POC (mg/L)	TKN as N (mg/L)	Nitrate as N (mg/L)	TN as N (mg/L)	TP as P (mg/L)
Ohio River	193	3	6/1/2005	1	Summer	Epilithic	40.56	157.5	0.87	0.265	* *	0.17	* *	0.025
Ohio River	193	3	7/13/2005	2	Summer	Epilithic	19.50	81.4	1.28	0.186	0.35	0.46	0.81	0.025
Ohio River	193	3	10/4/2005	3	Fall	Epilithic	54.37	149.5	1.01	0.588	0.42	0.04	0.46	0.025
Ohio River	195	3	6/22/2005	1	Summer	Epilithic	22.67	144.1	1.07	0.219	0.15	1.8	1.95	0.025
Ohio River	195	3	8/2/2005	2	Summer	Epilithic	69.00	149.4	0.84	0.195	0.15	0.46	0.61	0.025
Ohio River	195	3	9/13/2005	3	Fall	Epilithic	22.00	70.8	0.63	0.229	0.15	0.37	0.52	0.025

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