NATIONAL WATER-QUALITY ASSESSMENT PROGRAM

Occurrence and Distribution of Nutrients, Suspended Sediment, and Pesticides in the Mobile River Basin, Alabama, Georgia, Mississippi, and Tennessee, 1999–2001

U.S. Geological Survey

Water-Resources Investigations Report 03-4203

U.S. Department of the Interior
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By Ann K. McPherson, Richard S. Moreland, and J. Brian Atkins

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Montgomery, Alabama
2003

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

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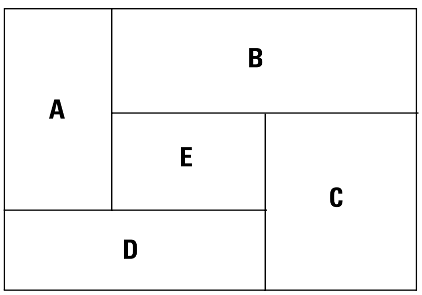
Cover photographs



A Cypress trees found in wetlands of the Mobile River Basin *(A.K. McPherson, USGS)*
B Tug boat and coal laden barges on the Black Warrior River *(H. Zappia, USGS)*
C Rolling hills and pastureland of the Valley and Ridge Province in northwest Georgia *(A.K. McPherson, USGS)*
D Cotton fields located in the Black Prairie Belt of Alabama *(D.A. Harned, USGS)*
E Stream reach upstream from USGS streamgaging station 02458450 in Birmingham, Alabama *(A.K. McPherson, USGS)*

For additional information write to:

District Chief
U.S. Geological Survey
2350 Fairlane Drive, Suite 120
Montgomery, AL 36116

email: dc_al@usgs.gov

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U.S. Geological Survey
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Information regarding the National Water-Quality Assessment (NAWQA) Program can be obtained from the National Web site http://water.usgs.gov/nawqa/nawqa_home.html or the Mobile River Basin Study Unit Web site http://tenn.er.usgs.gov/MOBL/mobl.html.

FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity *and* quality, even more critical to the long-term sustainability of our communities and ecosystems.

The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues and priorities. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multiscale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch
Associate Director for Water

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CONVERSION FACTORS, ABBREVIATIONS, and ACRONYMS

Multiply	by	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km^2)
	Area	
acre	0.4047	hectare (ha)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
acre-foot (acre-ft)	1,223	cubic meter (m^3)
	Flow	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
	Mass	
pound, avoirdupois (lb)	0.4536	kilogram (kg)

ABBREVIATIONS

kg/d	kilograms per day
$(kg/d)/mi^2$	kilograms per day per square mile
mg/L	milligrams per liter
ton/d	tons per day
$(ton/d)/mi^2$	tons per day per square mile
µg/L	micrograms per liter
µm	micron
<	less than

ACRONYMS

ADEM	Alabama Department of Environmental Management
AMLE	adjusted maximum likelihood estimator
ANOVA	analysis of variance
alpha-HCH	alpha-Hexachlorocyclohexane
DCPA	Dacthal – dimethyl 2,3,5,6-tetrachloro-1,4-benzenedicarboxylate
DSMA	disodium methanearsonate
E	concentration is estimated
EPTC	5-ethyl dipropylthiocarbamate
GC/MS	gas chromatography/mass spectrometry
HPLC/MS	high-performance liquid chromatography/mass spectrometry
LOWESS	locally weighted scatterplot smoothing
LRL	laboratory reporting level
LRS	laboratory reagent spike
LT-MDL	long-term method detection level
MCL	maximum contaminant level
MCPA	(4-chloro-2-methyl)phenoxyacetic acid
MCPB	4-(4-chloro-2-methylphenoxy)butanoic acid
MOBL	Mobile River Basin NAWQA Study Unit
MRL	minimum reporting level
MRLC	multi-resolution land characteristics
MSMA	monosodium methanearsonate
MVUE	minimum variance unbiased estimator
NAS/NAE	National Academy of Sciences and National Academy of Engineering
NAWQA	National Water-Quality Assessment
NWQL	National Water Quality Laboratory
THM	trihalomethane
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WY	Water year is the period October 1 through September 30, and is identified by the year in which it ends.

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ABSTRACT

The Mobile River Basin is one of more than 50 river basins and aquifer systems being investigated as part of the U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program. This basin is the sixth largest river basin in the United States and the fourth largest in terms of streamflow. The Mobile River Basin encompasses parts of Alabama, Georgia, Mississippi, and Tennessee, and almost two-thirds of the 44,0000-square-mile basin is located in Alabama. The extensive water resources of the Mobile River Basin are influenced by an array of natural and cultural factors, which impart unique and variable qualities to the streams, rivers, and aquifers and provide abundant habitat to sustain the diverse aquatic life in the basin.

From January 1999 to December 2001, a study was conducted of the occurrence and distribution of nutrients, suspended sediment, and pesticides in surface water of the Mobile River Basin. Nine sampling sites were selected on the basis of land use. The nine sites included two streams draining agricultural areas, two urban streams, and five large rivers with mixed land use. Surface-water samples were collected from one to four times each month to characterize the spatial and temporal variation in nutrient and pesticide concentrations.

Nutrient and suspended-sediment concentrations were highest in watersheds dominated by urban or agricultural land uses. Forty-two percent of the total phosphorus concentrations at all nine sites exceeded the U.S. Environmental Protection Agency's recommended maximum concentration of 0.1 milligram per liter. Flow-weighted mean concentrations at the Mobile River Basin sites generally were in the lower to middle percentile ranges compared with data from other NAWQA studies across the Nation. However, flow-weighted mean concentrations of ammonia, total nitrogen, orthophosphate, and total phosphorus at Bogue Chitto Creek, an agricultural watershed, ranked in the upper 20th percentile of agricultural sites sampled across the Nation as part of the NAWQA Program. Nutrient loads in the Tombigbee River were nearly twice as high compared with nutrient loads in the Alabama River. Nutrient yields were highest in Bogue Chitto Creek, Cahaba Valley Creek, and Threemile Branch because of agricultural and urban land uses in these watersheds.

Of the 104 pesticides and degradation products analyzed in the stream samples, 69 were detected in one or more samples. Of the 69 detected pesticides, 51 were herbicides, 15 were insecticides, and 3 were fungicides. A relatively small number of heavily used herbicides accounted for most of the detections, including atrazine and its metabolites (deethylatrazine, 2-hydroxyatrazine, deisopropylatrazine, and deethyldeisopropylatrazine), simazine, metolachlor, tebuthiuron, prometon, diuron, and 2,4-D. Diazinon, chlorpyrifos, and carbaryl were the most frequently detected insecticides; metalaxyl was the most frequently detected fungicide in the Mobile River Basin.

Concentrations of pesticides detected in surface water of the Mobile River Basin were among the highest concentrations recorded nationally by the NAWQA Program during 1991 to 2001. The three highest concentrations of atrazine detected at sites across the country were recorded at Bogue Chitto Creek; the highest concentrations of 2,4-D, imazaquin, and malathion recorded nationally were detected at

Threemile Branch. Aquatic-life criteria were exceeded by concentrations of five herbicides (2,4-D, atrazine, cyanazine, diuron, and metolachlor), six insecticides (carbaryl, chlorpyrifos, diazinon, dieldrin, malathion, and *p,p*'-DDE), and one fungicide (chlorothalonil). Drinking-water standards were exceeded by concentrations of four herbicides (2,4-D, atrazine, cyanazine, and simazine), three insecticides (*alpha*-HCH, diazinon, and dieldrin), and one fungicide (chlorothalonil).

The types and concentrations of pesticides found in surface water are linked to land use and to the types of pesticides used in each setting. Herbicides were detected more frequently and usually at higher concentrations in the agricultural stream, Bogue Chitto Creek. Insecticides, however, were detected more frequently and usually at higher concentrations in urban streams (Cahaba Valley Creek, Threemile Branch). Concentrations of pesticides varied seasonally in streams in response to the timing and amount of pesticides used and the frequency and magnitude of runoff from precipitation and irrigation. At Bogue Chitto Creek, the highest concentrations of atrazine were observed in April, May, and June, which coincide with its use as a preemergent herbicide on corn; the highest concentrations of cyanazine were observed in July and August, which coincide with its use as a postemergent herbicide on cotton. Seasonal patterns were less evident in urban streams, where concentrations of herbicides and insecticides remained relatively constant throughout the year.

Concentrations of pesticides in the large rivers generally were much lower than in their corresponding tributaries because of dilution and runoff from other land-use areas within the larger, more integrated basins. However, marked similarities were noted between the small streams with one primary land use and the large rivers draining basins encompassing these small streams. For example, the agricultural pesticides found in the Tombigbee River reflected those compounds present in its tributary, Bogue Chitto Creek, and the urban pesticides found in the Cahaba River reflected those compounds found in its tributary, Cahaba Valley Creek.

INTRODUCTION

The goal of the National Water-Quality Assessment (NAWQA) Program is to assess the status and trends in the quality of the Nation's ground- and surface-water resources on a regional or national scale, and to relate the status and trends with an understanding of the natural and human factors that affect the quality of water (Gilliom and others, 1995). In 1997, the U.S. Geological Survey (USGS) began an assessment of water quality in the Mobile River Basin. The Mobile River Basin (MOBL) is one of more than 50 river basins and aquifer systems (Study Units) being studied as part of the NAWQA Program (fig. 1). These Study Units represent the diverse geography, water resources, and land and water uses of the Nation.

In the NAWQA Program, an integrated approach is used to assess water quality. Physical, chemical, and biological data are collected over a wide range of conditions and used to determine water quality. As part of the NAWQA Program, a 3-year period of intensive data collection at each of the Study Units is followed by a 6-year low-intensity phase, in which fewer sites are sampled less frequently. This cycling of high-intensity and low-intensity data collection is repeated over time to assess trends in water quality. The results of this study, when combined with other NAWQA studies across the Nation, will provide resource managers and interested partners with a better understanding of how ecosystems respond to land-use changes and how these responses vary across a range of environmental settings.

This report focuses on the occurrence and distribution of nutrients, suspended sediment, and pesticides in the Mobile River Basin. Nutrients are chemical elements that are essential to plants and animals (Mueller and Helsel, 1996). These elements include various forms of reduced or oxidized nitrogen and phosphorus and, to a lesser extent, organic carbon. While nitrogen and phosphorus are natural and important elements in a healthy aquatic environment, excessive levels can be detrimental to aquatic ecosystems and the health of organisms using the water. Nonpoint nutrient sources include atmospheric deposition, biological fixation, animal manure, and applications of fertilizers; point nutrient sources include faulty septic tanks, outfall from industrial sources, and wastewater-treatment plants.

Pesticides are substances or mixtures of substances that are used to control pests, such as insects (insecticides), weeds (herbicides), and fungi (fungicides). Pesticides have been used in agricultural areas for many years, and their use in urban and undeveloped areas has increased in recent decades (Barbash and Resek, 1996). Because of their

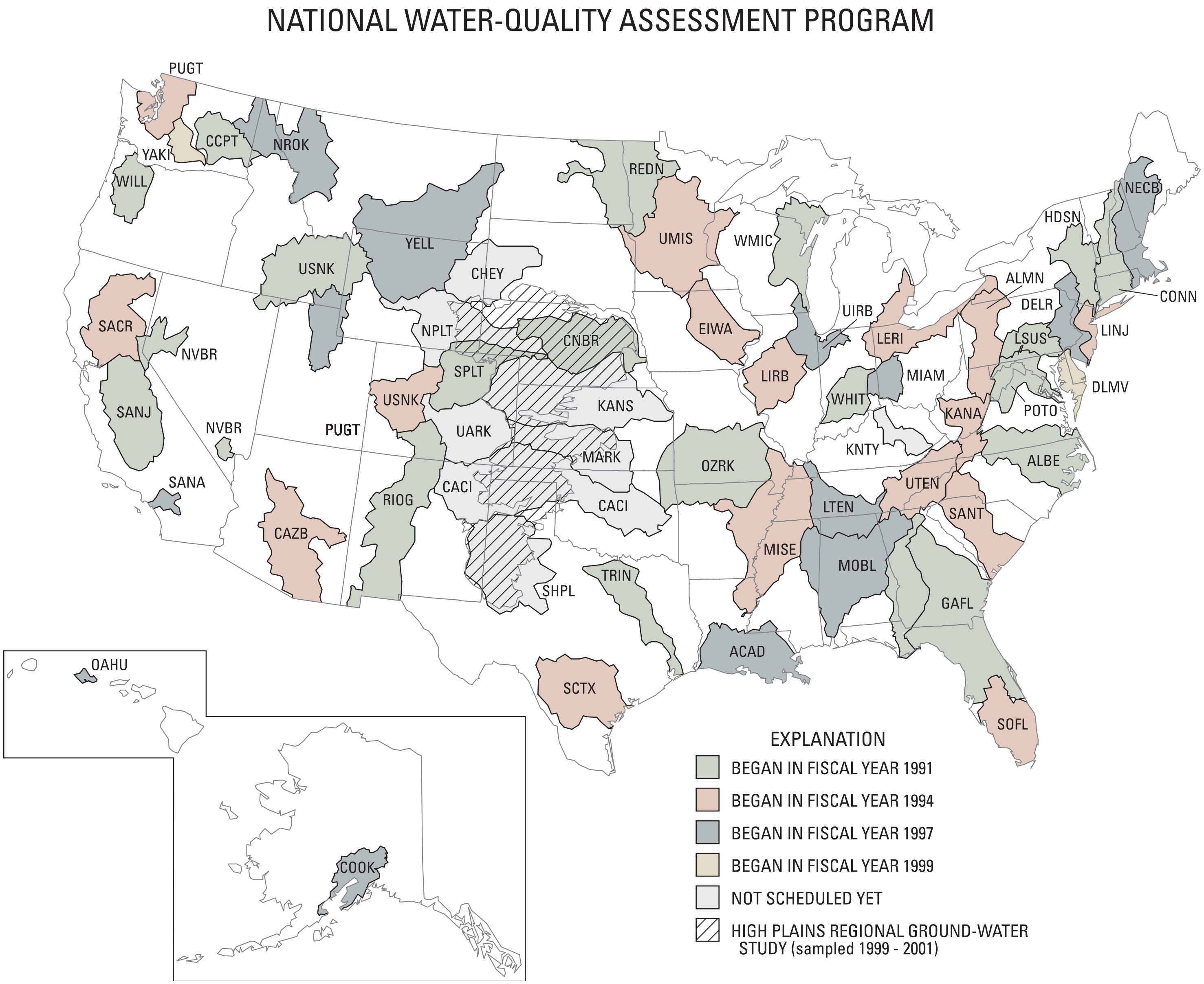


Figure 1. Study Units of the U.S. Geological Survey's National Water-Quality Assessment Program, identified by a four-letter basin code (U.S. Geological Survey, 2002).

widespread use, pesticides commonly are detected in streams and lakes (Larson and others, 1997). Many pesticides break down slowly in the environment; therefore, pesticide residuals or breakdown products also are found frequently in streams (Maluk, 2000). Possible human health effects from overexposure to some pesticides include cancer, reproductive or nervous-system disorders, and acute toxicity. In relation to the health of aquatic life, recent studies indicate that some pesticides may disrupt endocrine systems and affect reproduction by interfering with natural hormones (U.S. Geological Survey, 1999).

Purpose and Scope

The purpose of this report is to describe the spatial and seasonal variability in nutrient, suspended-sediment, and pesticide concentrations at nine surface-water sites and to relate these concentrations to streamflow conditions and land-use activities in the Mobile River Basin, 1999–2001. The nine sites included two streams draining agricultural areas, two urban streams, and five large rivers with mixed land use. Surface-water samples were collected from one to four times each month, from January 1999 to December 2001, and analyzed for a suite of nutrient species and pesticide compounds. This report also presents the results of load and yield estimates for nitrogen, phosphorus, and suspended sediment at the nine sites in the basin.

Acknowledgments

The authors gratefully appreciate the contributions of Richard H. Coupe, hydrologist with the USGS in Pearl, Mississippi, and Douglas A. Harned, hydrologist with the USGS in Raleigh, North Carolina, for their technical assistance during the preparation and review of this report.

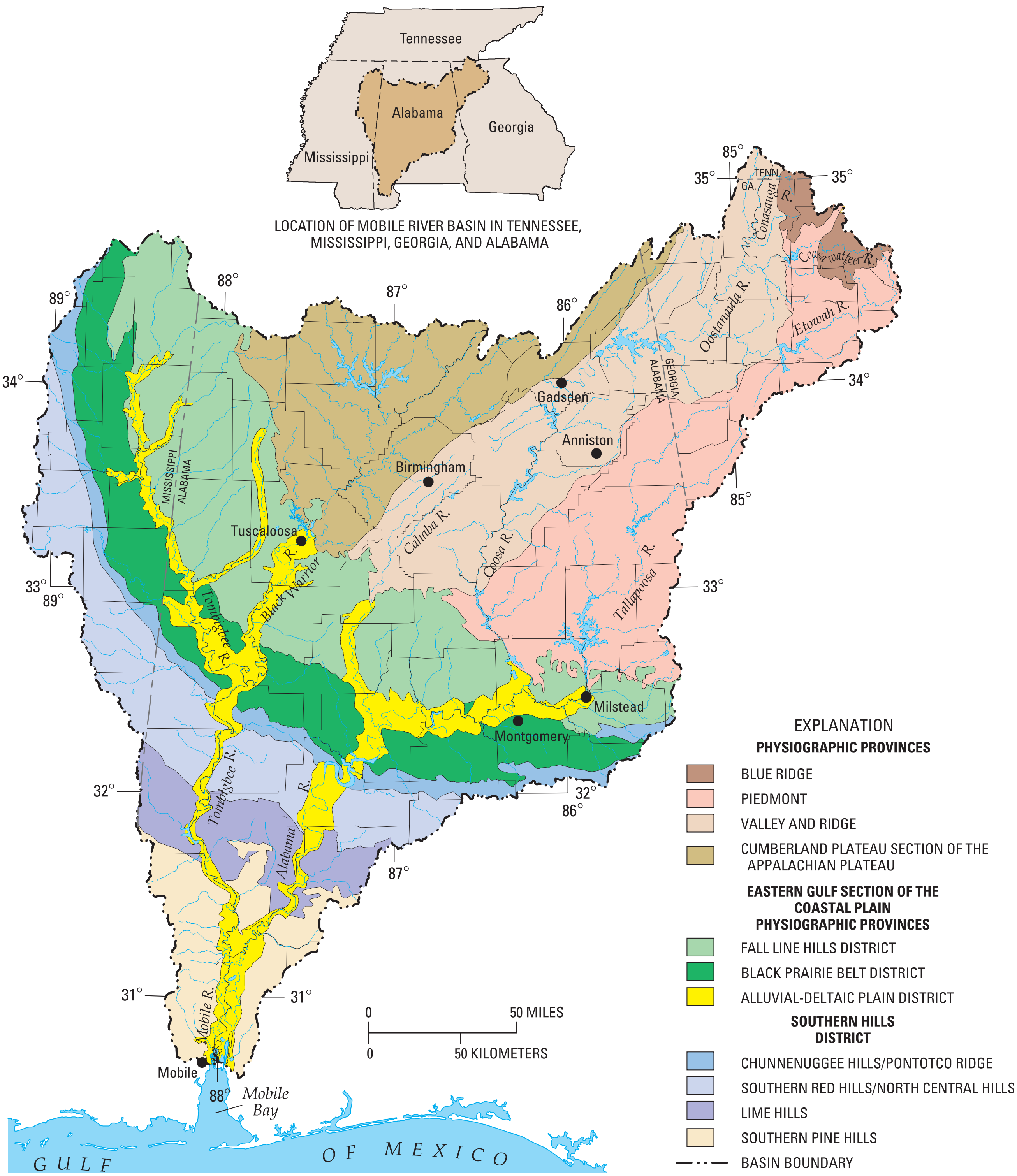
Description of the Study Unit

The Mobile River Basin is the sixth largest river basin in the Nation, encompassing nearly 44,000 square miles (mi^2) and draining portions of Mississippi, Tennessee, Georgia, and Alabama (fig. 2; Lamb, 1979). The Alabama and Tombigbee Rivers join to form the Mobile River, which then flows into Mobile Bay and discharges into the Gulf of Mexico. Approximately 70 percent of the basin lies in Alabama, 14 percent in Mississippi, 13 percent in Georgia, and 2 percent in Tennessee. The major land use in the Mobile River Basin is forested land, which covers approximately 70 percent of the basin. Agricultural land, including livestock and pastureland, covers approximately 26 percent of the basin, and urban areas account for only 3 percent of the total land use (fig. 3; Johnson and others, 2002). Agricultural activities include row crops, such as corn, soybeans, cotton, wheat, and sorghum; aquaculture; and poultry, swine, and cattle production. Major industries in the basin include silviculture and the production of chemicals, pulp and paper, iron and steel, coal, and textiles (Atkins, 1998). More detailed descriptions of the geographic setting, including physiography, geology, soils, climate, hydrology, and ecoregions, are described by Johnson and others (2002).

Description of the Sampling Sites

Major components of the site-selection process were to target specific watersheds that are influenced primarily by a dominant land use and to investigate the occurrence and distribution of nutrients and pesticides in the watersheds. Surface-water quality was monitored at two types of sites—basic fixed sites and intensive fixed sites. Basic fixed sites were sampled monthly for a period of 2 years. Intensive fixed sites were sampled more frequently for at least 1 year to characterize short-term variations in water quality. Both basic and intensive fixed sites are further classified as either indicator or integrator sites. Indicator sites represent relatively homogeneous and usually small basins associated with specific environmental settings. Integrator sites are established at downstream points in large drainage basins and represent the effects of multiple land uses in the basin (Gilliom and others, 1995).

Three intensive fixed sites and six basic fixed sites were selected for study in the Mobile River Basin (table 1; fig. 3). The three intensive fixed sites include an urban indicator site (Cahaba Valley Creek) at Pelham, Ala.; an agricultural indicator site (Bogue Chitto Creek) near Memphis, Ala.; and an integrator site (Cahaba River) at Centreville, Ala. The six basic fixed sites include two indicator sites and four integrator sites. The two basic indicator sites include a livestock agricultural area in the Black Prairie Belt (Pintlalla Creek) and an urban area (Threemile Branch) in Montgomery, Ala. The four basic integrator sites



Base map modified from Stephenson and Monroe, 1940; Sapp and Emplaincourt, 1975; and O'Hara, 1996

Figure 2. Physiographic provinces of the Mobile River Basin Study Unit.

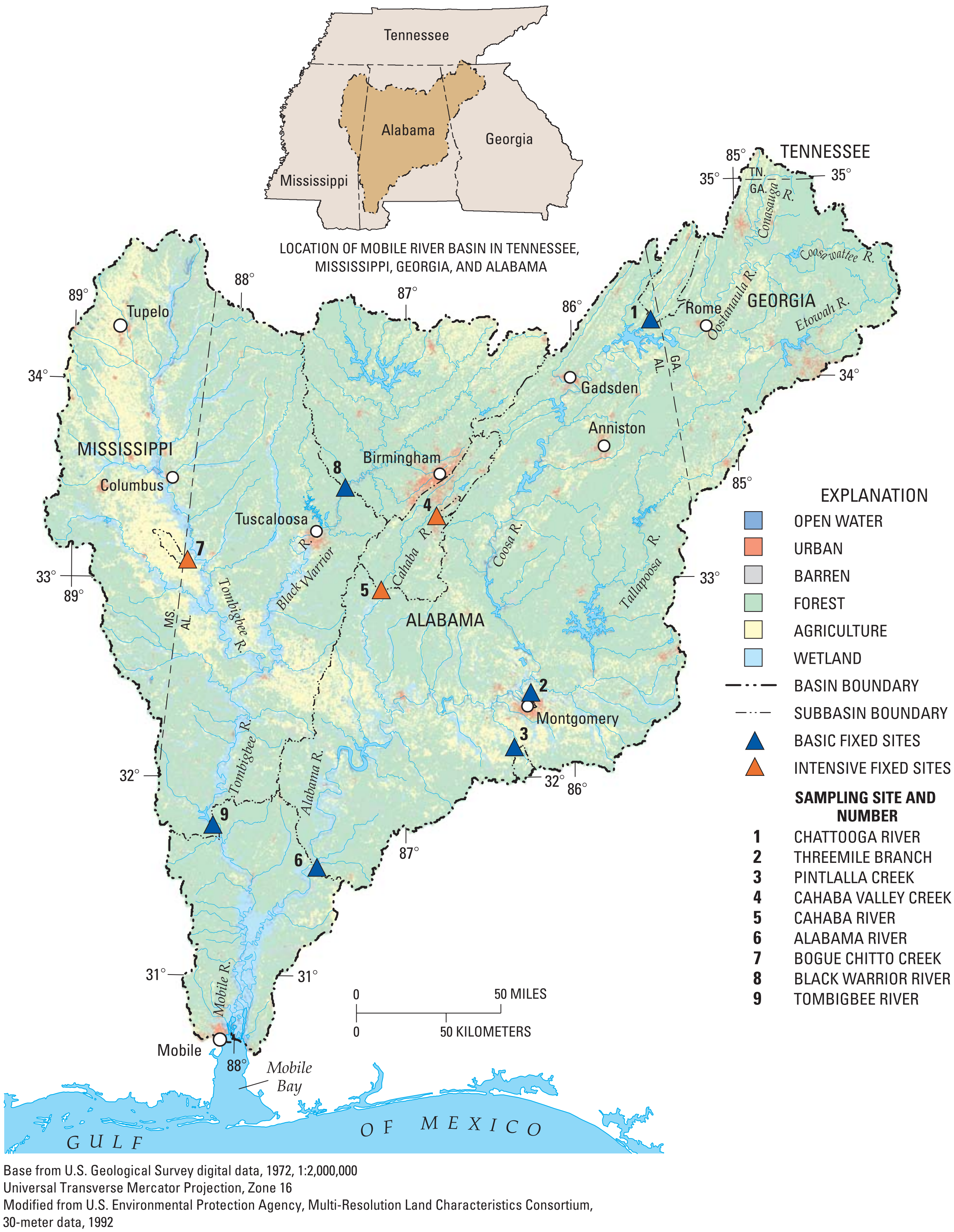


Figure 3. Land use and locations of sampling sites in the Mobile River Basin Study Unit.

Table 1. Site descriptions and sampling frequency of selected constituents at sites in the Mobile River Basin, Alabama, 1999–2001

[mi^2, square miles; GC/MS, gas chromatography/mass spectrometry; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Site number (fig. 3)	Station number	Station name	Type of fixed site	Site classification	Drainage area (mi^2)	Sampling period	Number of samples			
							Nutrients	Suspended sediment	Pesticides (GC/MS)	Pesticides (HPLC/MS)
1	02398300	Chattooga River above Gaylesville, Ala.	Basic	Integrator	366	01/1999–12/2000	25	25	2	0
2	02419977	Threemile Branch at North Boulevard at Montgomery, Ala.	Basic	Urban indicator	8.79	01/1999–09/2001	35	35	28	14
3	02421115	Pintlalla Creek at Liberty Church Road near Pintlalla, Ala.	Basic	Agricultural indicator	59.3	01/1999–12/2000	24	24	3	0
4	0242354750	Cahaba Valley Creek at Cross Creek Road at Pelham, Ala.	Intensive	Urban indicator	25.6	01/1999–12/2001	74	71	63	25
5	02424000	Cahaba River at Centreville, Ala.	Intensive	Integrator	1,027	01/1999–09/2001	41	40	40	18
6	02429500	Alabama River at Claiborne, Ala.	Basic	Integrator	21,967	01/1999–12/2001	34	34	18	9
7	02444490	Bogue Chitto Creek near Memphis, Ala.	Intensive	Agricultural indicator	52.6	01/1999–12/2001	55	53	52	20
8	02462501	Black Warrior River below Bankhead Lock and Dam near Bessemer, Ala.	Basic	Integrator	3,979	01/1999–12/2000	24	24	9	0
9	02469762	Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Ala.	Basic	Integrator	18,417	01/1999–12/2001	34	33	19	8

represent drainage from an area of mixed land use typical of the Valley and Ridge (Chattooga River); drainage from the Cumberland Plateau stratum (Black Warrior River); and drainage from the entire Study Unit (Alabama and Tombigbee Rivers).

The 1992 multi-resolution land characteristics (MRLC) map was used to quantify land-use characteristics in the watersheds of each of the sites (fig. 4). The MRLC is a digital LANDSAT satellite image (30-meter resolution) of major land use and land cover (U.S. Environmental Protection Agency, 1992a). A brief description of relevant characteristics at each of the nine sites is presented in the following paragraphs.

The Bogue Chitto Creek Basin is located primarily in Noxubee County, Miss., and drains the western part of the Black Prairie Belt, which extends in a wide arc through the Mobile River Basin (figs. 2, 3). The Black Prairie Belt is distinguished by rich vertisols—soils that shrink, swell, and crack (Johnson and others, 2002). Land use in the western part of the Black Prairie Belt is dominated by row crops, including soybeans, corn, cotton, and hay. Land use in the eastern part of the Black Prairie Belt is dominated by pastureland, with some interspersed areas of row crops. Approximately 67 percent of the 53-mi^2 basin consists of row crops, and 22 percent is used for pasture or hay (fig. 4). Zero-flow conditions were recorded frequently at Bogue Chitto Creek during the summer and fall, due to the lack of ground-water discharge to the creek (Pearman and others, 2000, 2001, 2002).

The Pintlalla Creek Basin, located in Montgomery County, lies in the eastern part of the Black Prairie Belt. Land use in this basin is dominated by forested land and pastureland, with some interspersed areas of row crops and hay fields. Montgomery County ranks fifth in Alabama in cattle and calf production (Vanderberry and Placke, 2002). The streams in this basin have little vegetative buffer and livestock have access to the headwaters of these streams. These factors may promote erosion in the Pintlalla Creek Basin. Increased sediment from erosion and runoff is considered to be one of the leading sources of stream impairment in Alabama (Alabama Department of Environmental Management, 2000a). Approximately 14 percent of the 59-mi^2 basin consists of row crops, and 10 percent contains pasture or hay (fig. 4). Zero-flow conditions were recorded at Pintlalla Creek during periods of drought in the summer and fall of 2000 (Pearman and others, 2001, 2002).

The Chattooga River Basin is located in the northeastern section of the Mobile River Basin and drains an area that is characteristic of the Valley and

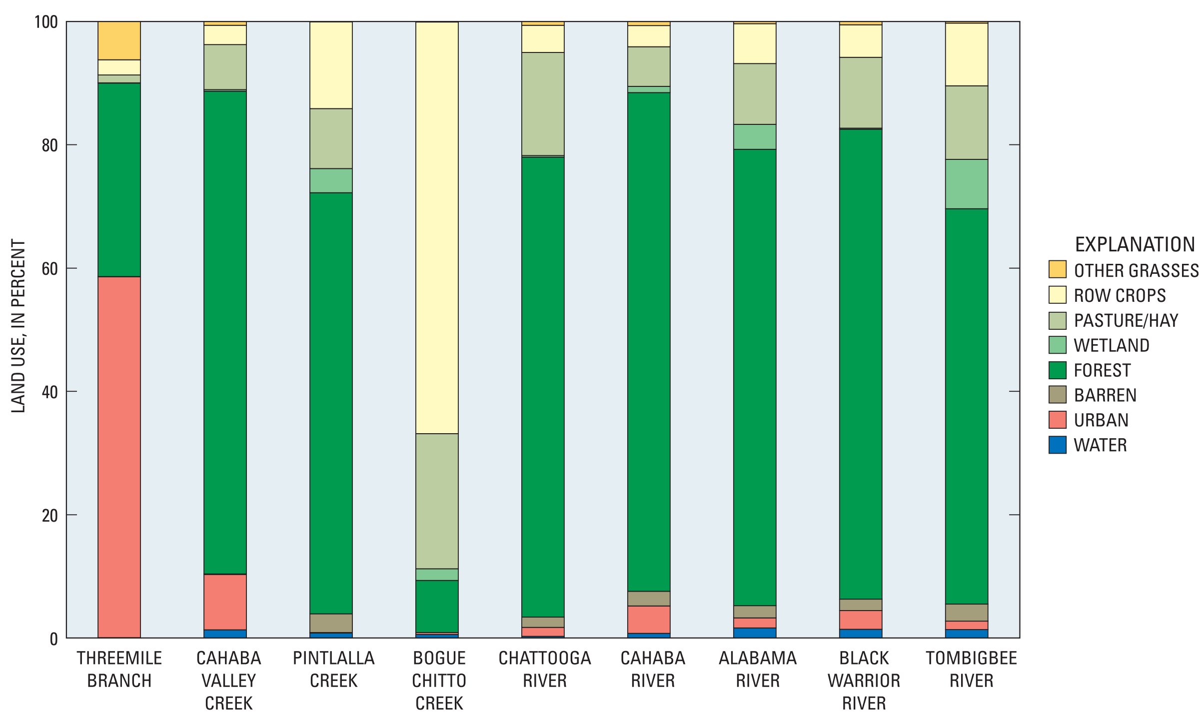


Figure 4. Land use in the watersheds of sampling sites in the Mobile River Basin.

Ridge Province. Agriculture in the Chattooga River Basin is typical of the Valley and Ridge—small areas of row cropping are in the flat lands of the valleys and pasturelands are found in the more rolling terrain. Crops are grown in approximately 21 percent of the 366-mi^2 basin (fig. 4) and include corn, soybeans, wheat, cotton, and hay (Vanderberry and Placke, 2002).

Threemile Branch is located in northern Montgomery in a suburban area. The stream channel contains natural and channelized segments and drains an area of 8.79 mi^2 (table 1). The land use of approximately 59 percent of the basin is urban and includes light industrial activities (fig. 4).

The Cahaba Valley Creek Basin is located in a rapidly developing area in the southeastern part of Birmingham. The drainage area of Cahaba Valley Creek is approximately 26 mi^2 (table 1), and the land use in the basin is approximately 9 percent urban and 78 percent forested (fig. 4).

The Cahaba River at Centreville drains an area of about 1,000 mi^2 (table 1) and is one of the drinking-water sources for the city of Birmingham. Approximately 10 percent of the basin is used for the cultivation of row crops, pasture, or hay, and about 81 percent is forested (fig. 4). The Cahaba River is home to several endangered species.

The Black Warrior River below Bankhead Lock and Dam is located at the southern edge of the Cumberland Plateau and drains an area of 3,979 mi^2 (table 1), integrating various land-use conditions over the entire plateau. Intensive agriculture is present in the northern part of the Cumberland Plateau; urban areas influenced by the city of Birmingham can be seen in the east-central part; and active surface and underground coal mining is present in the southern part of the Cumberland Plateau (Johnson and others, 2002). Approximately 17 percent of the basin is used for the cultivation of row crops or pasture and hay (fig. 4).

The Alabama River at Claiborne is located on the southeastern rim of the Mobile River Basin and drains an area of 21,967 mi^2 (table 1). This site is the farthest downstream location on the Alabama River within the Mobile River Basin that is not affected tidally. Approximately 17 percent of the Alabama River Basin is used for the cultivation of row crops, pasture, or hay (fig. 4).

The Tombigbee River below Coffeeville Lock and Dam is located on the southwestern rim of the Mobile River Basin and drains an area of 18,417 mi^2 (table 1). This site is the farthest downstream location on the Tombigbee River within the Mobile River Basin that is not affected tidally. Approximately 22 percent of the Tombigbee River Basin is used for the cultivation of row crops, pasture, or hay (fig. 4).

Estimated Pesticide Use in the Study Area

The quantities of active ingredients for the top 20 herbicides used in the study area were determined from crop-acreage data compiled from the 1997 Census of Agriculture (U.S. Department of Agriculture, 1999) and from pesticide-use rates compiled by the National Center for Food and Agricultural Policy (Gianessi and Marcelli, 2000; fig. 5). The quantities of active ingredients for the top 20 insecticides and top 16 fungicides used in the study area, which were compiled from the same data sources as the herbicides, are shown in figures 6 and 7, respectively. Methods used to estimate pesticide use in the NAWQA Study Units are described in Thelin and Gianessi (2000). The pesticides for which surface-water samples were analyzed in this study are listed in table 2.

Surface-water samples collected for this study were not analyzed for some of the most common herbicides (glyphosate, monosodium methanearsonate [MSMA], disodium methanearsonate [DSMA], paraquat, clomazone, prometryn, and fomesafen) or insecticides (oil, acephate, profenofos, thiodicarb, phosmet, dicrotophos, sulprofos, lambdacyhalothrin, and methamidophos) applied in the Mobile River Basin. The pesticide schedules developed by the National Water Quality Laboratory and used by personnel in the Mobile River Basin Study Unit did not include these compounds. Glyphosate, commonly known by the brand name Roundup®, is an herbicide used widely across the United States (Larson and others, 1997) and used frequently on soybeans, cotton, and pastureland in the Mobile River Basin (Alabama Cooperative Extension System, 1998). MSMA and DSMA are herbicides that are used frequently on cotton in the Mobile River Basin (Alabama Cooperative Extension System, 1998). Other compounds, including fungicides and compounds not easily categorized as herbicides or insecticides, also are applied frequently in the Mobile River Basin (fig. 7). Annual use of these other compounds is in the same range as the use of herbicides and insecticides, but water samples were not analyzed for many of these compounds during this study (fig. 7; table 2).

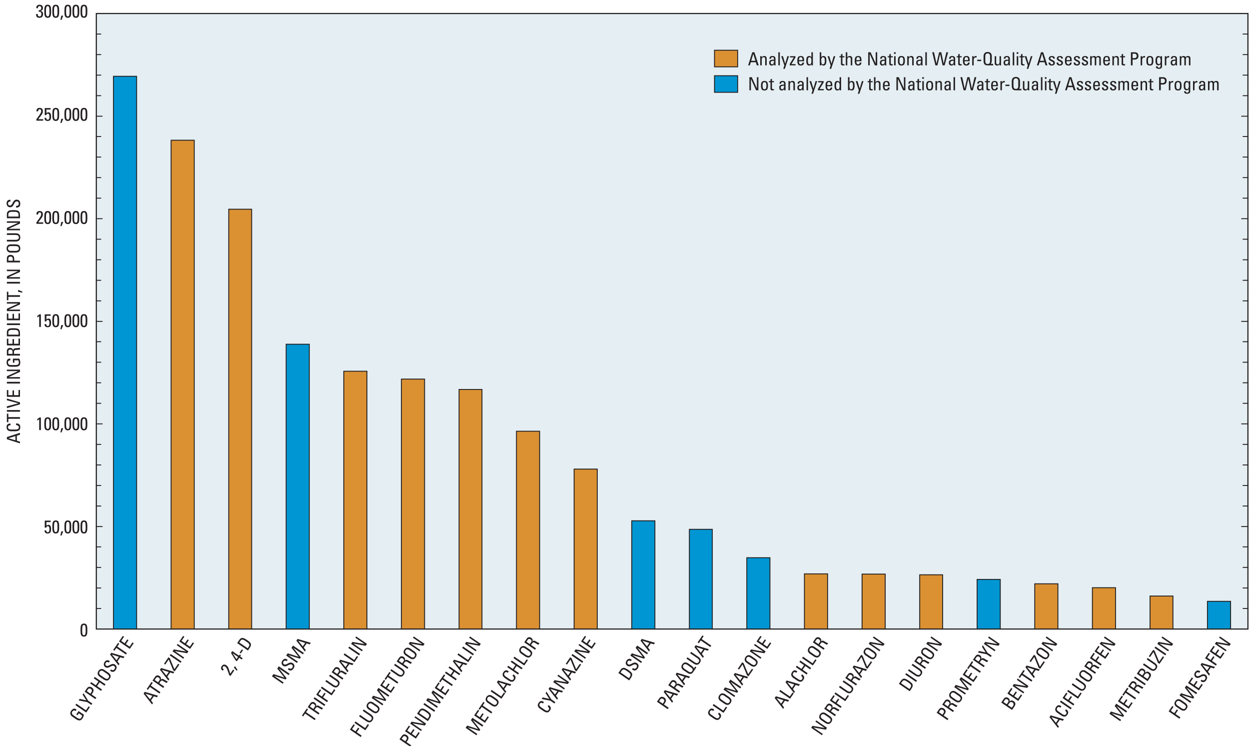


Figure 5. Herbicide use in the Mobile River Basin, 1997.

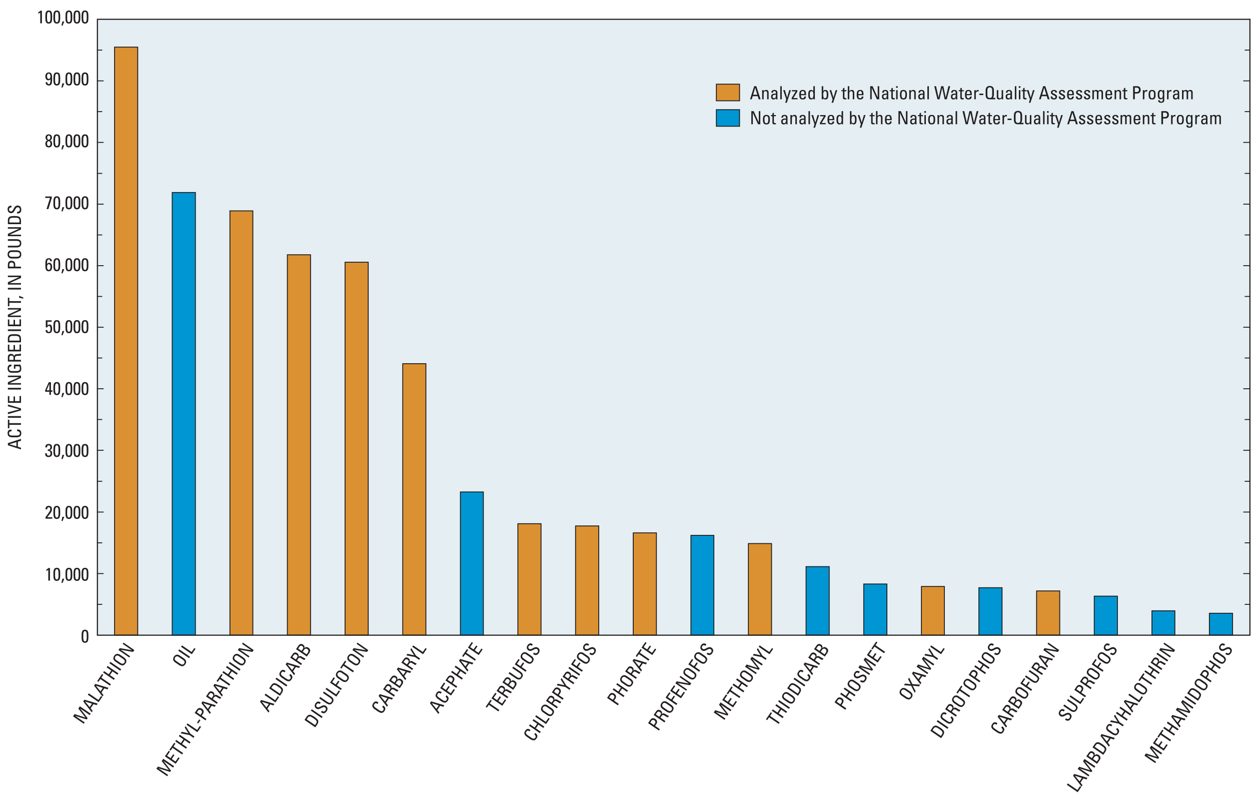


Figure 6. Insecticide use in the Mobile River Basin, 1997.

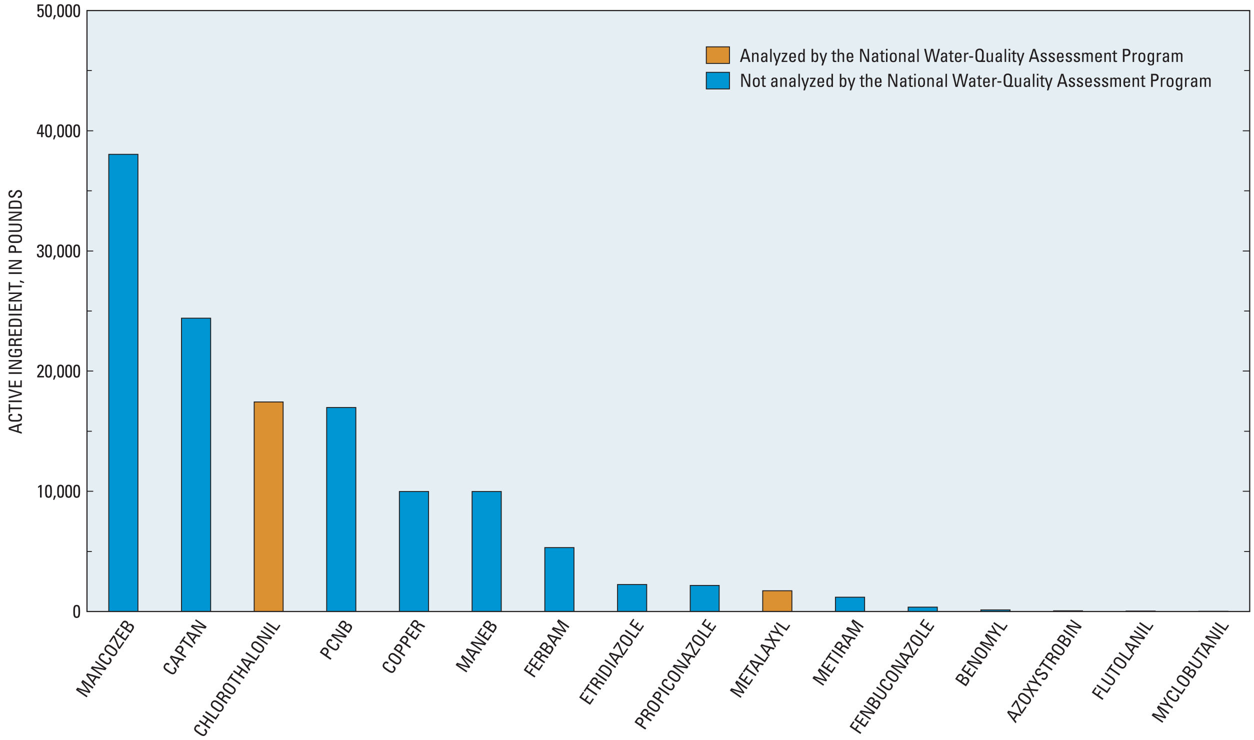


Figure 7. Fungicide use in the Mobile River Basin, 1997.

Table 2. Laboratory reporting levels and minimum reporting levels of pesticides and pesticide metabolites sampled in the Mobile River Basin

[NWIS, National Water Information System; µg/L, micrograms per liter; ND, not detected in any sample; Type: H, herbicide; M, metabolite; I, insecticide; N, nematocide; Ac, acaricide; F, fungicide; Mo, molluscicide; PGR, plant growth regulator]

NWIS parameter code	Pesticide	Type	Laboratory reporting level (µg/L)
Dissolved pesticides analyzed by gas chromatography/mass spectrometry (GC/MS)			
82660	2,6-diethylaniline (ND)	H, M	0.0017
49260	Acetochlor	H	0.0041
46342	Alachlor	H	0.0024
34253	*Alpha*-HCH	I	0.0253
39632	Atrazine	H	0.007
82673	Benfluralin	H	0.01
04028	Butylate (ND)	H	0.002
82680	Carbaryl	I	0.041
82674	Carbofuran	I, N	0.02
38933	Chlorpyrifos	I	0.005
04041	Cyanazine	H	0.018
82682	Dacthal (DCPA)	H	0.003
34653	*p,p'*-DDE	I, M	0.0025
04040	Deethylatrazine	H, M	0.006
39572	Diazinon	I, N	0.005
39381	Dieldrin	I	0.0048
82677	Disulfoton (ND)	I	0.021
82668	EPTC	H	0.002
82663	Ethalfluralin (ND)	H	0.009

Table 2. Laboratory reporting levels and minimum reporting levels of pesticides and pesticide metabolites sampled in the Mobile River Basin—Continued

[NWIS, National Water Information System; μg/L, micrograms per liter; ND, not detected in any sample; Type: H, herbicide; M, metabolite; I, insecticide; N, nematocide; Ac, acaricide; F, fungicide; Mo, molluscicide; PGR, plant growth regulator]

NWIS parameter code	Pesticide	Type	Laboratory reporting level (μg/L)
Dissolved pesticides analyzed by gas chromatography/mass spectrometry (GC/MS) (Continued)			
82672	Ethoprop	I, N	0.005
04095	Fonofox (ND)	I	0.0027
39341	Lindane	I	0.004
82666	Linuron (ND)	H	0.035
39532	Malathion	I	0.027
82686	Methyl azinphos (ND)	I	0.05
82667	Methyl parathion (ND)	I	0.006
39415	Metolachlor	H	0.013
82630	Metribuzin	H	0.006
82671	Molinate	H	0.0016
82684	Napropamide (ND)	H	0.007
39542	Parathion (ND)	I	0.007
82669	Pebulate (ND)	H	0.0016
82683	Pendimethalin	H	0.01
82687	*cis*-Permethrin (ND)	I	0.006
82664	Phorate	I	0.011
04037	Prometon	H	0.015
82676	Pronamide	H	0.0041
04024	Propachlor (ND)	H	0.01
82679	Propanil	H	0.011
82685	Propargite (ND)	I, Ac	0.023
04035	Simazine	H	0.011
82670	Tebuthiuron	H	0.016
82665	Terbacil	H	0.034
82675	Terbufos (ND)	I, N	0.017
82681	Thiobencarb (ND)	H	0.0048
82678	Triallate	H	0.0023
82661	Trifluralin	H	0.009
Dissolved pesticides analyzed by high-performance liquid chromatography/mass spectrometry (HPLC/MS)			
39732	2,4-D	H	0.021
50470	2,4-D methyl ester	H	0.0086
38746	2,4-DB	H	0.016
50355	2-hydroxyatrazine	H, M	0.008
61692	3,4-chlorophenyl-1-methyl urea	H	0.024
49308	3-hydroxycarbofuran (ND)	I, M	0.0058
50295	3-ketocarbofuran (ND)	I, M	1.5
49315	Acifluorfen	H	0.0066
49312	Aldicarb (ND)	I, Ac, N	0.04
49313	Aldicarb sulfone (ND)	I, N, M	0.02
49314	Aldicarb sulfoxide (ND)	I, M	0.0082
50299	Bendiocarb	I	0.025
50300	Benomyl	F	0.0038
61693	Bensulfuron-methyl	H	0.015
38711	Bentazon	H	0.011
04029	Bromacil	H	0.033

Table 2. Laboratory reporting levels and minimum reporting levels of pesticides and pesticide metabolites sampled in the Mobile River Basin—Continued

[NWIS, National Water Information System; µg/L, micrograms per liter; ND, not detected in any sample; Type: H, herbicide; M, metabolite; I, insecticide; N, nematocide; Ac, acaricide; F, fungicide; Mo, molluscicide; PGR, plant growth regulator]

NWIS parameter code	Pesticide	Type	Laboratory reporting level (µg/L)
Dissolved pesticides analyzed by high-performance liquid chromatography/mass spectrometry (HPLC/MS) (Continued)			
49311	Bromoxynil (ND)	H	0.017
49310	Carbaryl	I	0.028
49309	Carbofuran (ND)	I, N	0.0056
61188	Chloramben, methyl ester	H	0.018
50306	Chlorimuron, ethyl (ND)	H	0.0096
49306	Chlorothalonil	F	0.035
49305	Clopyralid	H	0.013
04031	Cycloate (ND)	H	0.013
49304	Dacthal mono-acid	H, M	0.011
04039	Deethyldeisopropylatrazine	H, M	0.01
04038	Deisopropylatrazine	H, M	0.044
38442	Dicamba	H	0.012
49302	Dichlorprop	H	0.013
49301	Dinoseb	H	0.012
04033	Diphenamid	H	0.026
49300	Diuron	H	0.015
49297	Fenuron (ND)	H	0.031
61694	Flumetsulam	H	0.011
38811	Fluometuron	H	0.031
50356	Imazaquin	H	0.016
50407	Imazethapyr	H	0.017
61695	Imidacloprid	I	0.0068
38478	Linuron (ND)	H	0.014
38482	MCPA	H	0.016
38487	MCPB (ND)	H	0.015
50359	Metalaxyl	F	0.02
38501	Methiocarb (ND)	I, Ac, Mo	0.008
49296	Methomyl	I	0.0044
61696	Methomyl oxime (ND)	I	0.011
61697	Metsulfuron-methyl	H	0.025
49294	Neburon	H	0.012
50364	Nicosulfuron	H	0.013
49293	Norflurazon (ND)	H	0.016
49292	Oryzalin	H	0.017
38866	Oxamyl (ND)	I, N, Ac	0.012
50410	Oxamyl oxime (ND)	I, N, Ac	0.013
49291	Picloram (ND)	H	0.019
49236	Propham (ND)	H, PGR	0.0096
50471	Propiconazole (ND)	F	0.021
38538	Propoxur	I	0.008
38548	Siduron	H	0.016
50337	Sulfometuron-methyl	H	0.0088
04032	Terbacil	H	0.0098
61159	Tribenuron-methyl (ND)	H	0.0088
49235	Triclopyr	H	0.022

METHODS

The data-collection methods used during this investigation conform to standard USGS protocols (Wilde and others, 1999). The analytical tools and reporting levels used to interpret the water-quality data in the Mobile River Basin are consistent with current water-quality standards and guidelines.

Sampling Frequency

Surface-water samples were collected in the Mobile River Basin from January 5, 1999, through December 20, 2001. Each surface-water sample was analyzed for nutrients, major ions, dissolved organic carbon, suspended organic carbon, and suspended sediment. Sampling for other constituents, such as pesticides, was less frequent (table 1) and varied annually, seasonally, and between sites, depending on the sampling objectives, the expected variability, and the resources available to conduct sampling at each site. Bogue Chitto Creek and Cahaba Valley Creek were sampled each week between March and October 1999. Samples were collected twice each month at the Cahaba River between January and December 1999 and at Cahaba Valley Creek between November 1999 and April 2000. Otherwise, samples generally were collected monthly for a 2-year period or for the duration of the sampling period (3 years).

Sample Collection

The data-collection procedures used during this investigation included equal-width increment sampling (Shelton, 1994). Equal-width increment sampling produces a composite sample that is representative of flow in a cross section. Most surface-water samples were collected by using a DH-81 sampler (Edwards and Glysson, 1999). Samples from the Alabama River, Tombigbee River, and Black Warrior River were collected by using either the D-95 or the D-77 sampler (Edwards and Glysson, 1999). Storm samples were not flow-weighted composite samples taken at specific intervals, as described in the U.S. Environmental Protection Agency (USEPA) sampling guide (U.S. Environmental Protection Agency, 1992b); instead, the storm samples were discrete samples collected using equal-width increment sampling. Field measurements of stream discharge, air temperature, water temperature, pH, dissolved oxygen, and specific conductance were made at the time of sampling.

A Teflon cone splitter and bottles were used to split the water samples into aliquots for analyses. After splitting, water samples for dissolved nutrients and major ions were filtered by using a 0.45-micron (µm) pore size filter that was pre-rinsed with deionized water and native streamwater. Samples for pesticide analyses were filtered by using a 0.7-µm pore size, baked, glass-fiber filter. Nutrient, pesticide, and organic carbon samples were preserved and chilled immediately after filtration and shipped overnight to the USGS National Water Quality Laboratory (NWQL) in Denver, Colo. Suspended-sediment samples were shipped to the USGS sediment laboratory in Louisville, Ky. Pesticide samples were analyzed by using gas chromatography/mass spectrometry (GC/MS; Zaugg and others, 1995) or by using high-performance liquid chromatography/mass spectrometry (HPLC/MS; Furlong and others, 2001). Equipment used to process organic carbon samples was cleaned with a 0.2-percent nonphosphate detergent and rinsed with pesticide-grade or volatile-organic-compound grade blank water obtained from the NWQL. All other equipment that was used to collect and process samples was cleaned with a 0.2-percent nonphosphate detergent and rinsed with tap water and deionized water. Equipment was rinsed with a solution of 5-percent hydrochloric acid followed by deionized water for metals sampling. A rinse of pesticide-grade methanol was added when pesticides were sampled.

Selection of Pesticide Analytes

Pesticides were selected for analysis from a list of nearly 400 most commonly used pesticides in the United States (Gianessi and Puffer, 1990, 1992). The pesticides were prioritized according to the following factors: a national use of more than 8,000 pounds (lbs) of active ingredient per year, inclusion in the analytical schedules of other Federal monitoring or assessment programs, toxicity, leachability, and the ability to trap and extract the analyte from the appropriate solid-phase concentration matrix (Gilliom and others, 1995). The final target analyte list (table 2) is a broad spectrum of pesticides that were analyzed by using either GC/MS (Zaugg and others, 1995) or HPLC/MS (Furlong and others, 2001). Most of the water samples analyzed by using HPLC/MS in 1999 exceeded the holding times for the method; consequently, the HPLC/MS data from 1999 were not included in this report. There were seven pesticides in common between the two methods: atrazine, carbaryl, carbofuran, deethyl-atrazine, linuron, tebuthiuron, and terbacil. The laboratory reporting level (LRL) for the HPLC/MS method generally was higher than the GC/MS method; therefore, the results sometimes were not identical between methods for these compounds. Forty-seven pesticides and metabolites were analyzed by using GC/MS, and 64 pesticides and metabolites were analyzed by using HPLC/MS.

Data Analysis and Review

Methods used to interpret water-quality results in this report include various graphical tools and statistical methods. Graphical tools include the use of bar charts, which illustrate the speciation of certain nutrients (nitrogen and phosphorus), monthly median concentrations (nutrients and pesticides), and the most frequently detected pesticides. Box plots display the variability in nutrient concentrations.

The NWQL has implemented new procedures for interpreting and reporting low-concentration data in water-quality samples (Childress and others, 1999). Concentrations of analytes that either were not detected or were not identified are reported as less than (<) the LRL and are considered to be nondetections. Analytes that were detected at concentrations between the LRL and the long-term method detection level (LT-MDL), which usually is one-half the LRL, and that pass identification criteria were estimated. Estimated concentrations are noted with the remark code E. The uncertainty associated with the magnitude of estimated concentrations is greater than that associated with values that were not estimated (Martin and others, 1999). The sample matrix and the instrument condition can limit the reliable measurement of an analyte in the laboratory.

The NWQL specifies the minimum reporting level (MRL) and(or) LRL for organic compounds. Quality-control data are collected by the NWQL on a continuing basis to determine the MRLs, LT-MDLs, and LRLs; these values are re-evaluated each year and, consequently, may change from year to year. The LRLs for pesticides analyzed by using GC/MS were updated by the NWQL for water year[1] 2001 (table 2). The LRLs for pesticides analyzed by using HPLC/MS were those in effect on October 1, 2001 (table 2).

[1] Water year is the period October 1 through September 30, and is identified by the year in which it ends.

Sensitive analytical methods used in this study resulted in low detection limits for many pesticides. Comparison of detection frequencies among pesticides can be misleading because of the different detection limits associated with each of the pesticides. For example, atrazine has an LRL of 0.007 microgram per liter (μg/L) and prometon has an LRL of 0.015 μg/L. Atrazine was detected more frequently than prometon in this study; however, it is unknown whether that conclusion would hold true if the LRL of prometon also were 0.007 μg/L. Pesticide data are frequently adjusted by censoring to a common threshold, such as 0.01 μg/L (values less than 0.01 μg/L are not considered detections), to reduce this type of bias. In this report, however, uncensored data were used when calculating detection frequencies for pesticides in the Mobile River Basin and nationwide in the NAWQA Program.

The USEPA and the Alabama Department of Environmental Management (ADEM) have water-quality standards and guidelines for some compounds that can have adverse effects on human health, aquatic organisms, and wildlife. Although the maximum contaminant levels (MCL) established by the USEPA and the ADEM pertain to finished drinking water supplied by a community water supply, these levels provide values for comparison with the sampled concentrations (Alabama Department of Environmental Management, 2000b; U.S. Environmental Protection Agency, 2000c, 2001). The USEPA also has developed guidelines for surface water that are intended to represent background concentrations of selected nutrients in individual ecoregions (U.S. Environmental Protection Agency, 2000a, 2000b). Aquatic-life criteria (U.S. Environmental Protection Agency, 1999; Alabama Department of Environmental Management, 2000c) provide for the protection of aquatic organisms for short-term (acute) and long-term (chronic) exposures to chemical compounds. In some instances, Canadian guidelines were used for comparisons when other criteria were not available (International Joint Commission United States and Canada, 1978; Canadian Council of Ministers of the Environment, 2001).

The Kruskal-Wallis test and the Tukey multiple-comparison test were used to evaluate whether nutrient concentrations for each land-use category were significantly different or whether nutrient concentrations at one site were significantly different from nutrient concentrations at other sites (SAS

Institute, Inc., 1989). The Kruskal-Wallis test is a one-way nonparametric analysis of variance (ANOVA) that was used to determine whether significant differences existed between land-use categories. The Tukey multiple-comparison test was then used to compare the differences in concentrations between the individual sites. The simplest procedures for performing nonparametric multiple comparisons are rank transformation tests (Helsel and Hirsch, 1992). Ranks were substituted for the original data and the Tukey multiple-comparison test was performed on the ranks.

Spearman's rho was used to measure the strength of association between nutrient concentrations and streamflow. Spearman's rho is the linear correlation coefficient computed on the ranks of the data (Helsel and Hirsch, 1992) and was computed based on the ranks of nutrient concentrations and streamflow. Values of rho range from -1.0 to 1.0 and the closer the value is to -1.0 or 1.0, the stronger the association between the two variables.

Trends in concentrations of total nitrogen and phosphorus, total ammonia and organic nitrogen, and dissolved nitrate, phosphorus, and orthophosphate were analyzed for the period of record at each site through 2001. Because at least 5 years of record are required for statistical trend testing (Schertz and others, 1991), data from only three of the nine sites were analyzed because these sites have periods of record prior to the period 1999–2001: the Cahaba River (1990–94), the Alabama River (1971–96), and the Tombigbee River (1975–96). Trends were analyzed for the entire period of record at each of these sites for long-term trends (decadal variations) and for 1988–2001 for short-term trends (annual variations).

Trend analyses were performed on concentrations adjusted for streamflow using a statistical technique known as locally weighted scatterplot smoothing (LOWESS; Cleveland, 1979; Helsel and Hirsch, 1992). The LOWESS trend lines illustrate relations between concentrations and streamflow that are difficult to discern in a simple scatterplot. The LOWESS trend line is computed by fitting a weighted least-squares equation to the concentration and streamflow data (Helsel and Hirsch, 1992). The smoothing technique used to calculate the LOWESS trend line is particularly useful because no assumptions regarding linearity of the data are required. The smoothing algorithm uses nearby data points to calculate a smoothed value for every data point. Each nearby data point is weighted so that the more distant points affect the smoothed value less than points that are close. A line is then drawn through the smoothed values. The number of nearby points used to calculate a smoothed value is controlled by the smoothness factor. A smoothness factor of 0.5 means that the closest 50 percent of all the data points were used to calculate each smoothed value. Residuals (differences between the LOWESS-fitted concentrations and measured concentrations) were computed and referred to as flow-adjusted nutrient concentrations. Changes in the flow-adjusted concentrations indicate changes in concentration over time that are independent of changes in streamflow.

Time-series flow-adjusted concentration plots were tested by using the seasonal Kendall test to detect the presence of trends (Hirsch and others, 1982). The seasonal Kendall test can be used to detect long-term changes in concentration, which may indicate long-term improvement or deterioration in stream quality. The seasonal Kendall test is based on the nonparametric Kendall's tau test (Kendall, 1975), which compares the relative values of all possible data values in a time series. In the seasonal Kendall test, comparisons between data values are restricted to pairs of data that are from the same time period annually; this period is defined as a season.

The seasonal Kendall test also was used for testing a null hypothesis of no trend (the nutrient concentration and its date of observation are independent of one another). A statistically significant trend is indicated when the null hypothesis obtained from the seasonal Kendall test has a probability level (p-value) of 0.05 or less. For example, a p-value of 0.05 means that there is a 5-percent chance of making an error when rejecting the null hypothesis. In this report, p-values less than or equal to 0.05 were considered statistically significant in indicating increasing or decreasing trends in nutrient concentrations.

Annual and monthly instream loads of total nitrogen and total phosphorus were calculated as the product of daily streamflow and estimated daily concentration using Cohn's ESTIMATOR model (Cohn and others, 1989; Gilroy and others, 1990; Cohn and others, 1992). This model includes a seven-parameter log-linear regression analysis of constituent concentrations against measured environmental variables:

$$\ln(C) = \beta_0 + \beta_1[\ln(Q - Q')] + \beta_2[\ln(Q - Q')]^2 + \beta_3(t - t') + \beta_4(t - t')^2 + \beta_5\sin(2\pi t) + \beta_6\cos(2\pi t) + \varepsilon \ , \quad (1)$$

where

- ln = natural logarithm function,
- C = concentration (in milligrams per liter),
- Q = instantaneous discharge (in cubic feet per second),
- t = time (in decimal years),
- sin = sine function,
- cos = cosine function,
- π = 3.14169,
- β_0 to β_6 = coefficients of the regression model,
- ε = model errors,
- Q' = centering variable defined so that β_1 and β_2 are statistically independent, and
- t' = centering variable defined so that β_3 and β_4 are statistically independent.

The regression analysis assumes that model errors (ε) are independent and normally distributed, with zero mean and variance. The minimum variance unbiased estimator (MVUE; Bradu and Mundlak, 1970) was included in the model to correct for the retransformation bias associated with log-linear regression models; the model also employs the adjusted maximum likelihood estimator (AMLE; Cohn, 1988), which statistically adjusts for censored data and multiple reporting limits.

Equation 1 results in an estimate of the daily logarithmic constituent concentrations. The estimated daily constituent concentrations are then multiplied by the daily mean discharge to produce a daily mean load by using the following equation:

$$\ln[L_i] = Q_i \times \ln[C_i] \times K, \quad (2)$$

where

- ln = the natural logarithm function,
- L_i = the daily mean load (in kilograms per day),
- i = any interval,
- Q_i = the daily mean discharge for that interval (in cubic feet per second),
- C_i = the mean concentration (in milligrams per liter), and
- K = 0.203, the correction factor for unit conversion to tons per day.

Yields, which allow for easy comparison among sites with different drainage areas, were computed by dividing the estimated load by the drainage area of the basin.

Quality-Control Methods and Results

Quality-assurance and quality-control measures were practiced throughout the study according to established USGS guidelines (Mueller and others, 1997). Laboratory and field blank samples were processed by using water certified to contain undetectable concentrations of constituents to be analyzed. Data from blank samples were used to determine the extent of contamination introduced during sampling, sample processing, shipping, or laboratory analysis. Blank water used for the inorganic constituent sample was distilled, deionized water obtained from the USGS Ocala Water Quality Research Laboratory in Ocala, Fla. Blank water used for the organic constituent sample was either pesticide-grade or volatile-organic-compound-grade blank water obtained from the NWQL.

Eighteen blank samples were analyzed for nutrients. Nitrogen species were detected in 10 of the blanks, and 4 of these detections were greater than the corresponding LRL. Concentrations of dissolved ammonia and dissolved ammonia plus organic nitrogen were detected in one blank sample each in amounts that exceeded the 75th percentile for environmental samples for these two constituents. All other nitrogen detections were lower than the 10th percentile of environmental samples. There were no detections of nitrite or nitrite plus nitrate in the blank samples. Phosphorus species were detected in four blank samples, and two of these detections were greater than the corresponding LRL. Two estimated detections of dissolved phosphorus were equal to or less than the 5th percentile for this constituent in all environmental samples. Orthophosphate and total phosphorus were detected once—concentrations were estimated and less than the corresponding LRL.

Dissolved organic carbon was detected in 3 of 18 blank samples—two of the detections were estimated and less than the LRL. All dissolved organic carbon detections were less than the minimum concentration for environmental samples. Suspended organic carbon was detected in 2 of 14 blank samples, and concentrations were equal to or less than the median concentration of this constituent in all environmental samples. Fourteen blank samples were analyzed for pesticides using the GC/MS method, and 7 additional blank samples were analyzed for pesticides using the HPLC/MS method. No pesticides were detected in any of the blank samples.

Replicate samples were used to assess variability as a result of sample processing and laboratory analysis. The relative percentage difference (relative percentage difference = $|A - B| / [(A + B)/2]$) between the environmental samples and the corresponding replicate samples for nutrients ranged from 0 to 147.3 percent, with a median of 1.6 percent. Replicate results for nutrients indicated good reproducibility (less than 10 percent difference) of the data in 83 percent of the detections (126 of 152 pairs). For dissolved organic carbon, the relative percentage difference ranged from 0 to 51.1 percent, with a median of 2.7 percent, and good reproducibility in 67 percent of the detections (12 of 18 pairs). For suspended organic carbon, the relative percentage difference ranged from 0 to 58.8 percent, with a median of 13.9 percent, and good reproducibility in 29 percent of the detections (4 of 14 pairs). For pesticides, the relative percentage difference ranged from 0 to 118.6 percent, with a median of 7.2 percent. Replicate results from pesticides indicated good reproducibility of data in 53.8 percent of the detections (189 of 351 pairs; appendix 1). In approximately 11.4 percent of the pesticide detections (40 of 351 pairs), a compound was detected in one sample but not detected in the other (appendix 1).

Recovery data were obtained from sets of field-matrix spikes and laboratory spikes. A spike set consisted of an environmental sample, a replicate, and two spiked replicates. Eleven samples were analyzed for field-matrix spikes using the GC/MS method; 5 samples were analyzed for laboratory spikes using the HPLC/MS method. Water samples were collected, filtered, and spiked (if appropriate) prior to shipping to the NWQL for analysis. Field matrix spikes were added to the filtered pesticide sample while in the field; laboratory spikes were added to the filtered pesticide sample at the NWQL. The results for the spiked data are shown in figure 8.

Most recoveries for the GC/MS method fell within the expected range of 60 to 140 percent; the median recovery was 103.5 percent (fig. 8A). Median recoveries of four compounds (carbaryl, carbofuran, methyl-azinphos, and terbacil) exceeded 140 percent. Median recoveries of two compounds (*p,p'*-DDE and *cis*-permethrin) were less than 60 percent. Five pesticides (carbaryl, carbofuran, deethylatrazine, methyl-azinphos, and terbacil) were identified in the GC/MS method development (Zaugg and others, 1995) as having highly variable recoveries and were reported as estimated regardless of concentration. Detections of these compounds were highly reliable, but the numerical concentrations associated with the detections were not reliable (Coupe, 2000). Nondetections of these five compounds were unreliable because the poor recovery results indicated a high potential for false nondetections (Coupe, 2000). Small recoveries of deethylatrazine occurred in all sample-matrix types, and the results were reported as estimated (Zaugg and others, 1995).

Most recoveries for the HPLC/MS method also fell within the range of 60 to 140 percent; the median recovery was 101.1 percent (fig. 8B). Median recoveries of six compounds (ethyl-chlorimuron, imazaquin, imazethapyr, imidacloprid, nicosulfuron, and methyl-sulfometuron) exceeded 140 percent; median recoveries of six compounds ranged between 120 and 140 percent (flumetsulam, linuron, neburon, propham, propiconazole, and siduron); and median recoveries of nine compounds (aldicarb, aldicarb sulfone, 3-ketocarbofuran, clopyralid, methyl-chloramben, deethyldeisopropylatrazine, methomyl oxime, oxamyl oxime, and methyl-tribenuron) were less than 60 percent.

The method development for the HPLC/MS method (Furlong and others, 2001) indicated that the HPLC/MS method had recoveries in organic-free water ranging from 28 to 175 percent, with elevated recoveries reflecting apparent matrix enhancement. Two statistics were used by the NWQL to determine if the reported concentration of any compound required qualification. Median recoveries calculated from long-term laboratory reagent spike (LRS) data were used to estimate the accuracy of concentrations. A nonparametric statistic, *f*-pseudosigma (Hoaglin, 1983) was calculated to determine the variation of LRS recoveries. The average median recovery for all compounds was 73.4 percent, and the average *f*-pseudosigma of recovery was 21.4 percent. Median recoveries had to fall within 60 to 120 percent for a compound to be considered reportable without qualification. In addition, the *f*-pseudosigma statistic had to be less than 25 percent for a compound to be reported without qualification. Nineteen compounds (2,4-DB, 3-ketocarbofuran, aldicarb, aldicarb sulfone, aldicarb sulfoxide, bentazon, bromoxynil, chloramben methyl ester, chlorothalonil, cycloate, flumetsulam,

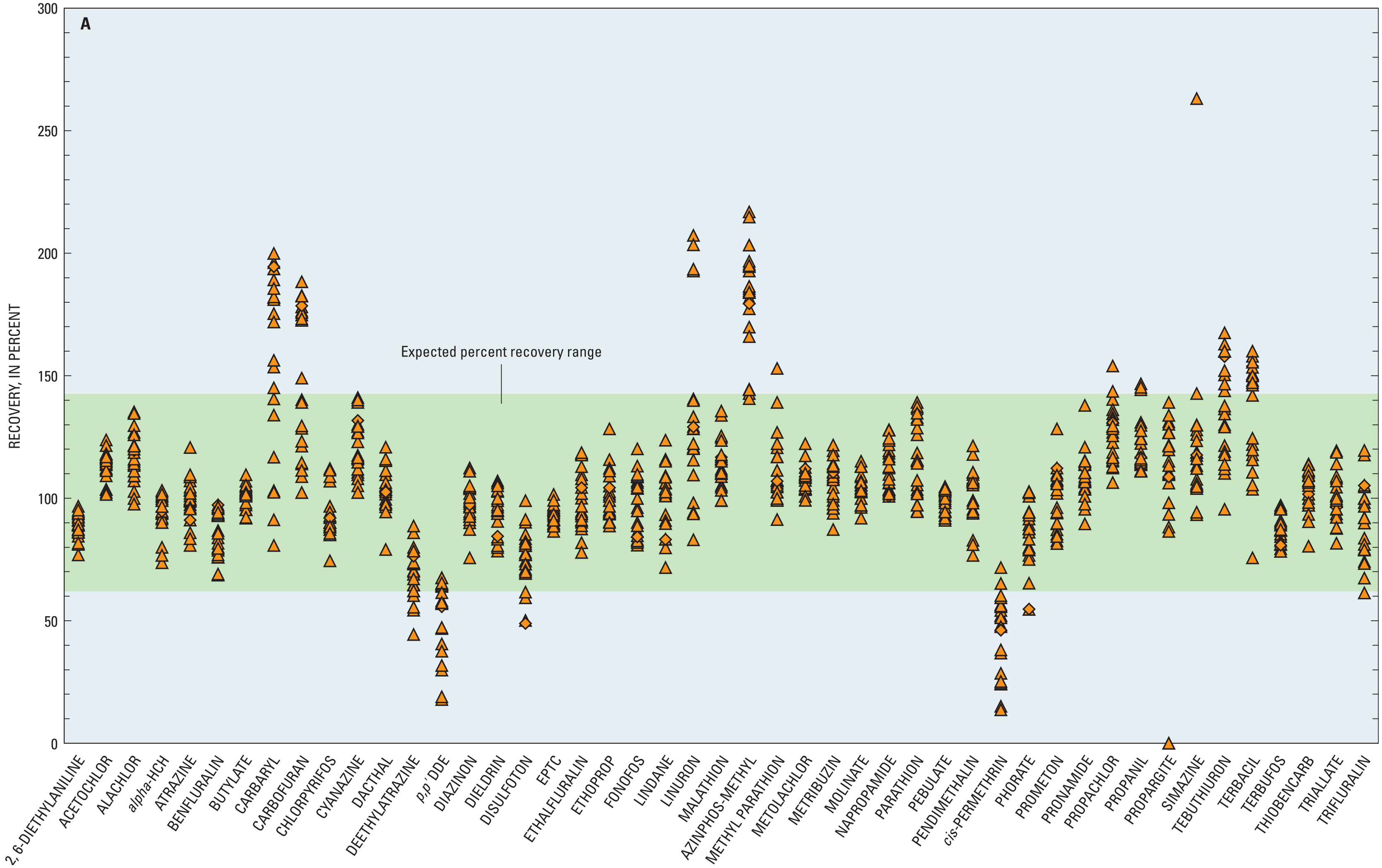


Figure 8A. Spike recoveries for pesticides and degradation products analyzed by the GC/MS method in surface-water samples from the Mobile River Basin.

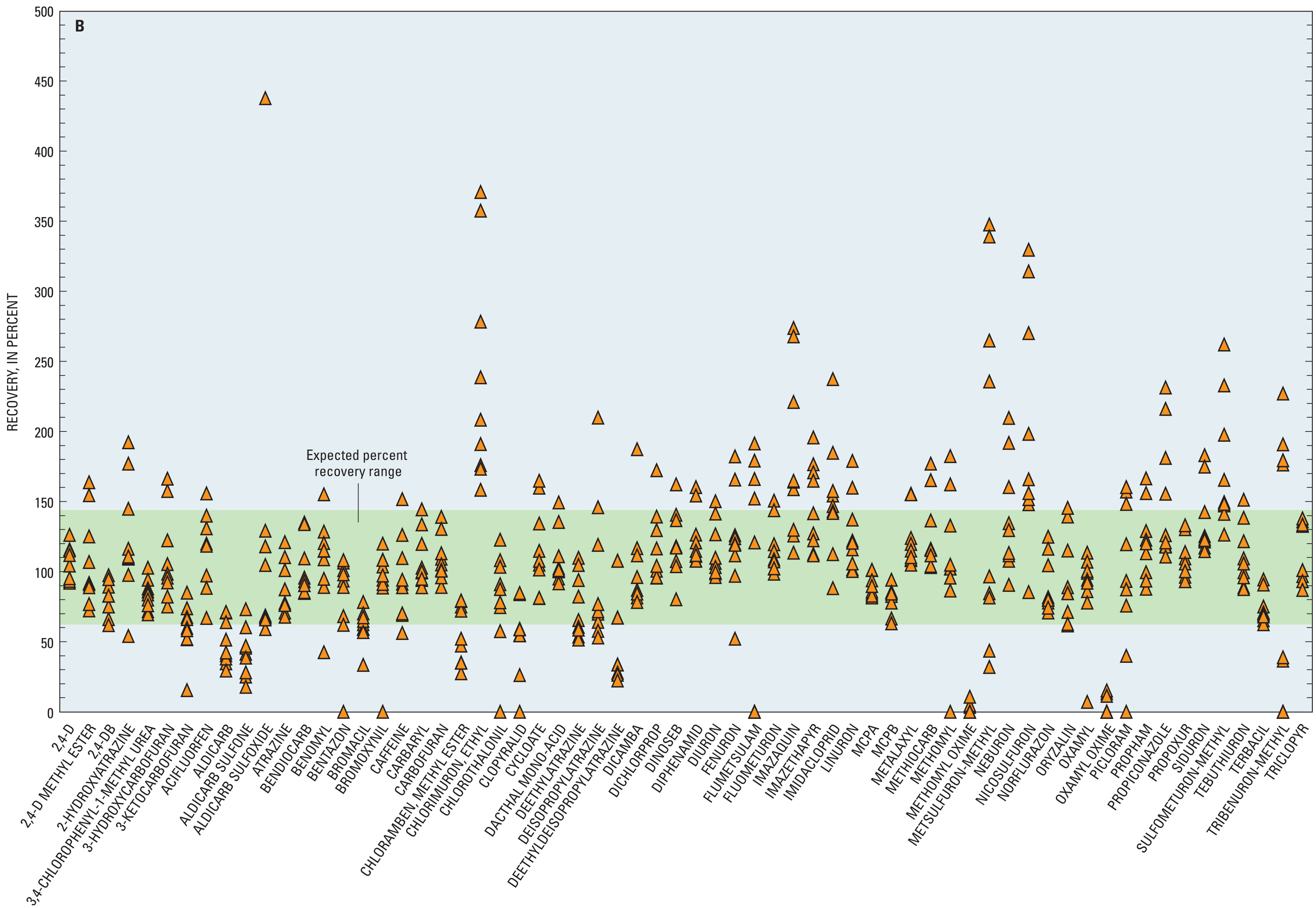


Figure 8B. Spike recoveries for pesticides and degradation products analyzed by the HPLC/MS method in surface-water samples from the Mobile River Basin.

imazaquin, MCPB, methiocarb, methomyl, methomyl oxime, methyl-metsulfuron, oxamyl oxime, and methyl-tribenuron) were reported as estimated because recoveries were outside the acceptable range (median recovery less than 60 percent or greater than 120 percent). Concentrations of eight compounds (2-hydroxyatrazine, bromacil, deethylatrazine, deethyldeisopropylatrazine, deisopropylatrazine, imazethapr, norflurazon, and terbacil) were reported as estimated because variation was outside the acceptable range (*f*-pseudosigma greater than 25 percent). The remaining 38 compounds met recovery performance criteria and were reported without qualification (Furlong and others, 2001).

The data from the HPLC/MS method should be used with care and with the understanding that there likely will be more frequent detections at comparable or lower concentrations than the HPLC method of Werner and others (1996), given that HPLC/MS offers more specific detection in the presence of matrix interferences than does HPLC with ultraviolet detection (Furlong and others, 2001).

Surrogate compounds were added to the samples at the NWQL. These surrogate compounds were not expected to be present in the environment but were expected to behave similarly to selected target analytes in the environment (Coupe, 2000). The GC/MS method called for the addition of two compounds—*alpha*-HCH-d_6, an organochlorine compound, and diazinon-d_{10}, an organophosphorus compound. The HPLC/MS method called for the addition of three surrogates—barban, C-13 caffeine, and 2,4,5-T. These surrogates were used to assess the recoveries for the targeted analytes (fig. 9). The median overall recoveries for these compounds were 105, 102, 84, 68, and 85 percent, respectively. For the GC/MS method, all of the recovery data were within the expected range of 60 to 140 percent (fig. 9); for the HPLC/MS method, 85 percent of the recovery data were within the expected range of 60 to 140 percent (fig. 9).

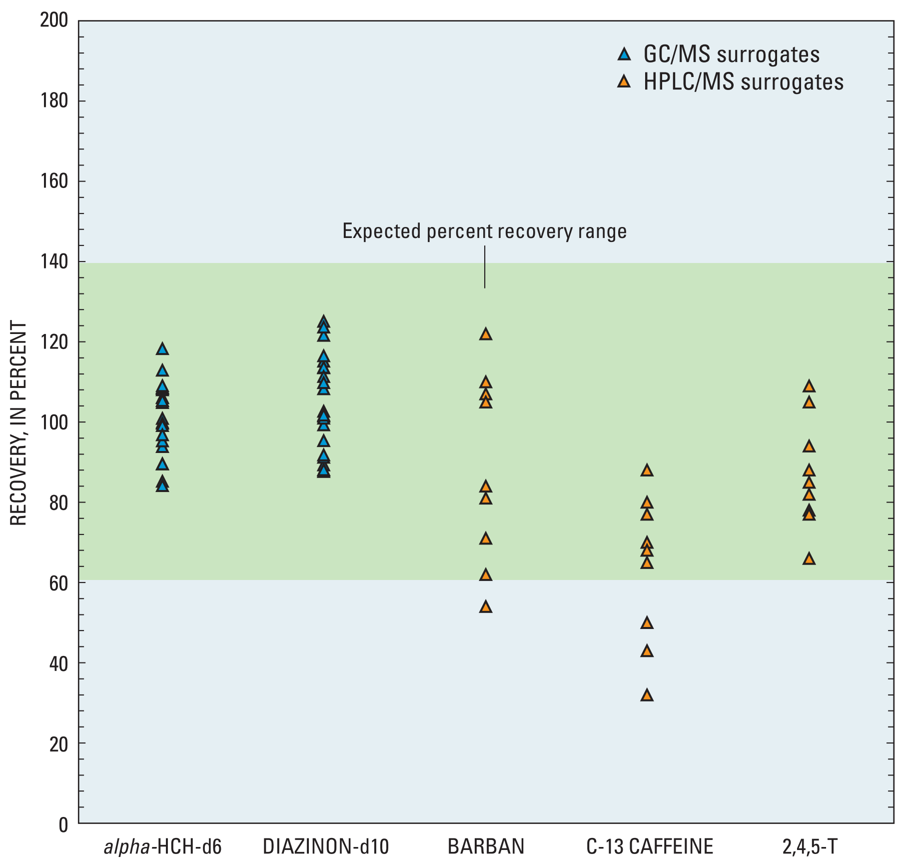


Figure 9. Recoveries of surrogate compounds in surface-water samples from the Mobile River Basin.

NUTRIENTS

Nutrients are chemical elements essential to plants and animals and include various forms of reduced or oxidized nitrogen, phosphorus, and organic carbon. Several species of nitrogen were measured during this study, including dissolved ammonia, nitrite, nitrite plus nitrate, organic nitrogen plus ammonia, and total ammonia plus organic nitrogen. Total nitrogen was computed as the sum of dissolved nitrite plus nitrate and total ammonia plus organic nitrogen. Organic nitrogen and nitrate usually are the predominant components of the total nitrogen concentration (appendix 2), because nitrite and ammonia generally are unstable in aerated waters (Hem, 1985). High levels of nitrate in drinking water have been linked to methemoglobinemia (blue baby syndrome) and also have been linked to certain types of cancer (Weyer and others, 2001).

Phosphorus species analyzed during this study were dissolved phosphorus, orthophosphate, and total phosphorus. Dissolved phosphorus generally is unstable and usually converts to orthophosphate (Hem, 1985). Eutrophication, the presence of excess nutrients, including phosphorus, can lead to nuisance plant growth and algal blooms, which in turn can cause reduced light penetration and dissolved oxygen levels, fouled water intakes, and taste and odor problems in drinking water.

Organic carbon was analyzed as both suspended organic carbon and dissolved organic carbon. While organic carbon is a minor nutrient, it is a concern because of its interaction with other compounds. Dissolved organic carbon forms trihalomethane (THM) compounds, which are suspected carcinogens, when treated with chlorine to disinfect drinking-water supplies. Organic carbon also can increase the solubility of certain pesticides and the mobility and bioavailability of heavy metals, such as mercury.

Several guidelines and standards have been established for nutrients in water (table 3). Current drinking-water standards, which are enforceable and apply to drinking-water supply systems, set maximum nitrite plus nitrate levels at 10 milligrams per liter (mg/L), maximum nitrate levels at 10 mg/L, and maximum nitrite levels at 1 mg/L (U.S. Environmental Protection Agency, 2002). The USEPA also has developed nutrient guidelines for surface water, which are intended to represent background concentrations of selected nutrients (U.S. Environmental Protection Agency, 2000a; 2000b). In order to account for regional and local influences, these guidelines are established for streams in individual ecoregions. Ecoregions are land divisions based on a combination of causal and integrative factors, including land use, land-surface form, potential natural vegetation, and soils (Omernik, 1987). The Mobile River Basin includes parts of the Southern Coastal Plain, Southeastern Plains, Southwestern Appalachians, Ridge and Valley, Piedmont, and Blue Ridge Mountains ecoregions (Johnson and others, 2002). The ecoregion nutrient criteria are not intended to be enforceable standards but rather serve as guidelines for certain nutrient concentrations within the ecoregions. Nutrient species sampled during this study with applicable ecoregion criteria are total nitrogen, nitrite plus nitrate, total organic nitrogen plus ammonia (total Kjeldahl nitrogen), and total phosphorus. The USEPA also recommends that total phosphorus concentrations not exceed 0.10 mg/L in streams not entering lakes or impoundments in order to prevent nuisance aquatic

Table 3. Nutrient criteria recommended by the U.S. Environmental Protection Agency for ecoregions in the Mobile River Basin

[mg/L, milligrams per liter]

Ecoregion[a]	Site name	Total Kjeldahl nitrogen (mg/L)	Nitrite plus nitrate (mg/L)	Total nitrogen (mg/L)	Total phosphorus (mg/L)
Ridge and Valley	Chattooga River, Cahaba River, Cahaba Valley Creek	0.3	0.095	0.214	0.01
Southwestern Appalachians	Black Warrior River	.1	.059	.3	.006
Southeastern Plains	Threemile Branch, Pintlalla Creek, Bogue Chitto Creek, Tombigbee River, Alabama River	.3	.095	.618	.0225

[a] U.S. Environmental Protection Agency (2000a; 2000b).

plant growth (U.S. Environmental Protection Agency, 1986).

Nitrogen

Nitrogen concentrations among the Mobile River Basin sites exhibited patterns associated with land use. Statistical descriptions of the concentration of nitrogen species are given by site in appendix 2. Total nitrogen concentrations ranged from 0.2 to 10 mg/L. Results of the Kruskal-Wallis test indicated that agricultural and urban indicator sites had significantly higher ($p < 0.05$) concentrations of total nitrogen than the integrator sites, which are composed of mixed land use (fig. 10). Additional analysis of the data using Tukey's test shows six tiers of data groups shown on figure 10 as multiple comparison groups A, B, BC, C, CD, and D. Letters were assigned to each site based on statistically significant similarities. Sites with different letter designations were significantly different ($p < 0.05$), whereas sites with the same letter were considered to be similar (Helsel and Hirsch, 1992). Sites can have multiple letter designations meaning they were similar to other sites but the other sites were not necessarily similar to each other. For example, for total nitrogen, Threemile Branch (multiple comparison group B) was similar to the Black Warrior River (multiple comparison group BC), but the Black Warrior River was also similar to the Cahaba River, Chattooga River, and Tombigbee River. Bogue Chitto Creek, primarily a row-crop agricultural indicator watershed, had the highest maximum and median concentrations of total nitrogen. Pintlalla Creek, primarily a pasture and grazing agricultural indicator watershed, had lower concentrations of nitrogen, which may be a result of differences in agricultural practices. The median concentrations of total nitrogen at all sites, except Pintlalla Creek and the Alabama River, exceeded the nutrient criteria for the respective ecoregion.

Nitrate concentrations showed a similar relation to land use as total nitrogen; however, values were significantly different ($p < 0.05$) for each land-use category. Nitrate concentrations ranged from 0.03 to 7.94 mg/L. The highest median concentrations of nitrate were from the urban indicator sites, Cahaba Valley Creek and Threemile Branch; the highest maximum concentration of nitrate was from Bogue Chitto Creek (fig. 10). At Cahaba Valley Creek, an average of 81 percent of the total nitrogen concentrations consisted of nitrate nitrogen (fig. 11). Nitrate concentrations at Cahaba Valley Creek (multiple comparison group A) also were significantly higher ($p < 0.05$) than all other sites. The Black Warrior River had the highest median nitrate concentration of the integrator sites, which also was higher than the median concentrations at both agricultural indicator sites. At the Black Warrior River, an average of 71 percent of the total nitrogen concentrations consisted of nitrate nitrogen (fig. 11). The upper part of the Black Warrior River Basin has some of the most concentrated poultry production in Alabama (Alabama Agricultural Statistics Service, 2002), and the lower part includes a large part of the Birmingham metropolitan area (fig. 3). Both of these factors may influence the nitrate concentrations at this site, as elevated nitrate levels are indicators of anthropogenic activities (U.S. Geological Survey, 1999). No samples had concentrations that exceeded the drinking-water standard of 10 mg/L for nitrate. Median nitrate concentrations exceeded the USEPA ecoregion criteria at all sites except Pintlalla Creek, Alabama River, and Tombigbee River (fig. 10).

Organic nitrogen plus ammonia concentrations ranged from 0.05 to 3.2 mg/L for dissolved species and 0.06 to 4.2 mg/L for total species and were significantly different ($p < 0.05$) among land-use categories. Concentrations of organic nitrogen plus ammonia, both dissolved and total, were highest at Bogue Chitto Creek and Pintlalla Creek, constituting 61 and 85 percent, respectively, of the total nitrogen concentrations. Organic nitrogen plus ammonia concentrations also were significantly higher ($p < 0.05$) at Bogue Chitto Creek (multiple comparison group A) than all other sites. Several samples at all sites exceeded the USEPA ecoregion nutrient criteria, and the median concentration of total organic nitrogen plus ammonia exceeded the ecoregion nutrient criteria at all sites except Threemile Branch (fig. 10).

Increases in streamflow resulted in no change or only slight increases in total nitrogen concentrations at integrator sites (fig. 12). Spearman's rho values for total nitrogen and streamflow ranged from 0.22 to 0.76. Cahaba Valley Creek was the only site where total nitrogen concentrations decreased as streamflow increased, which may indicate a point source for total nitrogen that is being diluted as streamflow increases (fig. 12).

Seasonal variations in nitrogen concentration occurred in relation to site and species of nitrogen (fig. 11), and are related to streamflow and nutrient

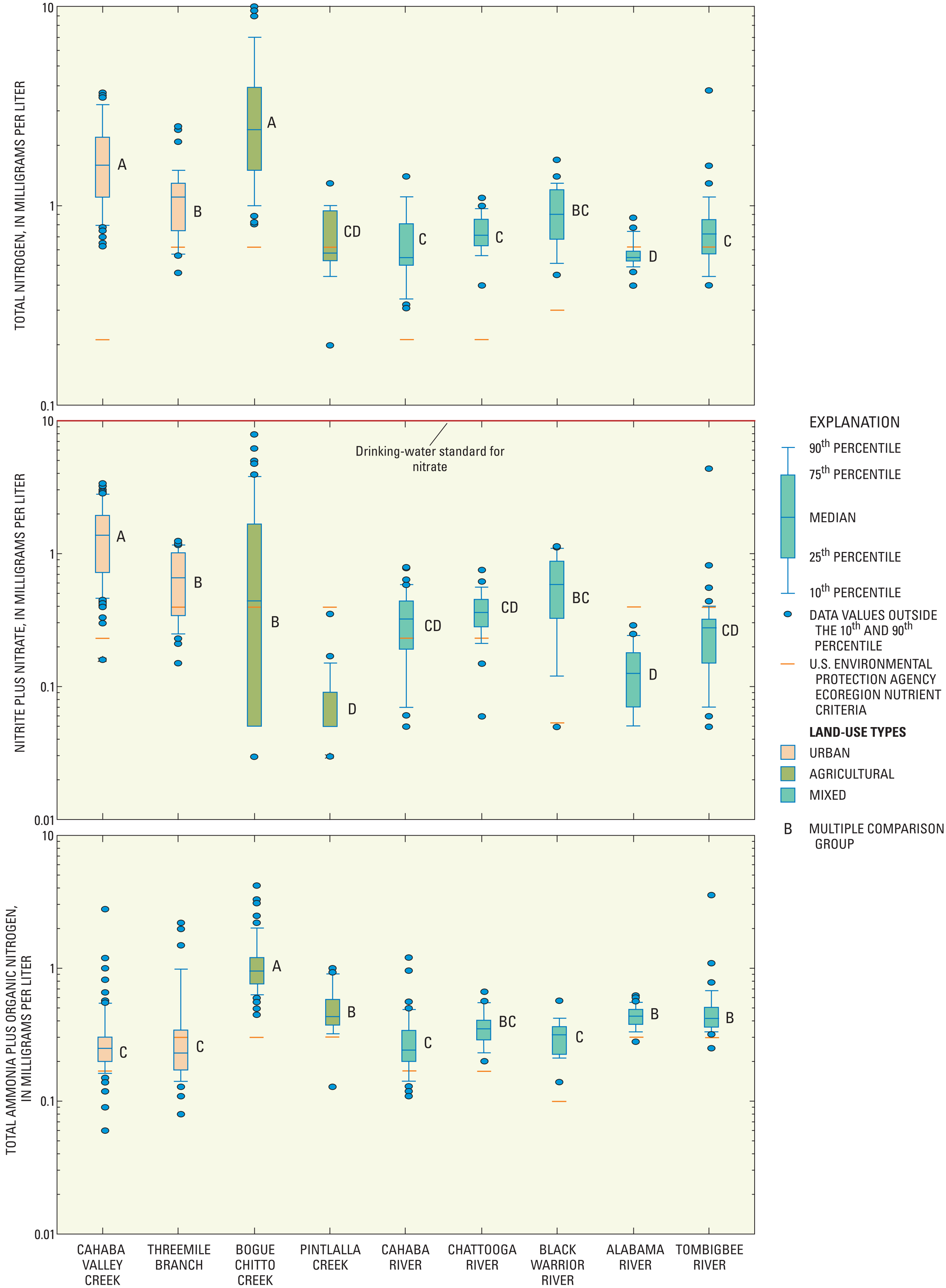


Figure 10. Distribution of total nitrogen, nitrite plus nitrate, and total ammonia plus organic nitrogen concentrations at sites in the Mobile River Basin.

Figure 11. Monthly median concentrations of nitrite plus nitrate and ammonia plus organic nitrogen at sites in the Mobile River Basin.

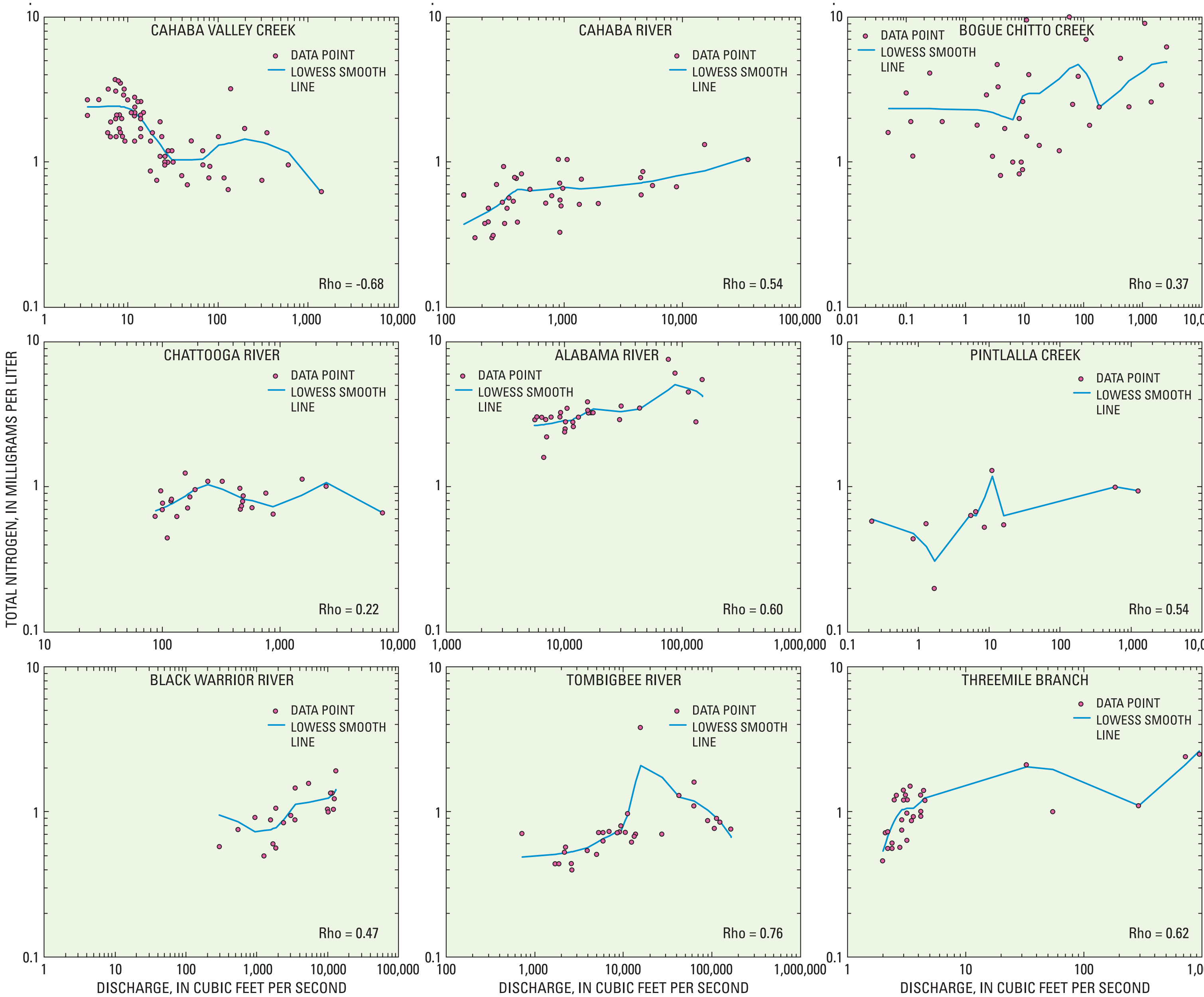


Figure 12. Relation between total nitrogen concentrations and streamflow at sites in the Mobile River Basin.

inputs including fertilizer application and outfalls. Nitrate values varied the most for the urban and agricultural indicator sites, reflecting the influences of both streamflow and fertilizer applications. Bogue Chitto Creek had higher values of nitrate during both periods of increased streamflow, late fall and winter, and during periods of fertilizer application, spring and summer. Cahaba Valley Creek had increased nitrate concentrations during the summer and fall months during periods of decreased streamflow. Nitrate concentrations in the Black Warrior River were higher during months with higher streamflow. Organic nitrogen plus ammonia concentrations remained fairly constant in all seasons at all sites.

Phosphorus

Phosphorus concentrations also were variable among the sites in the Mobile River Basin, with patterns associated more with land use than with physiography or natural setting. Statistical descriptions of the phosphorus species at each site are provided in appendix 2. Total phosphorus concentrations at all sites ranged from 0.008 to 2.22 mg/L. Results of the Kruskal-Wallis test indicated that the total phosphorus concentrations at the urban and agricultural indicator sites were significantly ($p < 0.05$) higher than the mixed land-use sites. Tukey's multiple comparison test showed seven groups of data; multiple comparison groups A, AB, B, BC, C, CD, and D (fig. 13). Bogue Chitto Creek had the highest maximum concentration of total phosphorus and Cahaba Valley Creek had the highest median concentration of total phosphorus of the indicator sites, and both are in multiple comparison group A (fig. 13). The Chattooga River had the highest concentrations (maximum and median) of total phosphorus of the integrator sites and had magnitudes and ranges in concentrations similar to the highest indicator sites; Chattooga River is in multiple comparison group A. Phosphorus concentrations are of particular interest because the Chattooga River flows into Weiss Lake, which has eutrophication problems (Alabama Department of Environmental Management, 2000a). The remaining sites were distributed among multiple comparison groups B, BC, C, CD, and D. Ecoregion nutrient criteria (table 3) for total phosphorus were exceeded at all sites in nearly all samples. Only two sites, Cahaba River and Chattooga River, had one sample each below the ecoregion nutrient criteria for total phosphorus. Forty-two percent of total phosphorus concentrations at all nine fixed sites exceeded the USEPA goal of 0.1 mg/L to prevent nuisance aquatic plant growth in streams (U.S. Environmental Protection Agency, 1986). Median total phosphorus concentrations at Bogue Chitto Creek, Cahaba Valley Creek, and the Chattooga River exceeded this goal.

Dissolved phosphorus ranged from 0.004 to 0.54 mg/L and dissolved orthophosphate concentrations ranged from 0.01 to 0.43 mg/L. The highest maximum and median concentrations for both dissolved phosphorus and orthophosphate were at the Chattooga River. The range and magnitude of concentrations at the Chattooga River were similar to those at Cahaba Valley Creek, an urban indicator site, and both sites are in multiple comparison group A (fig. 13). While the predominant land use in the Chattooga River Basin is forested, the similarity of phosphorus concentrations to those in the Cahaba Valley Creek Basin may indicate that other land uses or sources may influence phosphorus concentrations in the Chattooga River Basin. An average of 99 percent of the total phosphorus concentrations in the Chattooga River Basin consisted of dissolved phosphorus and orthophosphate; an average of 81 percent of the total phosphorus concentrations at Cahaba Valley Creek consisted of dissolved phosphorus and orthophosphate (fig. 14).

Total phosphorus concentrations at the Mobile River Basin sites generally increased as streamflow increased (fig. 15). This association is related to the affinity of phosphorus to bind to sediment. Correlation coefficients for total phosphorus and streamflow ranged from -0.85 at the Chattooga River to 0.22 at Pintlalla Creek. The urban indicator sites had distinctly different patterns from each other in that a positive correlation of orthophosphate with streamflow occurred at Threemile Branch (Spearman's Rho = 0.50), and a negative correlation of orthophosphate with streamflow occurred at Cahaba Valley Creek (Spearman's Rho = -0.58).

The distribution of monthly medians (fig. 14) indicates that most sites had relatively constant concentrations of all species of phosphorus in all months. Cahaba Valley Creek and Chattooga River had lower median concentrations of phosphorus during higher streamflow periods, January through May, with higher median concentrations during the remainder of the year. Bogue Chitto Creek had higher median phosphorus concentrations during periods of fertilizer

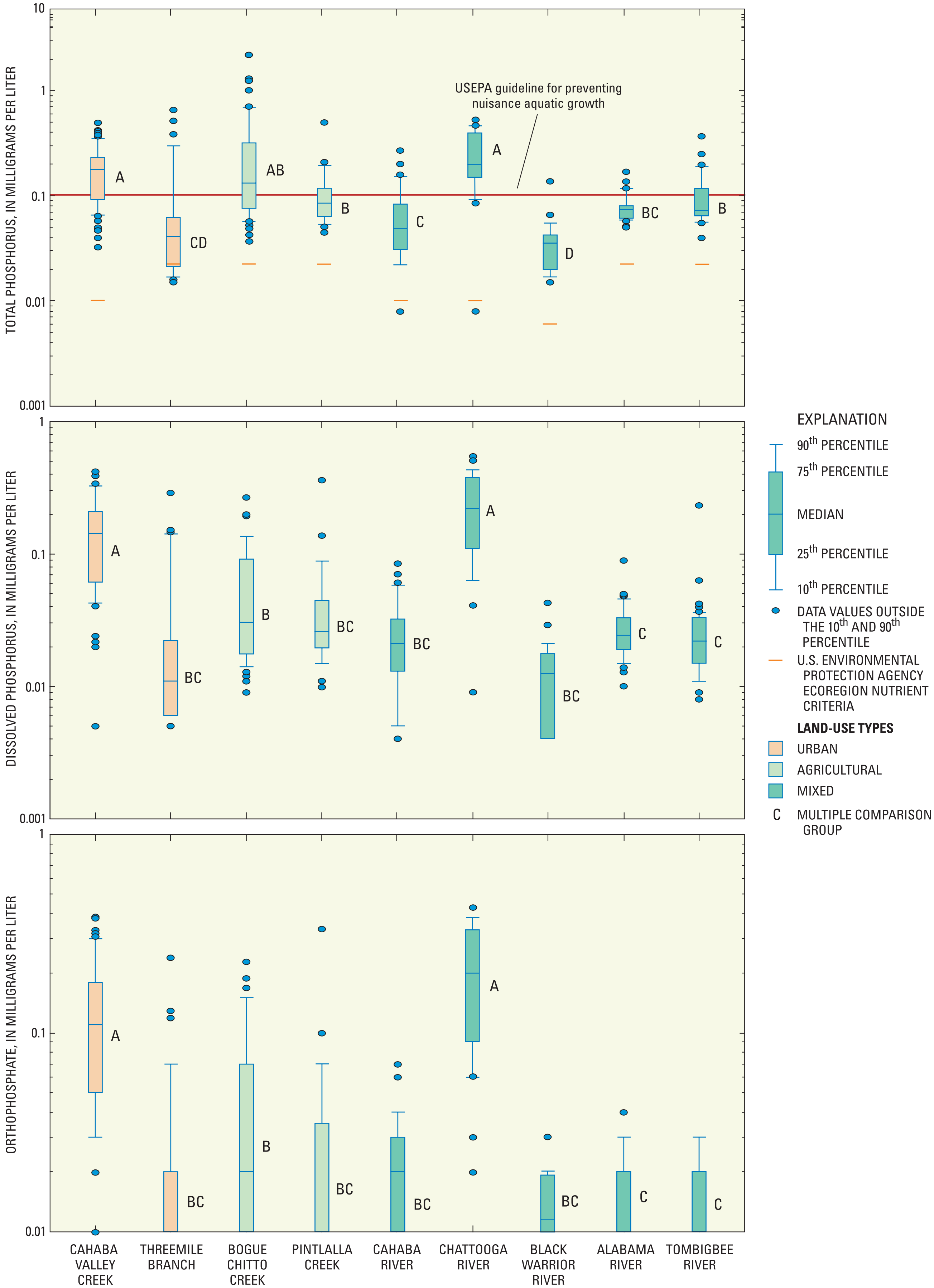


Figure 13. Distribution of dissolved phosphorus, orthophosphate, and total phosphorus concentrations at sites in the Mobile River Basin.

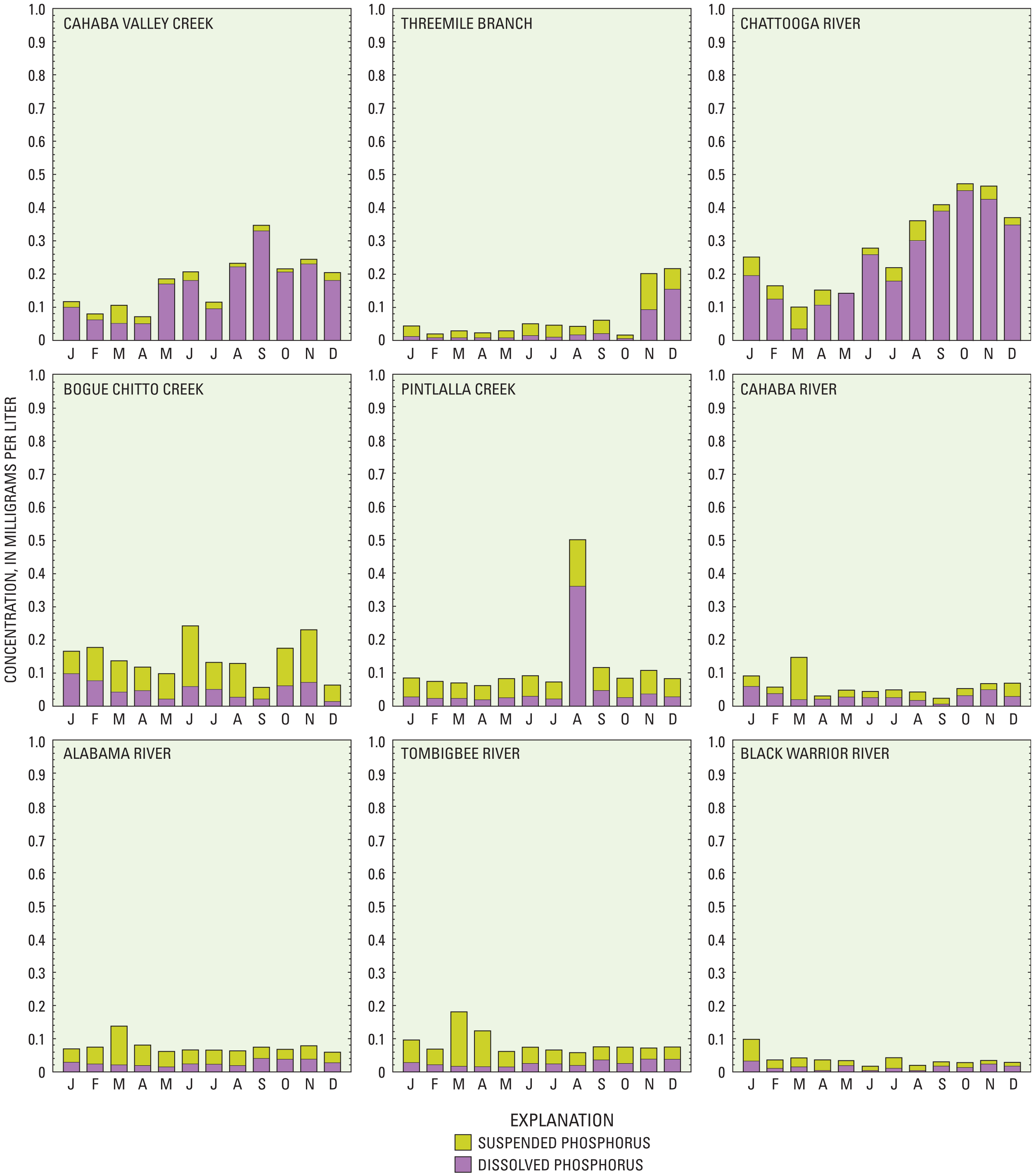


Figure 14. Monthly median concentrations of suspended phosphorus and dissolved phosphorus at sites in the Mobile River Basin.

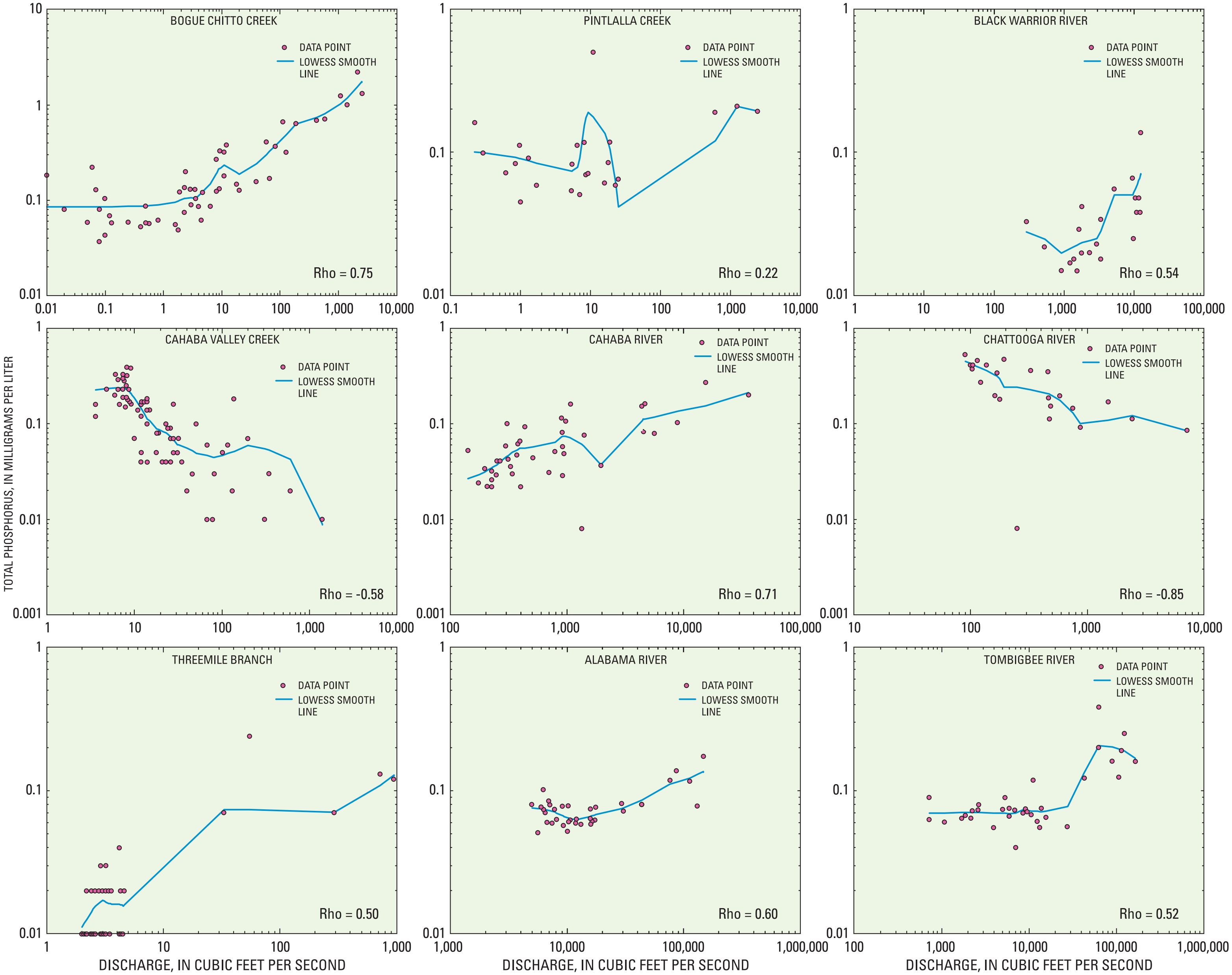


Figure 15. Relation between total phosphorus concentrations and streamflow at sites in the Mobile River Basin.

application, late spring and summer, and in late fall when streamflow increases. The decrease in phosphorus concentrations at Bogue Chitto in late summer may be attributed to the lack of streamflow and the lack of samples collected because of the ephemeral nature of the stream. The median phosphorus concentrations for Pintlalla Creek during August were much higher than normal because of a storm sample collected on August 25, 1999. The creek was dry in July and August 2000; therefore, the median values for July and August were equal to the July and August 1999 sample concentrations. It is likely that the monthly median concentrations for August would be similar to the phosphorus concentrations during the other summer months.

Organic Carbon

Dissolved organic carbon concentrations ranged from 0.9 to 17.8 mg/L and suspended organic carbon concentrations ranged from 0.2 to 6.0 mg/L. Median concentrations of dissolved organic carbon were highest at Bogue Chitto Creek and Pintlalla Creek (fig. 16). Results of the Kruskal-Wallis test show a significant difference in dissolved organic carbon concentrations between land-use groups. Results from Tukey's multiple comparison test show five tiers of multiple comparison groups: A, B, C, CD, and D (fig. 16). In the Bogue Chitto Creek Basin, land use primarily is row crops and pastureland; in the Pintlalla Creek Basin, land use primarily is forested, with some row crops and pastureland. The drainage basins of both sites are underlain primarily by chalk. The elevated concentrations of dissolved organic carbon in these basins may be more indicative of natural environmental influences than the agricultural practices in the two basins. Suspended organic carbon concentrations were significantly different ($p < 0.05$) among land-use groups. Tukey's multiple comparison test showed a slightly different pattern for dissolved organic carbon, resulting in multiple comparison groups A, B, BC, and C. Bogue Chitto Creek had significantly higher suspended organic carbon concentrations than all other sites (fig. 16).

Loads and Yields of Nutrients

Mean annual instream loads were calculated for each of the sites for total nitrogen, nitrate, total phosphorus, and dissolved orthophosphate. Results of these calculations and a summary of regression coefficients are shown in table 4. Analyses of instream loads can provide insight into the relative influence of seasons, temporal trends, and point and nonpoint sources on nutrient loads (Journey and Gill, 2001). Instream loads also can provide a means for comparing nutrients at sites with different drainage basin sizes or streamflow magnitudes by calculating yields and flow-weighted concentrations.

The ESTIMATOR model provides several diagnostic statistics for each constituent's load regression including the coefficient of determination (R^2), the variance (s), model variables, and the regression model coefficients (β_0–β_6). The R^2 values indicate how well the regression model explains variability in the estimated concentration and are expressed as a percentage of the variation. For example, an R^2 of 0.80 indicates that 80 percent of the variability is accounted for in the model. In general, higher R^2 values are more desirable, but no load regressions were excluded because of low R^2 values. The ESTIMATOR model also provides T values for each regression coefficient, which is a measure of the significance of the coefficients in the regression model (Cohn and others, 1992). Regression coefficients with T values greater than 2 were considered to be statistically significant (Journey and Gill, 2001) and are shown in bold in table 4. Variables that are considered to be statistically significant indicate a relation to a constituent's concentration. Streamflow is considered to be a good predictor of concentration when the coefficient β_1 is statistically significant. Seasonal influences or variation are indicated by a statistically significant sine or cosine coefficient, β_5 and β_6, because they both represent seasonal influences—if either variable was statistically significant, then they were both considered to be significant.

Point sources are likely to be the dominant nutrient input source at sites with statistically significant negative streamflow coefficients, β_1, whereas sites with statistically significant positive streamflow coefficients have nonpoint sources as the dominant nutrient input source. Sites with significant negative streamflow coefficients were the Chattooga River (orthophosphate), Threemile Branch (nitrate), and Cahaba Valley Creek (total nitrogen, nitrate, orthophosphate) (table 4). Sites with significant positive streamflow coefficients were the Tombigbee River (total phosphorus), Alabama River (total nitrogen, nitrate, total phosphorus), Cahaba River (total

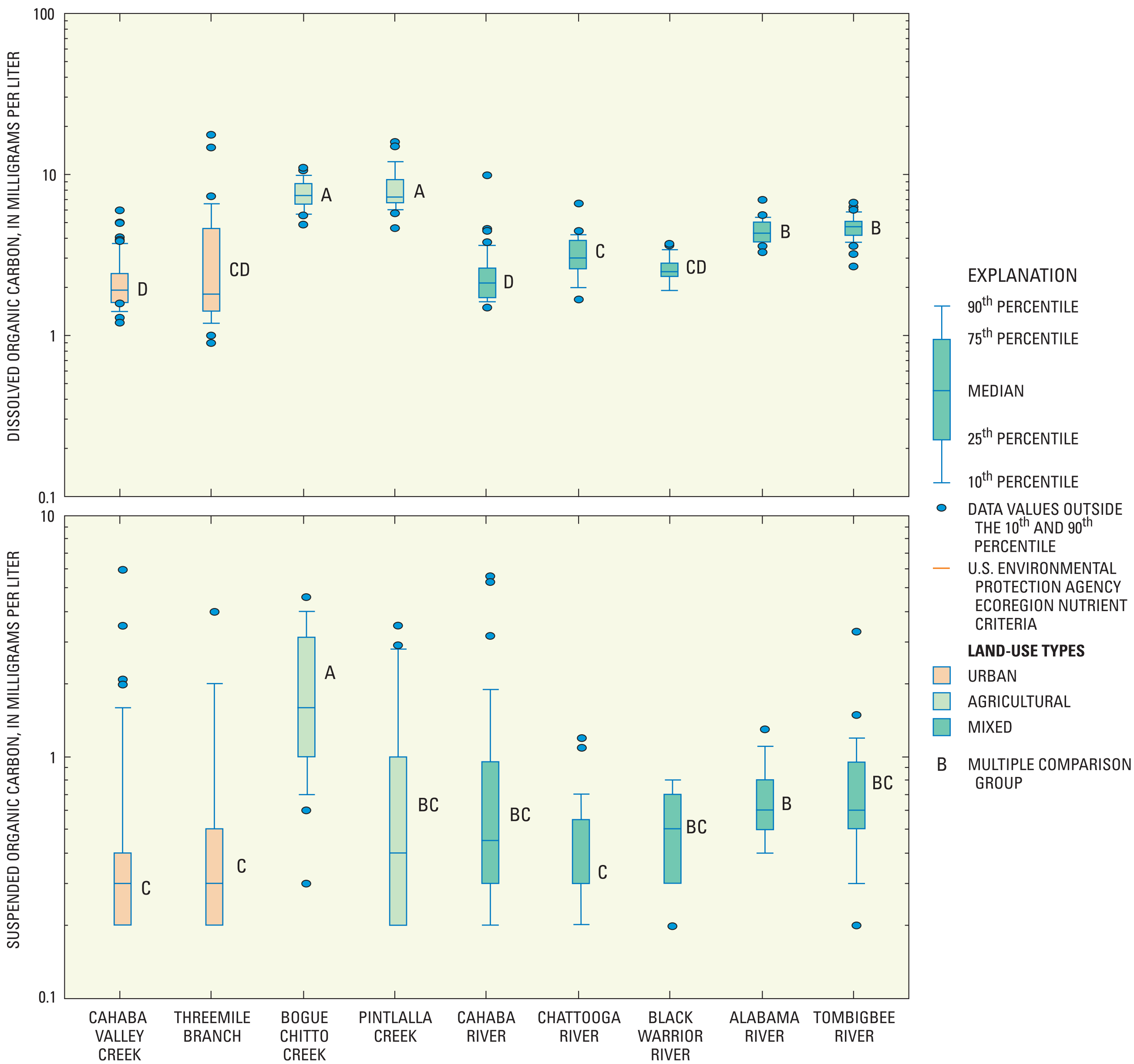


Figure 16. Distribution of dissolved and suspended organic carbon concentrations at sites in the Mobile River Basin.

Table 4. Regression summary for the seven-parameter, log-linear regression model used to estimate nutrient concentrations at sites in the Mobile River Basin

[s, standard deviation of the residuals from ordinary least-squares fit, in log units; R^2, coefficient of determination; B_0, constant; B_1, coefficient of natural logarithm of streamflow; B_2, coefficient of natural logarithm of streamflow, squared; B_3, coefficient of time; B_4, coefficient of time, squared; B_5, coefficient of sine (time); B_6, coefficient of cosine (time); bold indicates coefficients with an absolute T value greater than 2, which indicates statistical significance; —, no regression results because of insufficient data]

Constituent	s	R^2	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Annual nutrient loads, in tons per year			Mean annual load, in tons per day	Yield, in tons per day per square mile
										1999	2000	2001		
Alabama River at Claiborne, Alabama														
Total nitrogen	0.12	0.52	**-0.5214**	**0.0682**	-0.0087	0.0027	-0.0136	0.0603	0.0365	2,550	1,690	3,910	2,720	0.12
Dissolved nitrite-plus-nitrate nitrogen	.36	.67	**-1.8380**	**.2411**	**-.1937**	-.0690	.0689	**.3490**	**.3279**	848	430	997	758	.03
Total phosphorus	.20	.56	**-2.607**	**.1786**	**.1071**	-.0492	-.0397	-.0213	.0242	368	234	591	398	.02
Dissolved orthophosphate	.45	.24	-4.213	-.1488	.0546	-.1821	-.0475	-.0395	.1081	80	50	78	69	.003
Suspended sediment	.46	.81	**3.225**	**.7934**	-.0393	.1038	.1584	.116	-.1806	184,000	94,600	443,000	241,000	11
Black Warrior River below Bankhead Lock and Dam near Bessemer, Alabama														
Total nitrogen	0.20	0.79	-0.5028	0.0126	0.0042	0.0197	0.1387	**0.3157**	**0.2329**	1,390	1,300	—	1,350	0.34
Dissolved nitrite-plus-nitrate nitrogen	.49	.74	-.7663	-.0002	-.0011	-.1274	.0741	**.7576**	**.5863**	1,130	814	—	972	.24
Total phosphorus	.40	.59	**-4.9088**	.0366	**.0245**	.0834	-.0444	**-.0999**	**.3333**	71	94	—	82	.02
Dissolved orthophosphate	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Suspended sediment	.69	.36	**1.1439**	.0502	.0454	-.4065	.4314	.2130	.1341	11,700	11,800	—	11,800	3

Table 4. Regression summary for the seven-parameter, log-linear regression model used to estimate nutrient concentrations at sites in the Mobile River Basin—Continued

[s, standard deviation of the residuals from ordinary least-squares fit, in log units; R^2, coefficient of determination; B_0, constant; B_1, coefficient of natural logarithm of streamflow; B_2, coefficient of natural logarithm of streamflow, squared; B_3, coefficient of time; B_4, coefficient of time, squared; B_5, coefficient of sine (time); B_6, coefficient of cosine (time); bold indicates coefficients with an absolute T value greater than 2, which indicates statistical significance; —, no regression results because of insufficient data]

Constituent	s	R^2	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Annual nutrient loads, in tons per year			Mean annual load, in tons per day	Yield, in tons per day per square mile
										1999	2000	2001		
Bogue Chitto Creek near Memphis, Alabama														
Total nitrogen	0.62	0.35	**0.9518**	**0.1169**	0.0050	-0.0190	-0.0723	**-0.4359**	**-0.2017**	57	29	105	64	1.2
Dissolved nitrite-plus-nitrate nitrogen	2.10	.31	**-1.9861**	**.3641**	.0077	-.3386	.0620	-.1863	.3295	194	62	170	142	2.7
Total phosphorus	.54	.72	**-2.2521**	**.1931**	**.0287**	-.0987	-.1806	-.0637	.0037	14	9	20	14	.27
Dissolved orthophosphate	.98	.58	**-4.4214**	**.2873**	.0142	**-.4216**	.1330	-.4553	.3913	4.8	1.1	4	3.3	.06
Suspended sediment	.96	.71	**3.1245**	**.3349**	**.0426**	.0194	-.4499	.0155	.0137	11,300	14,600	21,300	15,700	298
Cahaba River at Centreville, Alabama														
Total nitrogen	0.29	0.51	-0.2163	**0.2305**	-0.0378	0.2711	0.0455	-0.0794	0.0029	184	177	393	251	0.24
Dissolved nitrite-plus-nitrate nitrogen	.67	.46	**-0.7924**	.1496	**-.2078**	.1463	.1332	-.0379	.3675	116	77	141	111	.11
Total phosphorus	.55	.56	**-2.5746**	.5435	-.0315	.3090	.3709	-.3649	.0515	27	25	92	48	.05
Dissolved orthophosphate	.59	.49	**-3.6079**	.0697	**-.2296**	.1505	.3674	-.1204	.2821	7	4	12	8	.01
Suspended sediment	.62	.79	**3.5701**	**1.0095**	-.0194	.3520	-.1383	**-.3049**	**-.3592**	16,500	31,300	27,600	25,100	24

Table 4. Regression summary for the seven-parameter, log-linear regression model used to estimate nutrient concentrations at sites in the Mobile River Basin—Continued

[s, standard deviation of the residuals from ordinary least-squares fit, in log units; R^2, coefficient of determination; B_0, constant; B_1, coefficient of natural logarithm of streamflow; B_2, coefficient of natural logarithm of streamflow, squared; B_3, coefficient of time; B_4, coefficient of time, squared; B_5, coefficient of sine (time); B_6, coefficient of cosine (time); bold indicates coefficients with an absolute T value greater than 2, which indicates statistical significance; —, no regression results because of insufficient data]

Constituent	s	R^2	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Annual nutrient loads, in tons per year			Mean annual load, in tons per day	Yield, in tons per day per square mile
										1999	2000	2001		
Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama														
Total nitrogen	0.36	0.49	**0.3502**	**-0.2265**	0.0329	0.0631	-0.1170	-0.0218	-0.0440	8	8.1	12	9.4	0.37
Dissolved nitrite-plus-nitrate nitrogen	.34	.77	-.1567	**-.501**	.0193	.1063	-.0675	.0453	-.0123	5.2	5.2	7.6	6	.23
Total phosphorus	.44	.55	**-1.7401**	-.0706	.0481	**-.2159**	**-.471**	**-.2316**	**-.0445**	.9	1	.8	.9	.04
Dissolved orthophosphate	.50	.75	**-2.5645**	**-.5323**	.0276	**-.28**	**-.4989**	-.0819	.0852	.5	.5	.3	.4	.02
Suspended sediment	.68	.64	**3.3777**	**.9537**	-.0455	-.0746	-.1086	**-.6077**	**-.3410**	293	494	822	536	21
Chattooga River above Gaylesville, Alabama														
Total nitrogen	0.21	0.36	-0.1388	0.1005	**-0.0919**	0.1675	0.0308	-0.0679	-0.1112	68	56	—	62	0.17
Dissolved nitrite-plus-nitrate nitrogen	.42	.47	**-1.0541**	-.0591	-.1227	.1718	.3699	.3036	-.2369	38	29	—	34	.09
Total phosphorus	.75	.50	**-1.9321**	.0982	-.0276	-.2094	-.1434	**-1.0236**	**.1281**	23	13	—	18	.05
Dissolved orthophosphate	.32	.90	**-1.9897**	**-.5542**	-.0374	-.0933	-.3588	**-.3617**	**.0335**	11	9	—	10	.03
Suspended sediment	.59	.68	**3.9187**	.9545	**-.3282**	.3565	-.8726	**-.7031**	**-.3333**	2,110	2,060	—	2,080	5.7

Table 4. Regression summary for the seven-parameter, log-linear regression model used to estimate nutrient concentrations at sites in the Mobile River Basin—Continued

[s, standard deviation of the residuals from ordinary least-squares fit, in log units; R^2, coefficient of determination; B_0, constant; B_1, coefficient of natural logarithm of streamflow; B_2, coefficient of natural logarithm of streamflow, squared; B_3, coefficient of time; B_4, coefficient of time, squared; B_5, coefficient of sine (time); B_6, coefficient of cosine (time); bold indicates coefficients with an absolute T value greater than 2, which indicates statistical significance; —, no regression results because of insufficient data]

Constituent	s	R^2	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Annual nutrient loads, in tons per year			Mean annual load, in tons per day	Yield, in tons per day per square mile
										1999	2000	2001		
Pintlalla Creek at Liberty Church Road near Pintlalla, Alabama														
Total nitrogen	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Dissolved nitrite-plus-nitrate nitrogen	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total phosphorus	0.44	0.55	**-2.0187**	**0.1970**	0.0045	0.1458	-0.2824	**-0.5120**	**-0.1353**	1.4	.5	—	.9	0.02
Dissolved orthophosphate	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Suspended sediment	.51	.72	**2.8225**	**0.2557**	0.0107	-0.3743	-0.5202	0.2045	-0.1057	360	281	—	320	5.4
Threemile Branch at North Boulevard at Montgomery, Alabama														
Total nitrogen	0.31	0.52	0.3021	**0.1201**	-0.0745	-0.0309	-0.0024	**0.0874**	**0.2709**	2.7	2	—	2.4	0.27
Dissolved nitrite-plus-nitrate nitrogen	.44	.54	**-0.6907**	**-0.2387**	-0.0927	**-0.2293**	0.1952	**0.0905**	**0.2927**	1.2	.7	—	1	0.11
Total phosphorus	.75	.57	**-1.9639**	**0.6709**	-0.125	0.2183	-0.1788	-0.2334	-0.1308	.33	.3	—	.32	0.04
Dissolved orthophosphate	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Suspended sediment	1.10	.63	**3.2539**	**1.0873**	-0.0711	0.4911	-0.1328	-0.1882	0.2899	141	185	—	163	19

Table 4. Regression summary for the seven-parameter, log-linear regression model used to estimate nutrient concentrations at sites in the Mobile River Basin—Continued

[s, standard deviation of the residuals from ordinary least-squares fit, in log units; R^2, coefficient of determination; B_0, constant; B_1, coefficient of natural logarithm of streamflow; B_2, coefficient of natural logarithm of streamflow, squared; B_3, coefficient of time; B_4, coefficient of time, squared; B_5, coefficient of sine (time); B_6, coefficient of cosine (time); bold indicates coefficients with an absolute T value greater than 2, which indicates statistical significance; —, no regression results because of insufficient data]

Constituent	s	R^2	β_0	β_1	β_2	β_3	β_4	β_5	β_6	Annual nutrient loads, in tons per year			Mean annual load, in tons per day	Yield, in tons per day per square mile
										1999	2000	2001		
Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama														
Total nitrogen	0.34	0.51	-0.3761	0.0370	-0.0317	-0.0709	0.1501	0.2689	0.0435	5,250	2,560	6,020	4,610	0.25
Dissolved nitrite-plus-nitrate nitrogen	.48	.63	**-1.2628**	.0975	**-.1489**	-.0628	.0445	.3604	.2236	1,730	978	2,050	1,590	.09
Total phosphorus	.32	.65	-2.5005	**.2363**	**.0802**	-.0227	-.0638	-.0043	.1057	660	430	1,030	707	.04
Dissolved orthophosphate	.53	.20	-3.9985	-.0718	-.0471	-.0840	-.1250	-.0998	.2356	71	52	97	73	.004
Suspended sediment	.61	.77	**3.6137**	**.7695**	.1087	.0955	-.1880	-.2630	-.0374	505,000	459,000	1,090,000	685,000	37

nitrogen), Bogue Chitto Creek (total nitrogen, nitrate, total phosphorus, orthophosphate), Pintlalla Creek (total phosphorus), and Threemile Branch (total nitrogen, total phosphorus).

Nutrient yields are useful for comparing nutrient loads from sites with different drainage basin sizes. Normalizing the nutrient load to basin size eliminates the effect of basin size. For example, the Tombigbee River had a mean annual nitrogen load of 4,610 tons per day (tons/d), and Bogue Chitto Creek had a mean annual total nitrogen load of 64 tons/d (table 4); however, the yield for the Tombigbee River and Bogue Chitto Creek was 0.25 tons per day per square mile ([tons/d]/mi^2) and 1.2 (tons/d)/mi^2, respectively, indicating higher total nitrogen inputs per square mile in the Bogue Chitto Creek Basin. Total nitrogen yields at Bogue Chitto Creek were almost five times higher than at the Tombigbee River, and Bogue Chitto Creek had the highest yields for all constituents for all sites.

Nutrient yields were nearly twice as high in the Tombigbee River compared to the Alabama River for total nitrogen, nitrate, and total phosphorus, reflecting more agricultural and urban influences in the Tombigbee River Basin (table 4). Nutrient yields in Bogue Chitto Creek were higher than the other indicator sites. Nutrient yields were highest in Bogue Chitto Creek, Cahaba Valley Creek, and Threemile Branch due to the agricultural and urban land-use influences in those watersheds.

Flow-weighted mean concentrations also are helpful in comparing nutrient loads from sites with differing streamflow regimes by eliminating the influence of streamflow. Flow-weighted mean concentrations were computed by dividing the estimated annual load by the mean annual streamflow for the load computation period. Clark and others (2000) calculated flow-weighted mean concentrations for selected nutrients in undeveloped basins around the United States to estimate background nutrient levels. Flow-weighted mean concentrations for the nine Mobile River Basin sites equaled or exceeded median flow-weighted means representing background concentrations of 0.02 mg/L of ammonia, 0.087 mg/L of nitrate, 0.26 mg/L of total nitrogen, 0.01 mg/L of orthophosphate, and 0.022 mg/L of total phosphorus (table 5).

Flow-weighted mean concentrations also were computed for ammonia, nitrate, total nitrogen, orthophosphate, and total phosphorus for all NAWQA Study Units, including the Mobile River Basin Study Unit, from the period 1999 to 2001, and sites from this study unit were ranked against these values according to land-use category (table 5). Flow-weighted mean concentrations for the Mobile River Basin sites generally were in the lower to middle percentile ranges compared to data from other NAWQA studies across the Nation. However, Bogue Chitto Creek's flow-weighted mean concentrations of ammonia, total

Table 5. Flow-weighted mean nutrient concentrations at sites in the Mobile River Basin

[ft^3/s, cubic feet per second; mg/L, milligrams per liter; —, not estimated]

Site name	Land-use category	Years	Mean annual streamflow (ft^3/s)	Ammonia		Nitrate		Total nitrogen		Orthophosphate		Total phosphorus	
				Flow-weighted mean concentration (mg/L)	Percentile	Flow-weighted mean concentration (mg/L)	Percentile	Flow-weighted mean concentration (mg/L)	Percentile	Flow-weighted mean concentration (mg/L)	Percentile	Flow-weighted mean concentration (mg/L)	Percentile
Alabama River	Mixed	2	21,549	—	—	0.16	22	0.62	25	0.02	33	0.09	40
Black Warrior River	Mixed	2	5,933	—	—	.74	53	1.41	52	—	—	.80	94
Bogue Chitto Creek	Agriculture	2	45	0.21	90	.14	19	4.19	83	.14	82	1.07	95
Cahaba River	Mixed	2	1,160	—	—	.45	42	1.11	43	.03	49	.21	65
Cahaba Valley Creek	Urban	2	33	.03	40	.83	56	1.42	52	.03	49	.14	53
Chattooga River	Mixed	2	380	—	—	.61	48	.88	36	.08	70	.14	52
Pintlalla Creek	Agriculture	2	53	—	—	—	—	—	—	—	—	.15	53
Threemile Branch	Urban	2	9	—	—	.41	38	1.31	51	—	—	.22	65
Tombigbee River	Mixed	2	21,133	.03	39	.31	34	.85	34	.02	33	.14	52

nitrogen, orthophosphate, and total phosphorus were in the upper 20th percentiles of agricultural sites. The Chattooga River's orthophosphate concentration ranked in the 70th percentile, and the Black Warrior River's total phosphorus concentration was in the 94th percentile of integrator sites.

Trends

No significant long-term trends were detected to be statistically significant for the Alabama, Cahaba, or Tombigbee Rivers except for a general decrease in nitrate at the Alabama River (figs. 17, 18). The decrease in nitrate could be due to improved wastewater-treatment practices as well as decreases in the amount of row-crop agricultural activities in the watershed (Alabama Agricultural Statistics Service, 2002). No short-term trends were detected at any of the three sites.

An examination of time-series plots of the flow-adjusted concentrations for the Alabama and Tombigbee Rivers indicated a general pattern of increases in total nitrogen and total ammonia and organic nitrogen from the mid-1970's to the mid-1980's followed by slight decreases or very little change from the mid-1980's to 2001 (fig. 17). The time-series plots also indicated that nitrate concentrations generally decreased from 1980 to 2001 at both sites. Total phosphorus remained unchanged or decreased slightly from the early 1970's to the mid-1980's followed by slight increases from the late 1980's to 2001, although no trends were detected to be statistically significant (fig. 18). A similar pattern was observed for dissolved phosphorus at both sites, but no trends were detected to be statistically significant. The presence of trends at the Cahaba River proved to be inconclusive because the analyses consisted primarily of comparing two clusters of data to each other (figs. 17, 18).

SUSPENDED SEDIMENT

Suspended sediment is all particulate matter suspended in the water column resulting from streambed resuspension and erosion (Guy and Norman, 1970). Suspended sediment is measured as total concentration in milligrams per liter and as the percentage of total material finer than 0.062 millimeters (mm) (appendix 2). Natural conditions and anthropogenic activities can influence suspended-sediment concentration. Natural conditions contributing to increased sediment concentrations include steep terrain, areas burned by forest fires, and soil erosion. Anthropogenic activities that impact sediment concentrations include activities such as construction, mining, and timber harvesting. High suspended-sediment concentrations can cause habitat destruction, reduced light penetration in the water column, loss of reservoir storage, and increased concentrations of hydrophobic compounds that commonly bind to sediment.

Suspended-sediment concentrations ranged from 1.0 to 2,450 mg/L and were significantly different ($p < 0.05$) among land-use categories. Multiple comparison tests resulted in four tiers of groups—A, AB, B, and C (fig. 19). Bogue Chitto Creek had the highest maximum and median concentrations of suspended sediment. The median value of percent sediment finer than 0.062 mm was 88 percent for all sites, indicating the majority of suspended sediment was finer than sand-sized particles.

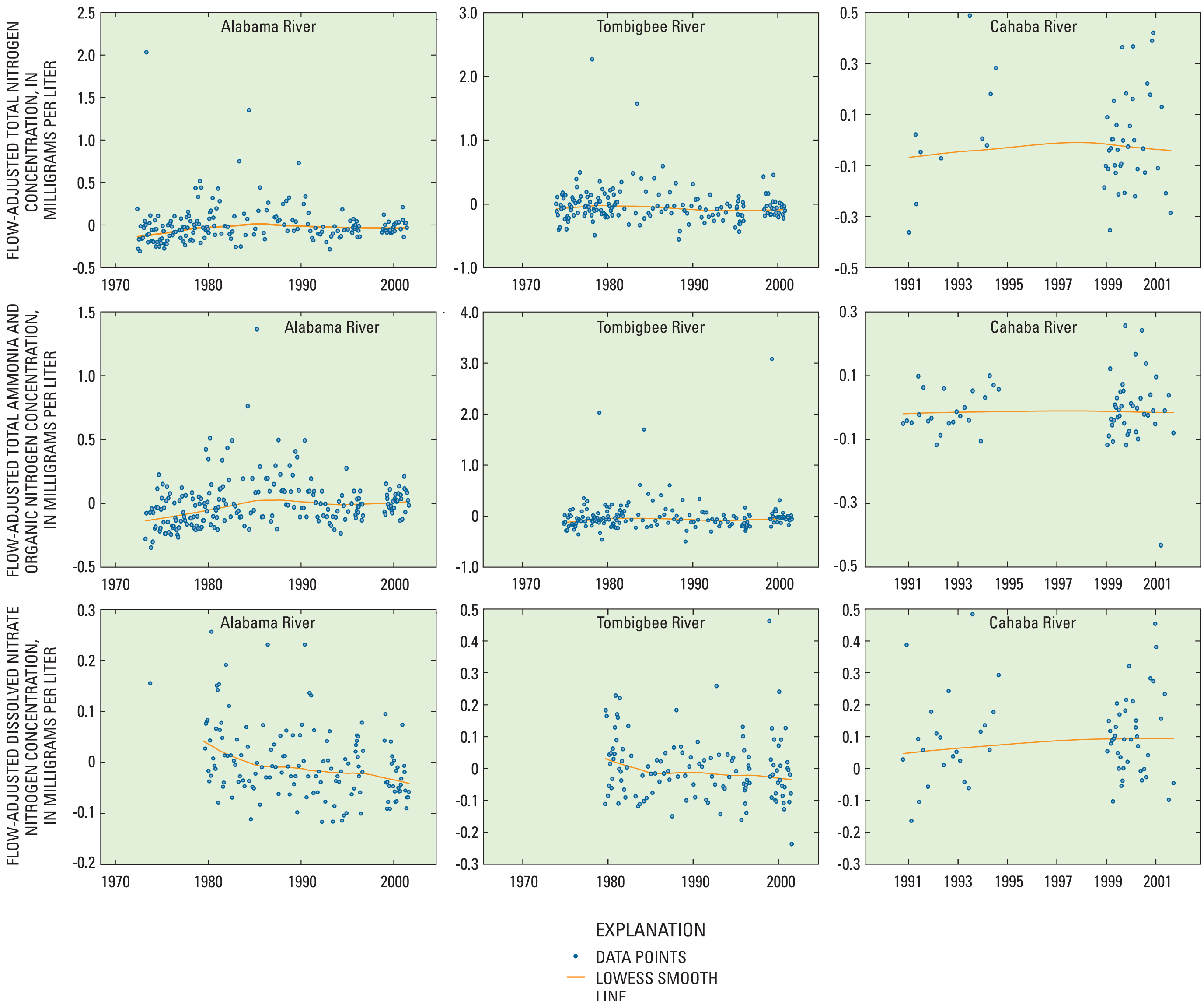


Figure 17. Trends in flow-adjusted total nitrogen, total ammonia and organic nitrogen, and dissolved nitrate concentrations for the Alabama, Tombigbee, and Cahaba River Basins.

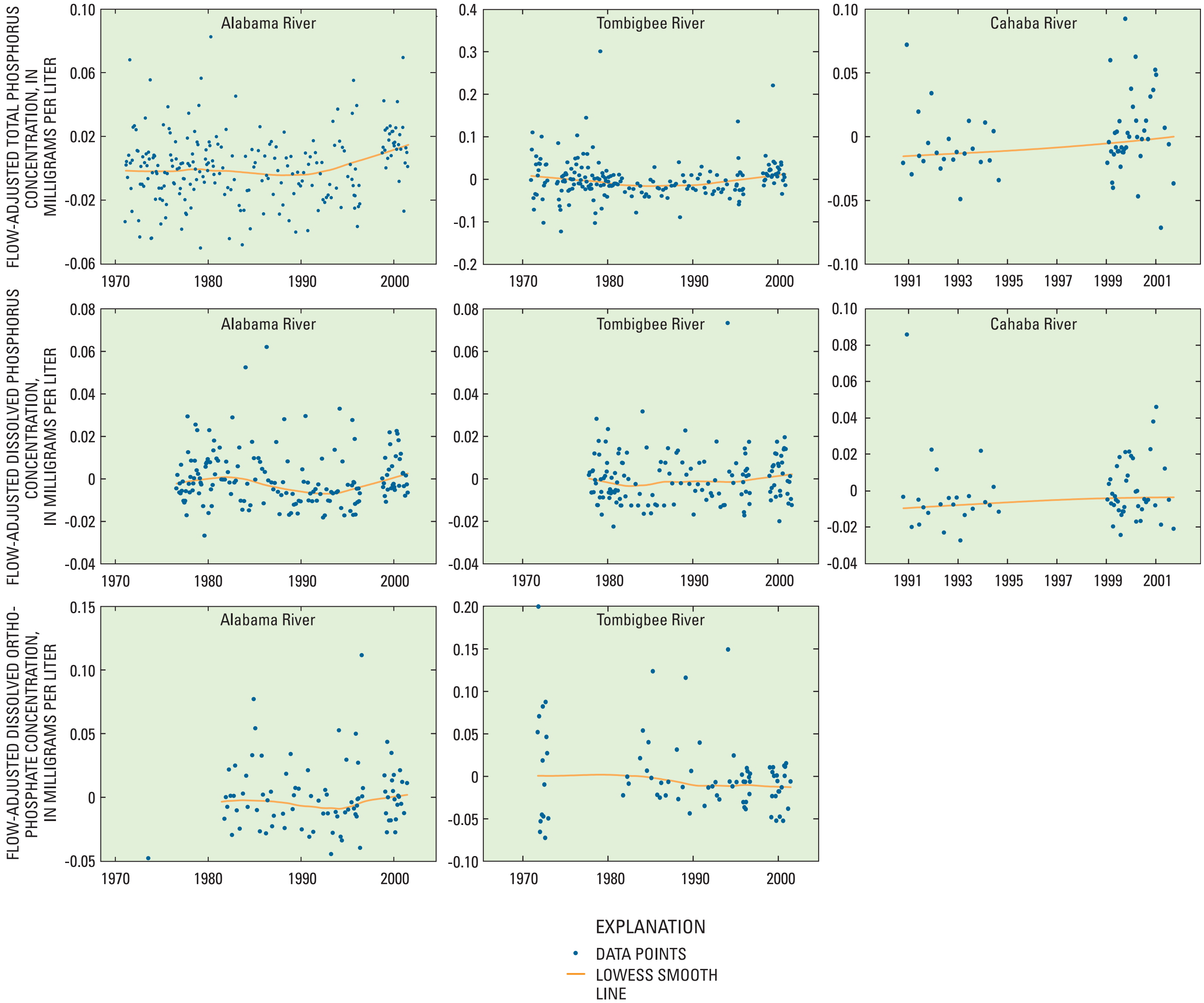


Figure 18. Trends in flow-adjusted total phosphorus, dissolved phosphorus, and dissolved orthophosphate concentrations for the Alabama, Tombigbee, and Cahaba River Basins.

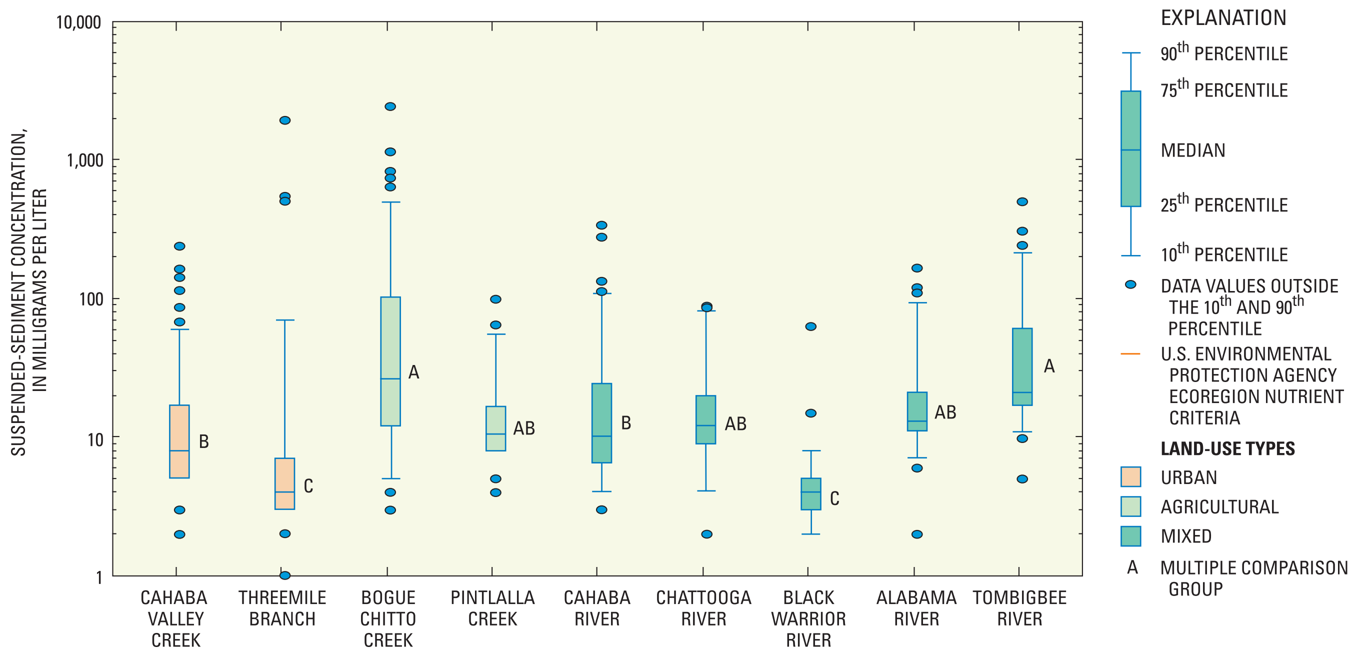


Figure 19. Distribution of suspended-sediment concentrations at sites in the Mobile River Basin.

Concentrations of suspended sediment were closely related to streamflow (fig. 20). Sediment concentrations had a significant ($p < 0.05$) positive correlation as streamflow increased for all sites and Spearman's rho values ranged from 0.47 to 0.81.

Loads and Yields of Suspended Sediment

Mean annual instream sediment loads and yields were calculated for each site in the Mobile River Basin (table 4). Mean annual sediment loads ranged from 685,000 tons/d at the Tombigbee River to 163 tons/d at Threemile Branch. Significant regression coefficients can suggest possible insight into sources and influences of sediment loads. A significant positive streamflow coefficient indicates that sediment inputs were from nonpoint sources for all sites except the Black Warrior River and Chattooga River (table 4). However, the lack of a significant positive streamflow coefficient does not imply that there is a point source of sediment at these two sites. Suspended-sediment loads were significantly influenced by seasonal variations at the Chattooga River, Cahaba River, and Cahaba Valley Creek.

Yields of suspended sediment ranged from 3 (tons/d)/mi^2 at the Black Warrior River to 298 (tons/d)/mi^2 at Bogue Chitto Creek (table 4). Suspended-sediment yields at Pintlalla Creek were significantly lower than Bogue Chitto Creek, which may be a reflection of the differences in agricultural practices in the Pintlalla Creek Basin, which is predominantly pasture and forestland, compared to the Bogue Chitto Creek Basin, which is predominantly row crops. The relatively low suspended-sediment yield for the Black Warrior River reflects the influence of impoundments upstream from the site.

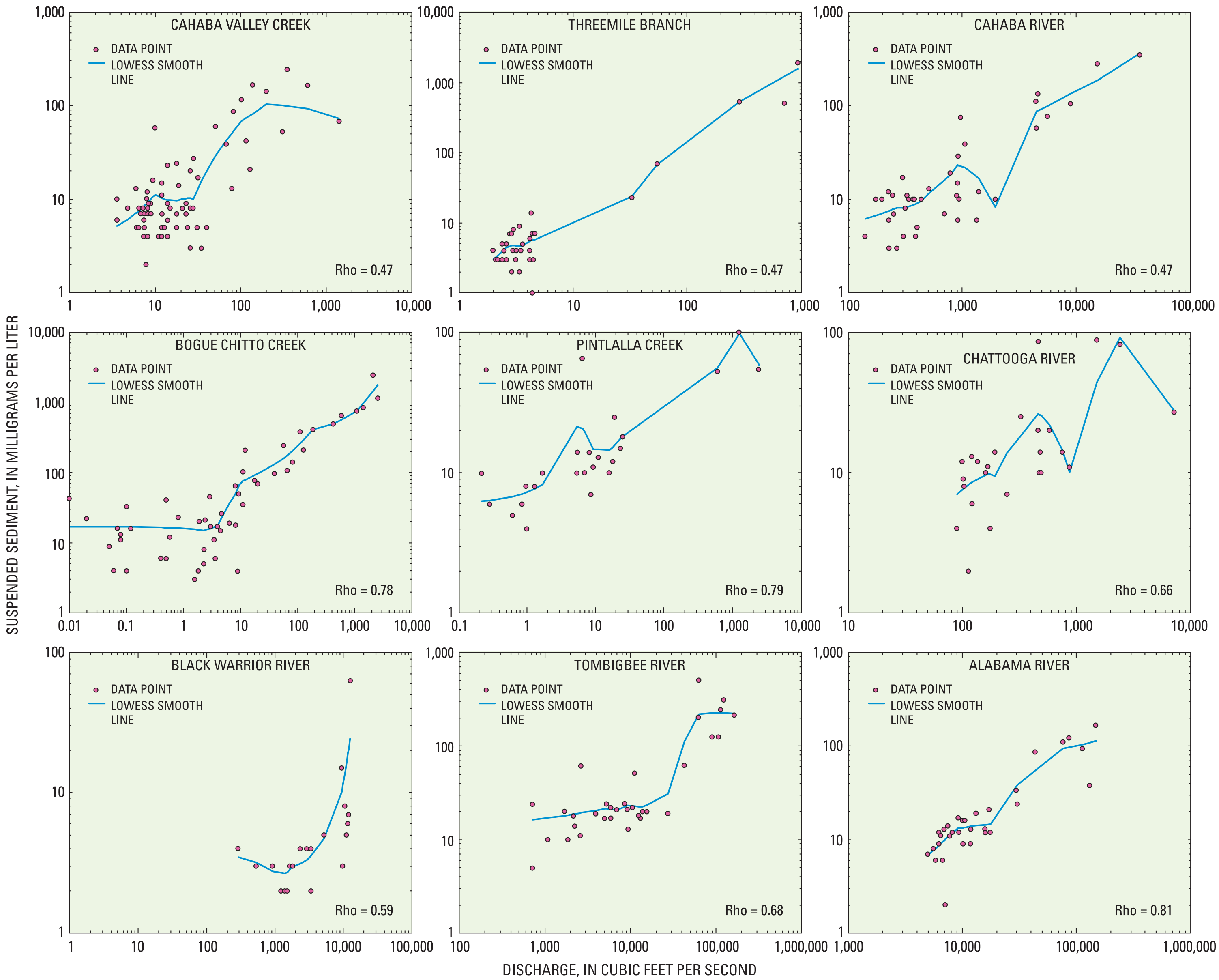


Figure 20. Relation between suspended-sediment concentrations and streamflow at sites in the Mobile River Basin.

PESTICIDES

From January 1999 through December 2001, a total of 234 surface-water samples were collected at nine sites in the Mobile River Basin and analyzed for 104 pesticides and degradation products. Of the 104 compounds, 69 were detected in one or more stream samples (table 2). Of the 69 detected pesticides, 51 were herbicides, 15 were insecticides, and 3 were fungicides (table 2). Atrazine, simazine, metolachlor, tebuthiuron, prometon, diuron, and 2,4-D were the most frequently detected herbicides in the Mobile River Basin. Diazinon, chlorpyrifos, and carbaryl were the most frequently detected insecticides; metalaxyl was the most frequently detected fungicide in the Mobile River Basin.

Statistical summaries of pesticide concentrations are shown by site in appendix 3. The majority of pesticides used for agricultural purposes in the Mobile River Basin are applied seasonally, and higher concentrations of pesticides often are related to rainfall-runoff events. In order to better define the occurrence of the pesticides in the streams, sampling was concentrated during storms and during the spring and summer. Therefore, the statistics shown in appendix 3 may not be representative of ambient conditions or commonly occurring conditions during other seasons because sampling was more frequent during these other periods. Median monthly total pesticide concentrations at six sites are shown in figure 21. Concentrations of the most frequently detected herbicides and insecticides are delineated individually; the rest are grouped together in the category “other.” Streamflow and selected pesticide concentrations (atrazine, simazine, and metolachlor) at six of the study sites for the 1999–2001 sampling period are shown in figures 22–24, respectively.

A relatively small number of herbicides accounted for most of the pesticide detections in the Mobile River Basin. These herbicides included atrazine and its metabolites (deethylatrazine, 2-hydroxyatrazine, deisopropylatrazine, and deethyldeisopropylatrazine), simazine, metolachlor, tebuthiuron, prometon, diuron, and 2,4-D. Atrazine was detected in nearly 99 percent of the surface-water samples. Atrazine is used primarily as a preemergent herbicide on corn in agricultural areas and on lawns and golf courses in urban areas. Simazine, tebuthiuron, and prometon are used in urban areas for weed control along roadways and railways, along fences, and in other public areas (Hoffman and others, 2000). Diuron and simazine are used to control broadleaf weeds and grasses in peach and pecan orchards and vineyards; 2,4-D is used as a postemergent herbicide to control broadleaf weeds in pastures, small grains, and forage crops (Alabama Cooperative Extension System, 1998). Metolachlor frequently is used as a preemergent herbicide on peanuts, soybeans, corn, and some vegetables (Alabama Cooperative Extension System, 1998).

Water-quality standards and guidelines have been developed for many pesticides to protect human health and aquatic life. Thirty-four of the pesticides detected in this study have recommended maximum concentration levels established by the USEPA (U.S. Environmental Protection Agency, 1999, 2000c, 2001); the ADEM (Alabama Department of Environmental Management, 2000b, 2000c); the International Joint Commission United States and Canada (1978); or the Canadian Council of Ministers of the Environment (2001; table 6). Thirty-two of the pesticides detected in this study have drinking-water standards, guidelines, or health advisories (table 6). The advisory levels were exceeded in concentrations of four herbicides (2,4-D, atrazine, cyanazine, and simazine), three insecticides (*alpha*-HCH, diazinon, and dieldrin), and one fungicide (chlorothalonil; table 6). Aquatic-life criteria have been established for 23 of the 70 pesticides detected in this study (table 6). These criteria were exceeded in concentrations of five herbicides (2,4-D, atrazine, cyanazine, diuron, and metolachlor), six insecticides (carbaryl, chlorpyrifos, diazinon, dieldrin, malathion, and *p,p'*-DDE), and one fungicide (chlorothalonil; table 6).

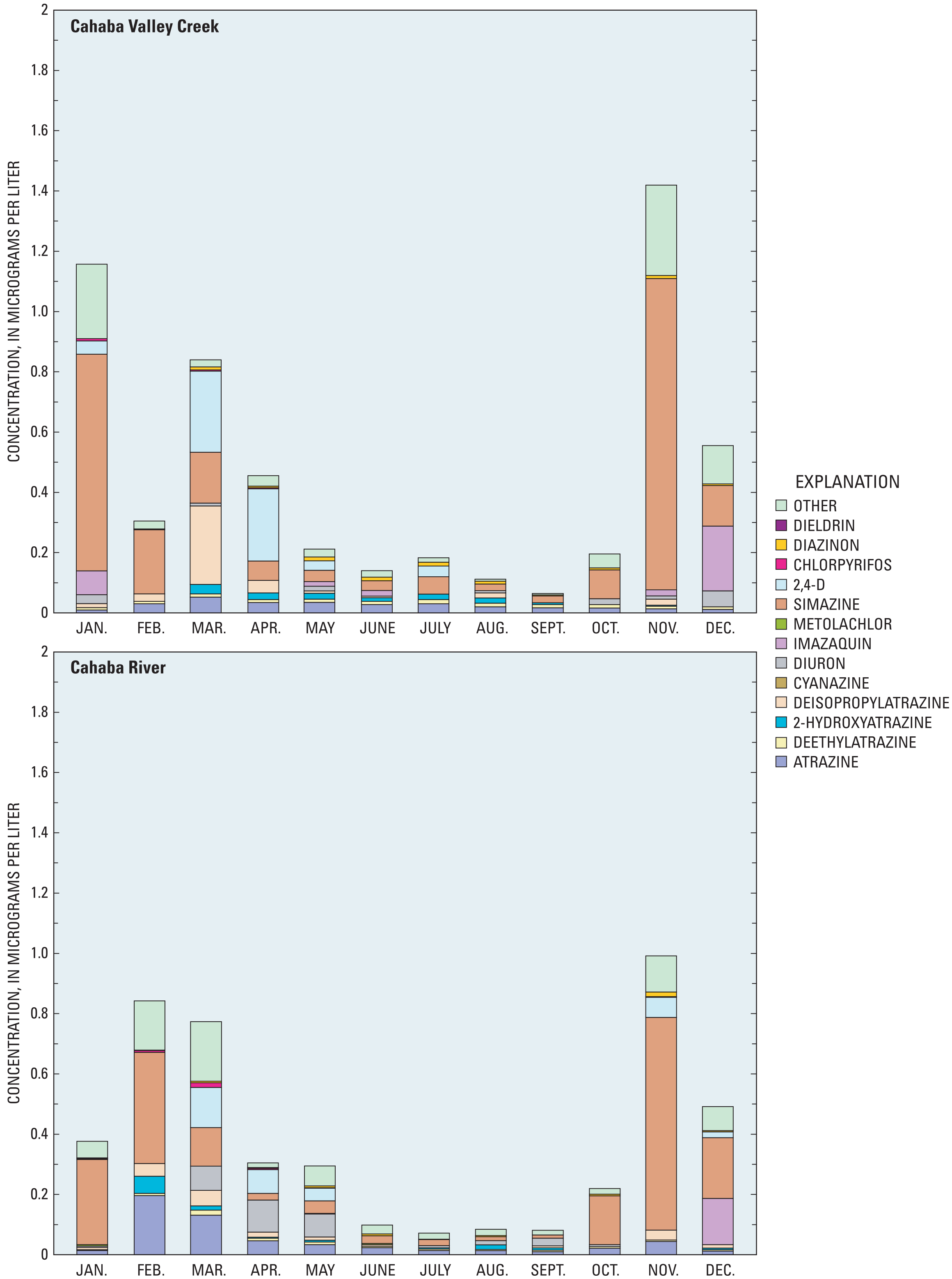


Figure 21. Median monthly total pesticide concentrations at selected sites in the Mobile River Basin, January 1999–December 2001.

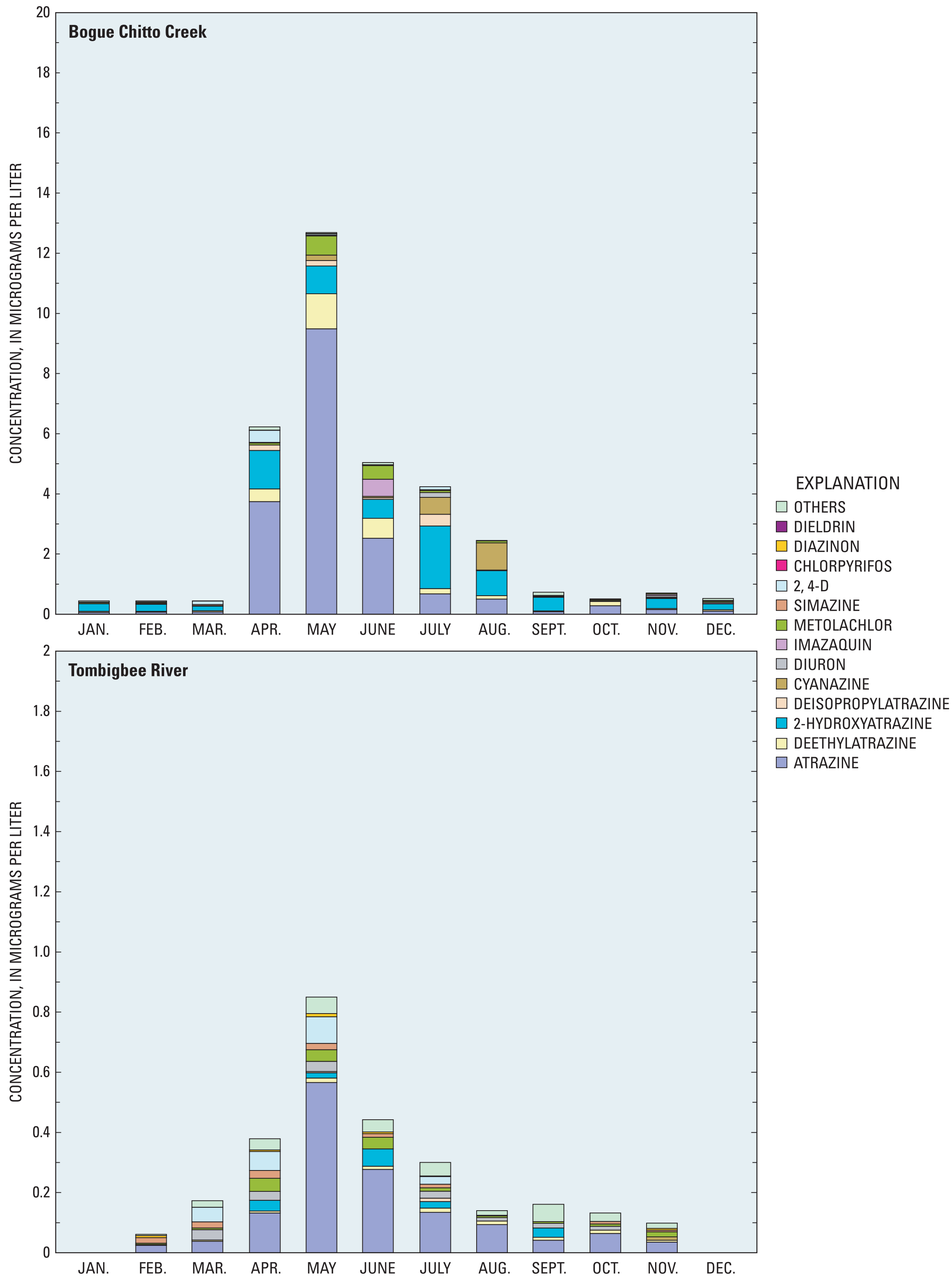


Figure 21. (Continued) Median monthly total pesticide concentrations at selected sites in the Mobile River Basin, January 1999–December 2001.

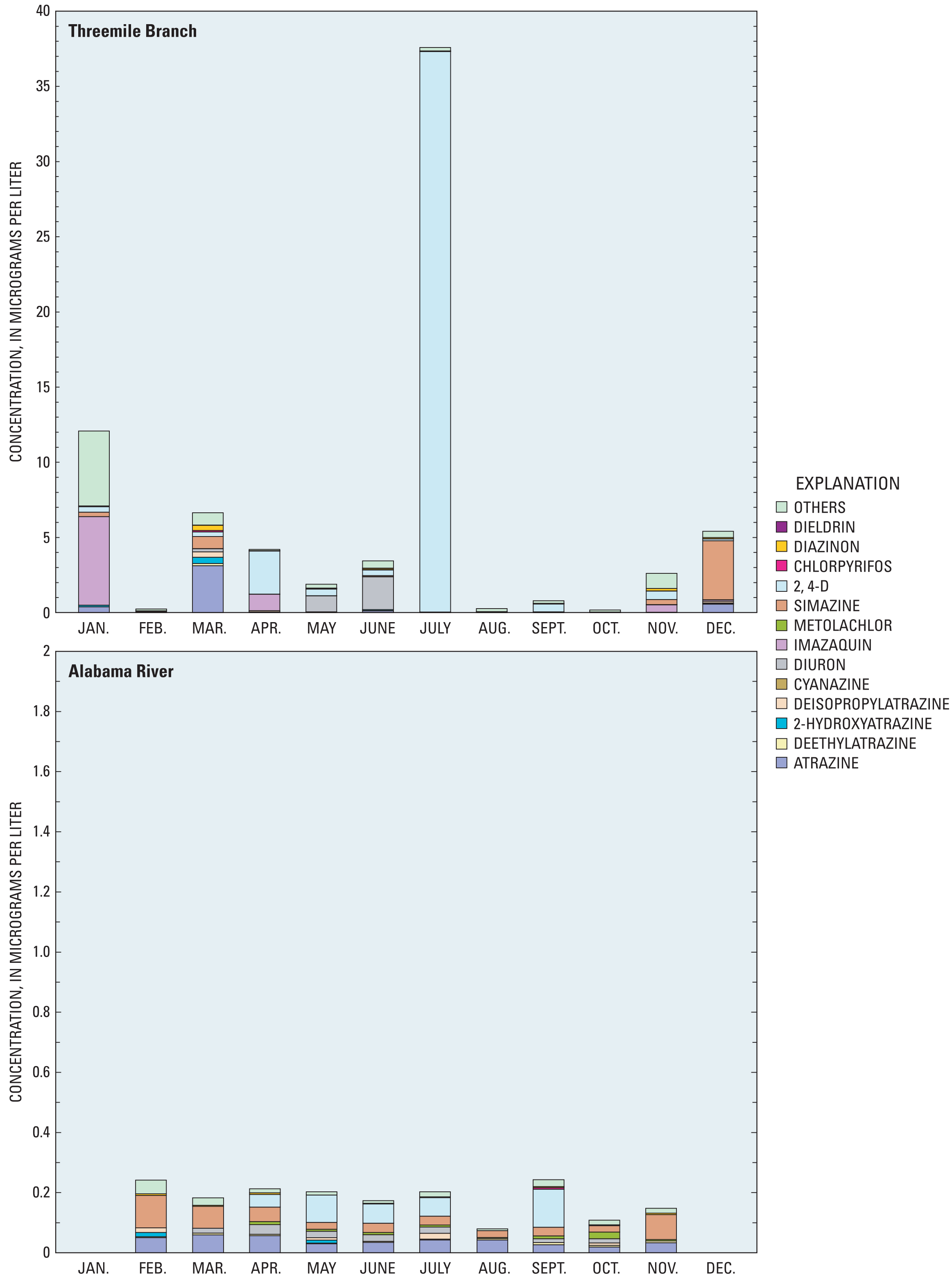


Figure 21. (Continued) Median monthly total pesticide concentrations at selected sites in the Mobile River Basin, January 1999–December 2001.

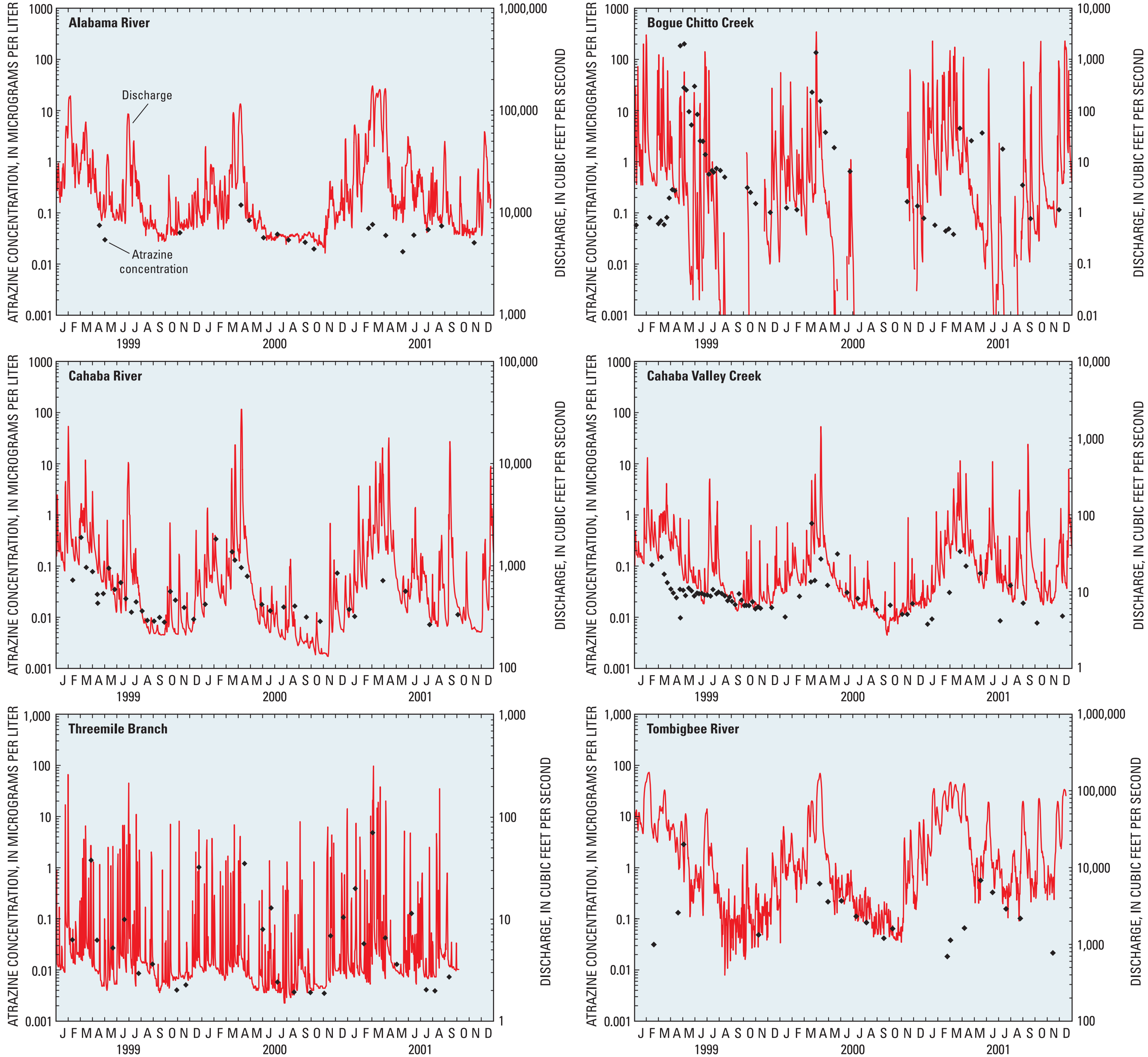


Figure 22. Atrazine concentrations and corresponding streamflow at six sites in the Mobile River Basin, January 1999–December 2001.

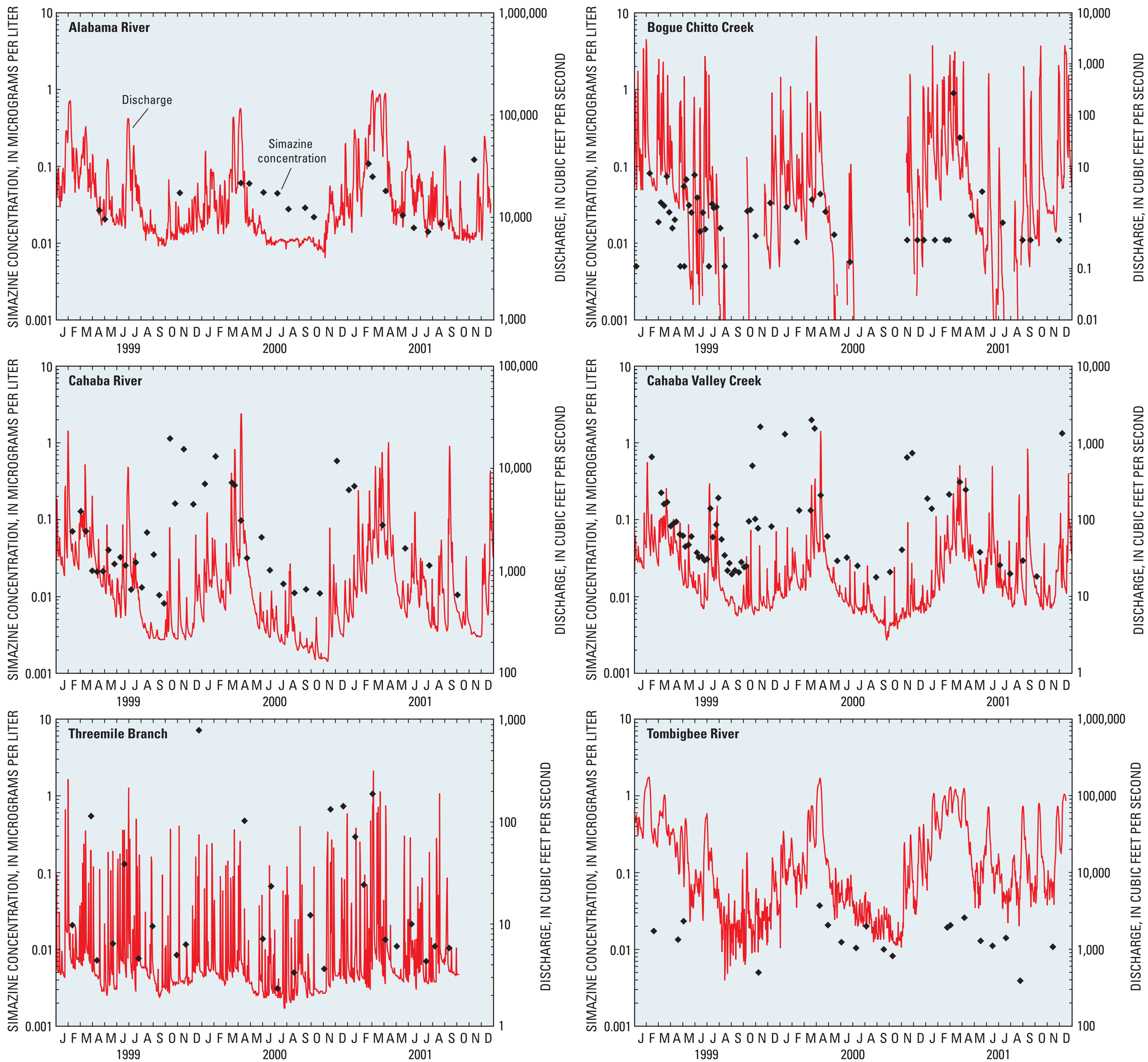


Figure 23. Simazine concentrations and corresponding streamflow at six sites in the Mobile River Basin, January 1999–December 2001.

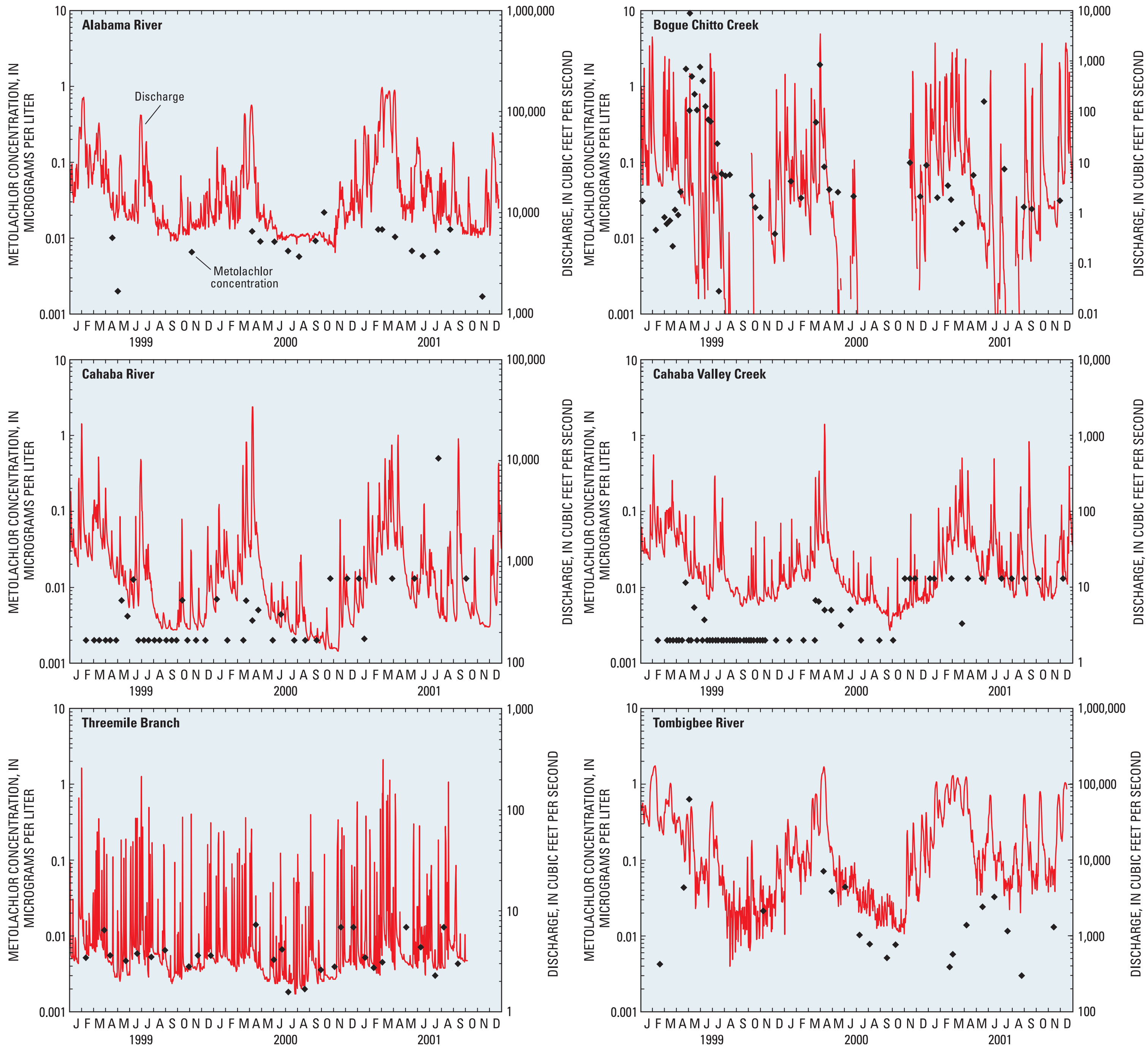


Figure 24. Metolachlor concentrations and corresponding streamflow at six sites in the Mobile River Basin, January 1999–December 2001.

Table 6. Water-quality standards, guidelines, and maximum concentrations of pesticides detected in surface-water samples from the Mobile River Basin

[Concentrations in micrograms per liter; MCL, maximum contaminant level; HAL, health advisory level; USEPA, U.S. Environmental Protection Agency; NAS/NAE, National Academy of Sciences and National Academy of Engineering; —, no standard or guideline has been established]

Pesticide	Maximum concentration	Drinking water			Ambient surface water		
		USEPA drinking-water standard or MCL[a]	USEPA lifetime HAL[a]	USEPA risk specific dose at 10E-6 cancer risk (RSD6)[a]	USEPA water-quality criteria—aquatic life[b]	Canadian water-quality guideline—aquatic life[c]	NAS/NAE maximum recommended concentration[d]
Herbicides							
2,4-D	74.6		70	—	—	4	3
2,4-DB	0.02	—	—	—	—	4	—
Acifluorfen	0.046	—	—	1	—	—	—
Alachlor	0.018	2	—	.4	—	—	—
Atrazine	201	3	200	—	—	1.8	—
Bentazon	0.053	—	200	—	—	—	—
Bromacil	0.15	—	90	—	—	5	—
Chloramben, methyl ester	0.045	—	100	—	—	—	—
Cyanazine	5.54	—	1	—	—	2	—
Dacthal	0.002	—	70	—	—	—	—
Dicamba	0.638	—	200	—	—	10	200
Dinoseb	0.004	7	7	—	—	.05	—
Diuron	2.19	—	10	—	—	—	1.6
Fluometuron	0.156	—	90	—	—	—	—
MCPA	0.634	—	4	—	—	2.6	—
Metolachlor	9.21	—	100	—	—	7.8	—
Metribuzin	0.319	—	200	—	—	1	—
Prometon	0.044	—	100	—	—	—	—
Pronamide	0.066	—	50	—	—	—	—
Simazine	7.13	4	4	—	—	10	10
Tebuthiuron	0.489	—	500	—	—	1.6	—
Terbacil	0.036	—	90	—	—	—	—
Triallate	0.002	—	—	—	—	.24	—
Trifluralin	0.039	—	5	5	—	.2	—
Insecticides							
alpha-HCH	0.02	—	—	0.006 [e]	—	—	—
Carbaryl	0.422	—	700	—	—	0.2	0.02
Carbofuran	0.017	40	40	—	—	1.8	—
Chlorpyrifos	0.213	—	20	—	0.083[f], 0.041[g]	.0035	.001
Diazinon	1.01	—	0.6	—	(0.1) draft	.08[h]	.009
Dieldrin	0.0241	—	—	.002	0.24[f], 0.056[g]	—	.005
Malathion	9.58	—	100	—	0.1[g]	—	.008
Methomyl	0.004	—	200	—	—	—	—
p,p'-DDE	0.004	—	—	.1	1.1[f], 0.001[g] (total DDT)	—	—
Fungicide							
Chlorothalonil	1.84	—	—	1.5	—	0.18	—

[a] U.S. Environmental Protection Agency (2000c; 2002).

[b] U.S. Environmental Protection Agency (1999).

[c] Canadian Council of Ministers of the Environment (2001).

[d] National Academy of Sciences and National Academy of Engineering (1973).

[e] Integrated Risk Information System (U.S. Environmental Protection Agency, 2003).

[f] Criterion maximum concentration for aquatic life (U.S. Environmental Protection Agency, 1999).

[g] Criterion continuous concentration for aquatic life (U.S. Environmental Protection Agency, 1999).

[h] International Joint Commission United States and Canada (1978).

Occurrence of Pesticides by Sampling Site

Pesticide samples were collected at all nine sites in the Mobile River Basin and statistical summaries of pesticide concentrations are shown by site in appendix 3. Sampling, however, was concentrated at the three intensive fixed sites (Bogue Chitto Creek, Cahaba River, and Cahaba Valley Creek), an urban indicator site (Threemile Branch), and the three largest integrator sites (Alabama River, Black Warrior River, and Tombigbee River). A detailed description of the pesticides detected at these seven sites is included in the following paragraphs.

Bogue Chitto Creek near Memphis, Alabama

The Bogue Chitto Creek Basin was selected as an agricultural indicator site—approximately 89 percent of the 53-mi^2 basin consists of row crops, pasture, or hay (fig. 4). The pesticides detected in the highest concentrations at Bogue Chitto Creek were atrazine (201 µg/L), molinate (13.9 µg/L), metolachlor (9.21 µg/L), cyanazine (5.54 µg/L), 2-hydroxyatrazine (3.42 µg/L), 2,4-D (2.29 µg/L), and deethylatrazine (2.33 µg/L; appendix 3). The herbicide, atrazine, and its metabolite, deethylatrazine, were detected in every pesticide sample collected from Bogue Chitto Creek. Fluometuron, metolachlor, and 2-hydroxyatrazine were detected in more than 84 percent of the samples collected from Bogue Chitto Creek.

A total of 17,217 surface-water samples were collected nationally by the 1991, 1994, and 1997 NAWQA Study Units and analyzed for atrazine. The three highest atrazine concentrations detected at sites across the country were recorded at Bogue Chitto Creek (U.S. Geological Survey, 2003). Concentrations of atrazine exceeded 100 µg/L during low flow (184 µg/L at 11 cubic feet per second [ft^3/s]) in April 1999 and during high flow (201 µg/L at 1,140 ft^3/s in May 1999 and 136 µg/L at 2,520 ft^3/s in April 2000) (fig. 22). Concentrations of atrazine exceeded 20 µg/L in four other samples collected in May and June 1999 and in March 2000 (fig. 22). The highest median monthly concentrations of atrazine occurred in April, May, and June, which coincide with applications as a preemergent herbicide on corn (fig. 21). Concentrations of atrazine exceeded Canadian aquatic life guidelines in 18 of 52 samples (35 percent); all 18 samples were collected from March through June (1999–2001).

The highest median monthly concentrations of cyanazine occurred in July and August, which coincide with its use as a postemergent herbicide on cotton (fig. 21). Concentrations of cyanazine and metolachlor exceeded the Canadian aquatic life guidelines once each; chlorpyrifos exceeded the USEPA aquatic criteria in 5 of 52 samples (10 percent) and the Canadian aquatic life guidelines in 14 of 52 samples (27 percent). Carbaryl exceeded the National Academy of Sciences and National Academy of Engineering (NAS/NAE) standards in one sample, and malathion exceeded the NAS/NAE standards in 4 of 52 samples (8 percent; National Academy of Sciences and National Academy of Engineering, 1973).

Cahaba River at Centreville, Alabama

The Cahaba River at Centreville was selected as an intensive integrator site. The pesticide detected in the highest concentration at this site was simazine (1.14 µg/L; appendix 3). Atrazine was detected in every pesticide sample collected from the Cahaba River. Deethylatrazine and simazine were detected in more than 92 percent of the pesticide samples. Concentrations of diazinon exceeded the NAS/NAE standards in 11 of 40 samples (28 percent); chlorpyrifos concentrations exceeded the NAS/NAE standards in 19 of 40 samples (48 percent) and the Canadian aquatic life guidelines in 13 of 40 samples (32 percent). Concentrations of carbaryl exceeded the NAS/NAE standards in 1 of 40 samples (2 percent).

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama

The 25.6-mi^2 Cahaba Valley Creek Basin was selected as an urban indicator site and is located in a rapidly developing area in the southeast part of Birmingham, Ala. (fig. 3). Approximately 9 percent of the basin is residential and commercial, and 78 percent is forested land. The pesticides detected in the highest concentrations at Cahaba Valley Creek were simazine (1.99 µg/L) and deisopropylatrazine (1.03 µg/L; appendix 3). Simazine was detected in every pesticide sample collected at Cahaba Valley Creek. Atrazine, deethylatrazine, and diazinon were detected in more than 81 percent of the pesticide samples collected from Cahaba Valley Creek. Concentrations of carbaryl exceeded the Canadian aquatic life guidelines in 2 of 63 samples (3 percent) and the NAS/NAE standards in 6 of 63 samples (10 percent). Concentrations of chlorpyrifos exceeded the Canadian aquatic life guidelines in 12 of 63 samples (19 percent) and the NAS/NAE standards in 21 of 63 samples (33 percent). Concentrations of diazinon exceeded the Canadian aquatic life guidelines in 2 of 63 samples (3 percent) and the NAS/NAE standards in 30 of 63 samples (48 percent). Malathion concentrations exceeded the NAS/NAE standards in 1 of 63 samples (2 percent).

Threemile Branch at North Boulevard at Montgomery, Alabama

The Threemile Branch Basin was selected as an urban indicator site and is located in northern Montgomery in a suburban area (fig. 3). Approximately 59 percent of the 8.79-mi^2 basin is urban and includes light industrial activities (fig. 4). The stream channel contains both natural and channelized sections. The pesticides detected in the highest concentrations at Threemile Branch were 2,4-D (74.6 µg/L), malathion (9.58 µg/L), simazine (7.13 µg/L), imazaquin (5.89 µg/L), atrazine (4.83 µg/L), diuron (2.19 µg/L), chlorothalonil (1.84 µg/L), and diazinon (1.01 µg/L; appendix 3). The highest concentrations of 2,4-D, imazaquin, and malathion recorded nationally by the 1991, 1994, and 1997 NAWQA Study Units were detected at Threemile Branch (U.S. Geological Survey, 2003). The insecticide chlorpyrifos was detected in every pesticide sample (28 of 28) collected from Threemile Branch. Atrazine, deethylatrazine, simazine, metolachlor, and diazinon were detected in more than 86 percent of the pesticide samples collected from Threemile Branch; dieldrin and bromacil were detected in more than 75 percent of the samples.

Concentrations of atrazine and chlorothalonil exceeded the Canadian guidelines for aquatic life in 1 of 28 and 1 of 14 samples, respectively. Concentrations of simazine exceeded the USEPA drinking-water standards once, and diuron concentrations exceeded the NAS/NAE standards twice. Concentrations of 2,4-D and diazinon each exceeded the USEPA lifetime health advisories once during the study period, and carbaryl concentrations exceeded the NAS/NAE standards in 8 of 28 samples (29 percent). Concentrations of malathion exceeded the USEPA aquatic-life criteria in 6 of 28 samples (21 percent) and the NAS/NAE standards in 16 of 28 samples (57 percent). Concentrations of chlorpyrifos exceeded the USEPA aquatic-life criteria in 3 of 28 samples (11 percent) and the Canadian aquatic life guidelines in 27 of 28 samples (96 percent).

Although dieldrin has been banned since the mid-1980’s (Barbash and Resek, 1996), concentrations of dieldrin were detected in 21 of 28 surface-water samples (75 percent) at Threemile Branch. Twenty of these concentrations exceeded the NAS/NAE standards. Dieldrin also was detected in the ground water at 7 of 30 wells (23 percent) in the Montgomery area (Robinson, 2002). Ground-water contributions to streams are most significant in geologic settings that allow the exchange of water between ground-water and surface-water systems, such as in the alluvial and terrace deposits underlying Threemile Branch. The median age of the ground water in the alluvial and terrace deposits underlying Threemile Branch is approximately 12 years (Robinson, 2002). Dieldrin also was detected in the streambed sediment and fish-tissue samples at Threemile Branch (Zappia, 2002).

Alabama River at Claiborne, Alabama

The Alabama River site is located on the southeastern rim of the Mobile River Basin and drains an area of 21,967 mi^2. This site was selected as a basic integrator site and is the farthest downstream location on the Alabama River that is not tidally affected. Atrazine and simazine were detected in every pesticide sample collected from the Alabama River. Deethylatrazine, metolachlor, and diuron were detected in more than 78 percent of the pesticide samples. Concentrations of chlorpyrifos exceeded the Canadian aquatic life guidelines in 1 of 18 samples (5 percent). Concentrations of diazinon exceeded the NAS/NAE standards in 2 of 18 samples (11 percent).

Black Warrior River below Bankhead Lock and Dam near Bessemer, Alabama

The Black Warrior River site is located at the southern edge of the Cumberland Plateau and drains an area of 3,979 mi^2, integrating various land-use conditions over the entire plateau. Atrazine, deethylatrazine, simazine, and metolachlor were detected in each of the nine pesticide samples collected from the Black Warrior River. Prometon was detected in over 78 percent of the pesticide samples. Concentrations of diazinon exceeded the NAS/NAE standards in 1 of 9 samples (11 percent).

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama

The Tombigbee River below Coffeeville Lock and Dam is located on the southwestern rim of the Mobile River Basin and drains an area of 18,417 mi^2. This site was selected as a basic integrator site and is the farthest downstream location on the Tombigbee River that is not tidally affected. The pesticide detected at this site in the highest concentration was atrazine (2.86 µg/L; appendix 3). The herbicides atrazine and metolachlor were detected in every pesticide sample collected from the Tombigbee River. Deethylatrazine, simazine, and diuron were detected in over 84 percent of the pesticide samples. The highest median monthly concentrations of atrazine occurred in April, May, and June, which coincide with applications of atrazine as a preemergent herbicide on corn in the Tombigbee River Basin (fig. 21). Concentrations of atrazine exceeded the Canadian guidelines for aquatic life in 1 of 19 samples (5 percent); chlorpyrifos concentrations exceeded the Canadian guidelines for aquatic life in 1 of 19 samples (5 percent) and the NAS/NAE standards in 2 of 19 samples (10 percent).

Occurrence of Pesticides in the Mobile River Basin

Pesticide occurrence in water is related to the physical properties of the compound as well as the method of pesticide application. The types and concentrations of pesticides found in surface water are linked to land use and to the types of pesticides used in each setting. Each site described in the previous section was categorized according to land use—agricultural, mixed, and urban. The most frequently detected pesticides, based on land use, are shown in figure 25. Some pesticides were detected more frequently in basins draining specific land uses. Herbicides, for example, were detected more frequently and usually at higher concentrations in Bogue Chitto Creek, the agricultural stream (fig. 25). Fluometuron and cyanazine were detected in 84 and 60 percent of the water samples, respectively, at this site; however, they were detected in less than 12 percent of the samples from urban or mixed land-use sites. Thirteen of 21 herbicides (atrazine, deethylatrazine, 2-hydroxyatrazine, 2,4-D, deisopropylatrazine, deethyldeisopropylatrazine, metolachlor, imazaquin, pendimethalin, trifluralin, fluometuron, bentazon, and

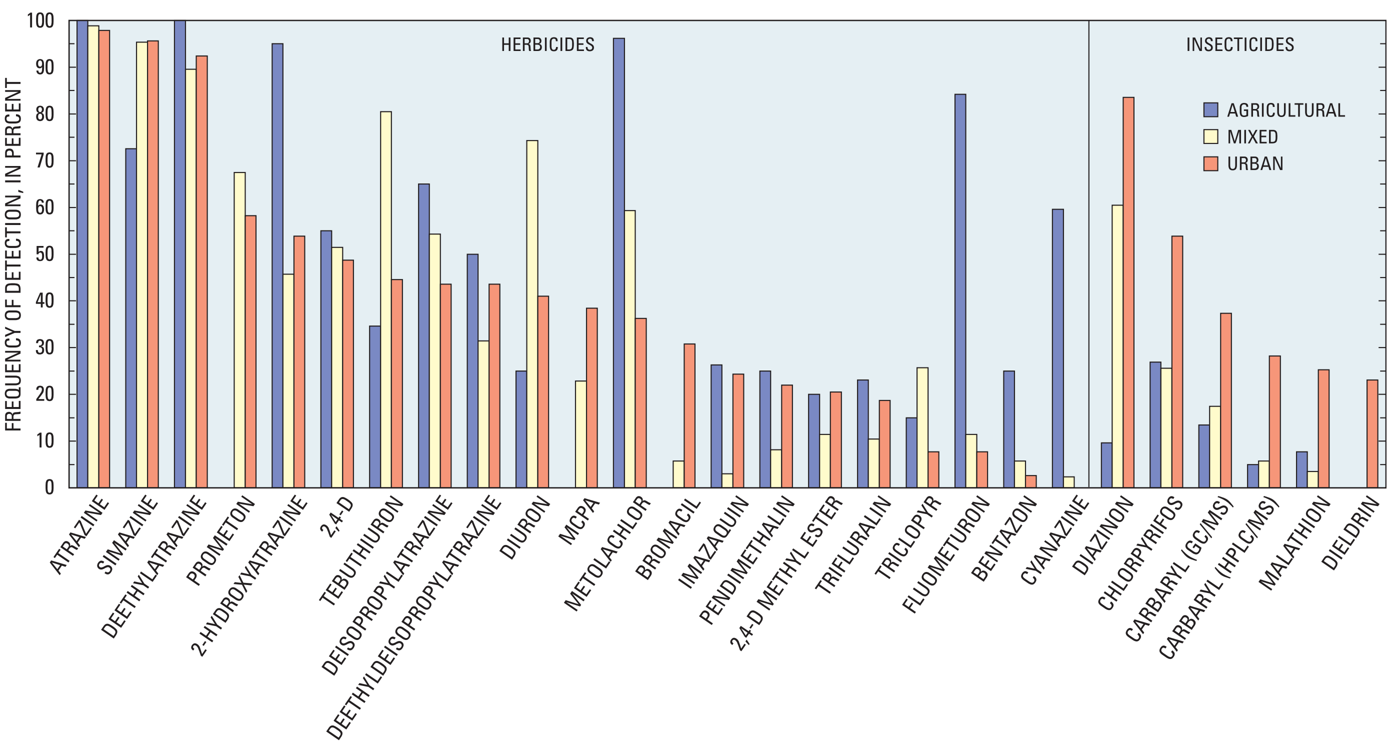


Figure 25. Frequencies of pesticide detections in surface-water samples from the Mobile River Basin, 1999–2001.

cyanazine) were detected more frequently at the agricultural basin than at the urban or mixed land-use basins (fig. 25). Insecticides, however, were detected more frequently and usually at higher concentrations in the urban streams (Cahaba Valley Creek, Threemile Branch) than at the agricultural or mixed land-use sites (fig. 25). Diuron, tebuthiuron, and prometon were detected more frequently in streams draining mixed land use (Alabama River, Cahaba River, Black Warrior River, and the Tombigbee River; fig. 25).

Concentrations of pesticides varied seasonally in streams, mainly as a result of the timing and amount of pesticide use and the frequency and magnitude of runoff from precipitation and irrigation. Concentrations of herbicides generally were higher in agricultural streams and varied according to season and the frequency and magnitude of runoff (figs. 22–24). For example, the highest concentrations of atrazine were at Bogue Chitto Creek and generally occurred in April and May, corresponding to its application on corn (figs. 21, 22). Seasonal patterns were less evident in urban streams, where concentrations of herbicides and insecticides remained relatively constant throughout the year. One exception was simazine, which was detected at elevated concentrations during the fall and winter months, November through March, at Cahaba Valley Creek (figs. 21, 23). Simazine is applied during the fall to control winter weeds and during late winter to control summer annual weeds (Alabama Cooperative Extension System, 1997).

The occurrence and timing of pesticides found in streams is largely determined by crop type(s) in agricultural basins. Agricultural production in each of the nine basins is shown in table 7 (U.S. Department of Agriculture, 1999, 2002). The primary herbicides, insecticides, and fungicides applied to agricultural land in Alabama are listed in table 8, along with the types of crops on which the pesticides are used most frequently (Gianessi and Marcelli, 2000; National Center for Food and Agricultural Policy, 2000). Many pesticides are applied at specific stages of the crop growth cycle. Pesticide applications commonly include preplant, preemergent, and postemergent applications. Atrazine, for example, is a triazine herbicide used to control weeds in corn and grain sorghum in the Mobile River Basin (Alabama Cooperative Extension System, 1998). Atrazine is applied as a preemergent herbicide on corn, which is one of the major crops grown in the Mobile River Basin (table 7). Planting of corn generally begins in mid-March and continues through early June (Vanderberry and Placke, 2002). In basins where corn production is high, atrazine concentrations would be expected to peak shortly after planting has occurred. Corn production in the Bogue Chitto Creek Basin exceeded 445,000 bushels in 2001 (table 7). The highest concentrations of atrazine in the Mobile River Basin were detected in water samples collected from Bogue Chitto Creek during May (figs. 21, 22). Corn production in the Tombigbee River Basin exceeded 9,783,000 bushels in 2001 (table 7). The highest concentrations of atrazine at the Tombigbee River also were detected during May (figs. 21, 22).

Cyanazine is a triazine herbicide used extensively in the Midwest as a preemergent herbicide on corn; however, in the Mobile River Basin, cyanazine is used primarily as a postemergent herbicide on cotton (Alabama Cooperative Extension System, 1998). In basins where cotton production is high, cyanazine concentrations would be expected to peak well after planting has occurred. In the Mobile River Basin,

Table 7. Agricultural production in the Mobile River Basin, 2001 (U.S. Department of Agriculture, 1999; 2002)

Site number (fig. 3)	Site name	Drainage area (square miles)	Corn (bushels)	Cotton (bails)	Hay (tons)	Oats (bushels)	Peanuts (pounds)	Sorghum (bushels)	Soybeans (bushels)	Wheat (bushels)
1	Chattooga River	366	87,820	2,859	2,053	0	0	0	44,129	29,388
2	Threemile Branch	8.79	95	5	58	0	0	0	0	0
3	Pintlalla Creek	59.3	3,786	211	2,534	0	53,396	0	0	0
4	Cahaba Valley Creek	25.6	130	198	651	0	0	0	0	0
5	Cahaba River	1,027	10,779	2,557	23,989	0	0	0	0	2,054
6	Alabama River	21,967	2,642,034	165,532	715,208	0	990,181	0	862,626	648,707
7	Bogue Chitto Creek	52.6	445,714	2,066	891	0	0	0	73,250	12,956
8	Black Warrior River	3,979	509,023	11,249	300,604	0	0	0	191,295	33,956
9	Tombigbee River	18,417	9,783,666	84,650	549,742	0	0	0	4,575,821	394,642

Table 8. Selected herbicides, insecticides, and fungicides applied to crops in Alabama, 1997 (National Center for Food and Agricultural Policy, 2000)

Herbicides	Main crop(s) treated	Insecticides	Main crop(s) treated	Fungicides	Main crop(s) treated
2,4-D	Pasture, corn, hay, wheat	Acephate	Cotton, peanuts	Azoxystrobin	Peanuts
2,4-DB	Peanuts, soybeans	Aldicarb	Cotton, peanuts	Captan	Peaches
Acifluorfen	Peanuts, soybeans	Carbaryl	Hay, corn, peaches, pecans	Chlorothalonil	Peanuts, potatoes, tomatoes
Alachlor	Soybeans, corn	Carbofuran	Alfalfa, watermelons	Copper	Tomatoes
Atrazine	Corn	Chlorpyrifos	Peanuts, pecans, corn	Etridiazole	Cotton
Bentazon	Peanuts, soybeans	Dicrotophos	Cotton	Fenbuconazole	Pecans
Chlorimuron	Soybeans, peanuts	Disulfoton	Cotton, peanuts, pecans	Ferbam	Peaches
Clomazone	Cotton	Imidacloprid	Cotton, pecans	Flutolanil	Peanuts
Cyanazine	Cotton	Lambdacyhalothrin	Cotton, wheat	Mancozeb	Watermelon, potatoes, tomatoes
Diuron	Cotton, pecans, peaches	Malathion	Cotton, hay, wheat	Maneb	Potatoes, tomatoes
DSMA	Cotton	Methamidophos	Cotton, potatoes	Metalaxyl	Cotton
Flumetsalem	Soybeans, corn	Methomyl	Cotton, soybeans, hay, corn, peanuts	PCNB	Cotton
Fluometuron	Cotton	Methyl parathion	Cotton, corn, soybeans	Propiconazole	Peanuts, pecans, wheat
Fomesafen	Soybeans	Oil	Cotton, peaches	Sulfur	Peaches
Glyphosate	Soybeans, cotton, pasture, pecans, corn	Oxamyl	Cotton	Tebuconazole	Peanuts
Imazaquin	Soybeans	Phorate	Cotton, peanuts		
Imazathapyr	Peanuts, soybeans	Phosmet	Pecans, sweet potatoes		
MCPA	Wheat, oats	Profenos	Cotton		
Metolachlor	Peanuts, soybeans, corn	Spinosad	Cotton		
Metribuzin	Soybeans	Sulprofos	Cotton		
MSMA	Cotton, sod	Terbufos	Corn		
Nicosulforon	Corn	Thiodicarb	Cotton		
Norflurazon	Cotton				
Paraquat	Peanuts, cotton, corn, soybeans				
Pendimethalin	Cotton, peanuts, soybeans				
Prometryn	Cotton				
Sethoxydim	Cotton, soybeans, peanuts				
Simazine	Corn, pecans, peaches				
Trifluralin	Cotton, soybeans				

cotton generally is planted in early April to mid-June (Vanderberry and Placke, 2002). Although cotton is grown in several basins (table 7), cyanazine was detected at only two sites—Bogue Chitto Creek and the Tombigbee River (fig. 21; appendix 3). Cyanazine was detected most frequently at Bogue Chitto Creek (31 of 52 samples, 60 percent), and peak concentrations were recorded during July and August (fig. 21).

The types, concentrations, and timing of pesticides found in streams are related to the proportion of urban and agricultural land in the drainage basin and the hydrology and basin characteristics. Marked similarities were observed between pesticides detected in small streams draining one primary land-use area and the pesticides detected in large rivers draining basins encompassing these small streams. Concentrations of pesticides in the large rivers generally were much lower than in their corresponding tributaries because of dilution and runoff from other land-use areas within the larger, more integrated basins. For example, the agricultural pesticides in the Tombigbee River reflected those compounds present in its tributary, Bogue Chitto Creek (fig. 21). The highest median monthly concentrations of atrazine and two of its metabolites (deethylatrazine and 2-hydroxyatrazine) were found in samples from Bogue Chitto Creek, with peak concentrations occurring in May, and decreasingly high concentrations occurring in April, June, and July (fig. 21). The same pattern occurred in the Tombigbee River, although the concentrations were approximately one order of magnitude less (fig. 21).

Similarities also occurred in the urban pesticides detected in the Cahaba River and Cahaba Valley Creek (fig. 21). The highest median monthly concentrations of simazine in Cahaba Valley Creek occurred during November with decreasingly high concentrations occurring in January and February; a similar pattern occurred in the Cahaba River, where simazine concentrations also peaked in November (fig. 21). Imazaquin concentrations were highest at both sites in December, and 2,4-D concentrations were highest at both sites during March and April. Median monthly total pesticide concentrations were lowest at both sites during June–October (fig. 21).

Differences also were observed between the large rivers draining the western half of the Mobile River Basin and those draining the eastern half. In general, pesticide concentrations in the Tombigbee River were dominated by the presence of atrazine and, to a lesser degree, 2-hydroxyatrazine, 2,4-D, and metolachlor (fig. 21). Total pesticide concentrations in the Tombigbee River exceeded those in the Alabama River during the growing season (April–August) and mirrored the type and pattern of pesticides detected at one of its tributaries, Bogue Chitto Creek, although concentrations were less in the Tombigbee River. Pesticide concentrations in the Alabama River were dominated by the presence of simazine and, to a lesser degree, atrazine and 2,4-D (fig. 21).

Differences were observed in water samples from the two urban sites, Threemile Branch in Montgomery and Cahaba Valley Creek in Birmingham. Total pesticide concentrations generally were more than one order of magnitude greater at Threemile Branch than at Cahaba Valley Creek. Atrazine, 2,4-D, diuron, and imazaquin were detected in greater concentrations at Threemile Branch than at Cahaba Valley Creek; metolachlor, 2,4-D, chlorpyrifos, dieldrin, and bromacil were detected more frequently at Threemile Branch than at Cahaba Valley Creek (appendix 3). One explanation for this may be the different percentages of urban land use in each basin (Threemile Branch—59 percent; and Cahaba Valley Creek—9 percent; fig. 4). Another explanation may be the differences in sampling frequencies at the two sites (table 1).

The number of pesticides present in a stream also may be important from a toxicological standpoint. At least one pesticide was detected in all but 2 of the 234 stream samples collected during this study. More than 90 percent of all the stream samples contained three or more pesticides; more than 50 percent contained nine or more compounds. Chemical breakdown products, which can have similar, lesser, or even greater toxicities than parent compounds, can be as common in the water as parent compounds (U.S. Geological Survey, 1999). Atrazine was detected in 99 percent of all stream samples in the Mobile River Basin, and deethylatrazine, a breakdown product of atrazine, was detected in nearly 92 percent of the samples. Generally, the effects of pesticide mixtures on biota or humans are not included in water-quality criteria, which most commonly are based on single-species, single-chemical toxicity tests conducted under laboratory conditions (Hampson and others, 2000).

Pesticide information gathered in the Mobile River Basin indicates that exposure is complicated by lengthy periods of low concentrations that are often punctuated by seasonal pulses of much higher concentrations, in addition to complex mixtures of compounds and breakdown products. Possible risks from these patterns of exposure have not been fully evaluated because drinking-water or aquatic-life standards have not been determined for many of the contaminants and their breakdown products; furthermore, the existing standards do not address exposure to mixtures or brief pulses of high concentrations. Some pesticides may become more toxic when combined with other compounds. The additive and synergistic effects created from low concentrations of multiple pesticides have yet to be quantified (Hoffman and others, 2000). The combined ecological effects of multiple pesticides in the streams are unknown.

Occurrence of Pesticides in the Mobile River Basin Compared to Other NAWQA Study Units

Surface-water samples were collected for pesticide analyses at more than 162 sites in 49 of the Nation's major river basins during 1991–2001 as part of the NAWQA Program. The analytical results can be used to improve the understanding of the relation between water quality and land use, pesticide use, soils, climate, and other natural or human influences. Surface-water sites in the NAWQA Program were classified into four land-use groups: agricultural (78 sites), undeveloped (4 sites), urban (33 sites), and mixed (47 sites). Three sites in the Mobile River Basin were included in this aggregate data set: Bogue Chitto Creek, Cahaba Valley Creek, and Cahaba River. A 1-year period of data was selected for each site included in the aggregate data set to describe annual distributions of pesticide concentrations and annual detection frequencies. Detections in water samples were time-weighted, and the pooled detection frequency was calculated across all sites in a land-use category. As a consequence, the frequency of detection may be interpreted as an estimate of the percentage of time that pesticides are detected at a NAWQA site in a particular land-use category (J.D. Martin, U.S. Geological Survey, written commun., 2003). The water samples in the aggregate NAWQA pesticide data were collected by using the same sampling procedures as those used in the Mobile River Basin. The aggregate NAWQA pesticide data are comparable to the data collected in the Mobile River Basin, although there may be slight differences in the MRLs and LRLs as a result of refined analytical techniques and the different methods used by the NWQL.

Pesticide data from the Mobile River Basin included samples collected for the entire 3-year period (1999–2001) at the following sites: Bogue Chitto Creek (agricultural land use), Cahaba Valley Creek and Threemile Branch (urban land use), and Alabama River, Black Warrior River, Cahaba River, and Tombigbee River (mixed land use). Results summarized in figure 26 provide a framework for comparing water quality among sites with different types of land use.

A comparison of the results from Bogue Chitto Creek with the aggregate data set for agricultural streams indicates some strong similarities and some regional differences (fig. 26A). In the aggregate data set, the five most frequently detected pesticides (not including pesticide metabolites) were atrazine (90 percent), metolachlor (83 percent), simazine (57 percent), prometon (43 percent), and cyanazine (40 percent). At Bogue Chitto, the five most frequently detected pesticides (not including pesticide metabolites) were atrazine (100 percent), metolachlor (96 percent), fluometuron (84 percent), simazine (73 percent), and cyanazine (60 percent). The frequent occurrence of fluometuron at Bogue Chitto Creek is indicative of the use of this pesticide on cotton in the basin. Fluometuron also was detected frequently in agricultural settings in the Lower Tennessee River Basin (about 65 percent; Hoos and others, 2002) and in the Mississippi Embayment (about 65 percent; Kleiss and others, 2000), both areas with extensive cotton production. Although prometon was the fourth most frequently detected pesticide (43 percent) in the aggregate NAWQA data set, it was not detected at Bogue Chitto Creek. The herbicide 2,4-D, commonly used on corn and wheat, also was detected more frequently at Bogue Chitto Creek (55 percent) than at other agricultural sites across the country (15 percent).

The five most frequently detected pesticides in the urban aggregate data set were prometon (84 percent), atrazine (74 percent), diazinon (65 percent), simazine (64 percent), and metolachlor (50 percent; fig. 26B). At the two urban sites in the Mobile River Basin, the five most frequently detected pesticides were atrazine (98 percent), simazine (96 percent), diazinon (84 percent), prometon (58 percent), and chlorpyrifos (54 percent). The presence of prometon and metolachlor was not as common at the urban sites in the Mobile River Basin as

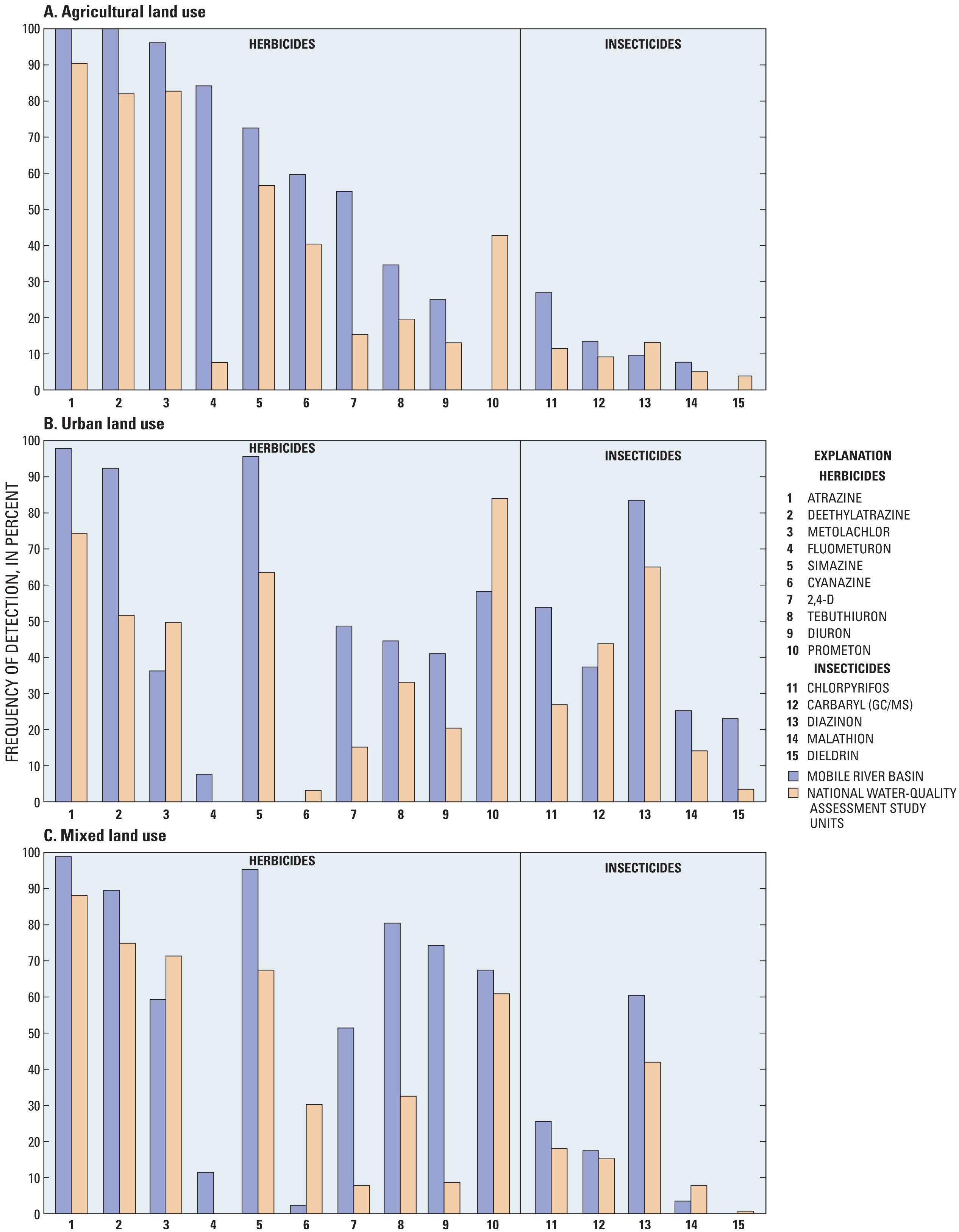


Figure 26. Frequencies of pesticide detections in surface-water samples from (A) agricultural, (B) urban, and (C) mixed land-use sites in the Mobile River Basin and at other National Water-Quality Assessment Study Units throughout the United States.

at the urban sites across the country. Conversely, atrazine, fluometuron, simazine, 2,4-D, tebuthiuron, diuron, chlorpyrifos, diazinon, malathion, and dieldrin were detected more frequently in the Mobile River Basin than at other urban sites across the country (fig. 26B).

The five most frequently detected pesticides in the mixed land-use aggregate data set were atrazine (88 percent), metolachlor (71 percent), simazine (67 percent), prometon (61 percent), and diazinon (42 percent; fig. 26C). At the mixed land-use sites in the Mobile River Basin, the five most frequently detected pesticides were atrazine (99 percent), simazine (95 percent), tebuthiuron (80 percent), diuron (74 percent), and prometon (67 percent). Diuron was detected only in 9 percent of the water samples from the mixed land-use aggregate data set. The herbicide 2,4-D also was detected more frequently in the Mobile River Basin (51 percent) than at other mixed land-use sites across the country (8 percent).

SUMMARY

In 1997, the U.S. Geological Survey began a study of surface-water quality in the Mobile River Basin as part of the National Water-Quality Assessment (NAWQA) Program. Surface-water samples were collected at nine sites in Alabama. Indicator sites were chosen to characterize water quality in smaller basins draining predominantly agricultural or urban land-use settings. Large rivers were sampled as integrator sites to characterize water quality in drainage areas with mixed land use. Water-quality samples were collected between January 1999 and December 2001. More than 340 water samples were analyzed for nitrogen and phosphorus, and more than 230 water samples were collected and analyzed for up to 104 pesticides.

The nine sites included two streams draining agricultural areas, two urban streams, and five large rivers with mixed land-use drainage areas. The streams draining primarily agricultural watersheds were Bogue Chitto Creek and Pintlalla Creek. The Bogue Chitto Creek Basin, located primarily in Noxubee County, Miss., drains the western part of the Black Prairie Belt and is intensively cropped in soybeans, corn, cotton, and hay. The Pintlalla Creek Basin, located in Montgomery County, Ala., lies in the eastern part of the Black Prairie Belt. Land use in this basin is dominated by forested land and pastureland, with some interspersed areas of row crops and hay fields. The two urban streams include Threemile Branch in Montgomery, Ala., and Cahaba Valley Creek, located in a rapidly developing area in southeast Birmingham, Ala. The Chattooga River Basin is located in the northeastern section of the Mobile River Basin, and the Cahaba River is located at Centreville in central Alabama. The Black Warrior River below Bankhead Lock and Dam is located at the southern edge of the Cumberland Plateau. The Alabama River at Claiborne is located on the southeastern rim of the Mobile River Basin, and the Tombigbee River below Coffeeville Lock and Dam is located on the southwestern rim of the Mobile River Basin.

Nutrient concentrations varied in relation to land use. High nutrient concentrations generally occurred at agricultural and urban sites. Total nitrogen concentrations ranged from 0.2 to 10 mg/L, and nitrate concentrations ranged from 0.03 to 7.94 mg/L, which was lower than the U.S. Environmental Protection Agency's drinking-water standard of 10 mg/L for nitrate. Median nitrate concentrations in the Black Warrior River, a large river mixed land-use site, were higher than in the smaller agricultural indicator watersheds, and likely reflects extensive poultry production operations in the upper part of the Black Warrior River Basin and urban influences from the Birmingham metropolitan area.

Total phosphorus concentrations ranged from 0.008 to 2.22 mg/L. The highest total phosphorus concentration occurred at Bogue Chitto Creek, and the highest median concentration occurred at Cahaba Valley Creek, an urban site. The Chattooga River had the highest median and maximum phosphorus concentrations of all the integrator sites, which is of particular interest because the Chattooga River flows into Weiss Lake, where eutrophication problems have been noted. Forty-two percent of total phosphorus concentrations at all nine sites exceeded the U.S. Environmental Protection Agency goal of 0.10 mg/L for preventing nuisance plant growth in streams. Median total phosphorus concentrations at Bogue Chitto Creek, Cahaba Valley Creek, and the Chattooga River exceeded this goal. Dissolved phosphorus and dissolved orthophosphate concentrations also were high at Cahaba Valley Creek and the Chattooga River.

Flow-weighted mean concentrations for the Mobile River Basin sites were generally in the lower to middle percentile ranges compared with data from other NAWQA studies across the Nation. However, flow-weighted mean concentrations of ammonia, total nitrogen, orthophosphate, and total phosphorus at Bogue Chitto Creek were in the upper 20th percentiles of agricultural sites. The orthophosphate concentration at the Chattooga River ranked in the 70th percentile, and the total phosphorus concentration at the Black Warrior River was in the 94th percentile of integrator sites.

Nutrient loads were nearly twice as high in the Tombigbee River compared to the Alabama River for total nitrogen, nitrate, and total phosphorus, which reflects the agricultural influences occurring in the Tombigbee River drainage basin. Nutrient loads in Bogue Chitto Creek were higher than loads at the other indicator sites. Nutrient yields were highest in Bogue Chitto Creek, Cahaba Valley Creek, and Threemile Branch as a result of the agricultural and urban land uses in the watersheds. No significant long-term trends were detected for the Alabama, Cahaba, or Tombigbee Rivers, except for a decrease in nitrate at the Alabama River. The decrease in nitrate could be a result of improved wastewater-treatment practices and decreases in the amount of row-crop agricultural activities in the watershed. No short-term trends were detected at any of the three sites.

Organic carbon concentrations generally were low and ranged from 0.9 to 17.8 mg/L for dissolved organic carbon and from 0.2 to 6.0 mg/L for suspended organic carbon. Concentrations generally were highest in the two agricultural watersheds, Bogue Chitto Creek and Pintlalla Creek; however, the high concentrations probably are due to the natural occurrence of organic carbon in soils and the chalk that underlies the basins, rather than agricultural land uses.

Suspended-sediment concentrations ranged from 1 to 2,450 mg/L at all nine sites. Bogue Chitto Creek had the highest median and maximum concentrations. Sediment yields were highest in Bogue Chitto Creek and lowest in the Black Warrior River, likely an influence of reservoirs upstream.

Of the 104 pesticides and degradation products analyzed in the stream samples, 69 were detected in one or more samples. Of the 69 detected pesticides, 51 were herbicides, 15 were insecticides, and 3 were fungicides. A relatively small number of heavily used herbicides accounted for most of the detections, including atrazine and its metabolites (deethylatrazine, 2-hydroxyatrazine, deisopropylatrazine, and deethyldeisopropylatrazine), simazine, metolachlor, tebuthiuron, prometon, diuron, and 2,4-D. Diazinon, chlorpyrifos, and carbaryl were the most frequently detected insecticides; metalaxyl was the most frequently detected fungicide in the Mobile River Basin. At least one pesticide was detected in all but two of the 234 stream samples. More than 90 percent of all the stream samples contained three or more pesticides; more than 50 percent contained nine or more compounds.

Concentrations of pesticides detected in surface water of the Mobile River Basin were among the highest concentrations recorded nationally by the 1991, 1994, and 1997 NAWQA Study Units. The three highest concentrations of atrazine detected at sites across the country were recorded at Bogue Chitto Creek; the highest concentrations of 2,4-D, imazaquin, and malathion recorded nationally were detected at Threemile Branch.

Aquatic-life criteria have been established for 23 of the 69 pesticides detected in this study. These criteria were exceeded by five herbicides (2,4-D, atrazine, cyanazine, diuron, and metolachlor), six insecticides (carbaryl, chlorpyrifos, diazinon, dieldrin, malathion, and *p,p'*-DDE), and one fungicide (chlorothalonil). Drinking-water standards, guidelines, or health advisories have been established for 32 of the pesticides detected in this study. These limits were exceeded by concentrations of four herbicides (2,4-D, atrazine, cyanazine, and simazine), three insecticides (*alpha*-HCH, diazinon, and dieldrin), and one fungicide (chlorothalonil).

The types and concentrations of pesticides found in surface water are linked to land use and to the types of pesticides used in each setting. Herbicides were detected more frequently and usually at higher concentrations in the agricultural stream, Bogue Chitto Creek, than in the urban or mixed land-use streams. Insecticides, however, were detected more frequently and usually at higher concentrations in the urban streams (Cahaba Valley Creek, Threemile Branch). Concentrations of pesticides varied seasonally in streams in response to the timing and amount of pesticides used and the frequency and magnitude of runoff from precipitation and irrigation. At Bogue Chitto Creek, the highest concentrations of atrazine occurred in April, May, and June, which coincide with its use as a preemergent herbicide on corn. The highest concentrations of cyanazine at Bogue Chitto Creek occurred in July and August, when cyanazine frequently is used as a postemergent herbicide on cotton. Seasonal patterns were less evident in urban streams, where concentrations of herbicides and insecticides in surface water remained relatively constant throughout the year.

The types, concentrations, and timing of pesticides found in streams are related to the proportion of urban and agricultural land in the drainage basin and the hydrology and basin characteristics. Marked similarities were observed between pesticides detected in small streams draining one primary land-use setting and pesticides detected in large rivers draining basins encompassing these small streams. Concentrations of pesticides in the large rivers generally were much lower than in their corresponding tributaries because of dilution and runoff from other land-use areas within the larger, more integrated basins. For example, the agricultural pesticides found in the Tombigbee River reflected those compounds present in its tributary, Bogue Chitto Creek, and the urban pesticides in the Cahaba River reflected those compounds found in its tributary, Cahaba Valley Creek. In both cases, the types of pesticides detected were similar between main stem and tributary, but the concentrations were greater in the tributaries.

Differences also were noted between the large rivers draining the western half of the Mobile River Basin and those draining the eastern half. In general, pesticide concentrations on the Tombigbee River were dominated by the presence of atrazine and, to a lesser degree, 2-hydroxyatrazine, 2,4-D, and metolachlor. Pesticide concentrations on the Alabama River were dominated by the presence of simazine and, to a lesser degree, atrazine and 2,4-D. Total pesticide concentrations on the Tombigbee River exceeded concentrations on the Alabama River during the growing season (April–August). Differences also were noted between the two urban sites, Threemile Branch and Cahaba Valley Creek. Total pesticide concentrations generally were more than one order of magnitude greater at Threemile Branch than at Cahaba Valley Creek, which may be a result of the different percentages of urban land use in each basin and differences in sampling frequencies at the two sites.

Exposure to pesticides is complicated by lengthy periods of low concentrations that are often punctuated by seasonal pulses of much higher concentrations, and complex mixtures of compounds and breakdown products. Possible risks associated with exposure have not been fully evaluated because drinking-water standards and aquatic-life standards have not been determined for many of the contaminants and their breakdown products. Furthermore, the existing standards do not address exposure to mixtures or brief pulses of high concentrations.

Strong similarities and some regional differences were observed in the results from an aggregation of agricultural site data collected from other NAWQA Study Units (1991–2001) and the agricultural indicator site at Bogue Chitto Creek. In the aggregate data set, the most frequently detected pesticides (not including pesticide metabolites) were atrazine, metolachlor, simazine, prometon, and cyanazine. At Bogue Chitto Creek, the most frequently detected pesticides (not including pesticide metabolites) were atrazine, metolachlor, fluometuron, simazine, and cyanazine. The frequent occurrence of fluometuron at Bogue Chitto Creek is indicative of the use of this pesticide on cotton in the basin. Although prometon was the fourth most frequently detected pesticide in the aggregate NAWQA data set, it was not detected at Bogue Chitto Creek. The five most frequently detected pesticides in the urban aggregate data set (NAWQA) were prometon, atrazine, diazinon, simazine, and metolachlor. Three of these pesticides (atrazine, diazinon, and simazine) were detected more frequently at urban sites in the Mobile River Basin; prometon and metolachlor were detected less frequently at urban sites in the Mobile River Basin. The five most frequently detected pesticides in the mixed land-use aggregate data set (NAWQA) were atrazine, metolachlor, simazine, prometon, and diazinon. At the mixed land-use sites in the Mobile River Basin, the five most frequently detected pesticides were atrazine, simazine, tebuthiuron, diuron, and prometon.

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APPENDIX 1 Quality Control

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
2,4-D	0.6285	0.2
	0.6274	
	0.2399	2.8
	0.2333	
	0.4885	1.8
	0.4976	
	0.1068	3.6
	0.103	
	0.1267	7.8
	0.137	
	0.4615	9.7
	0.4187	
	0.1154	12.1
	0.1022	
	0.3367	4.7
	0.3528	
2,4-D methyl ester	E0.0813	4.3
	E0.0849	
	E0.0225	5.2
	E0.0237	
	E0.0162	1.2
	E0.016	
	E0.0283	3.5
	E0.0293	
2-hydroxyatrazine	E0.0832	22.9
	E0.1047	
	E0.0221	4.6
	E0.0211	
	E0.0549	3.0
	E0.0566	
	E0.025	0.0
	E0.025	
	E3.4174	32.7
	E4.7551	
	E0.3349	4.6
	E0.3505	
	E0.2695	2.2
	E0.2636	
	E0.1566	3.9
	E0.1629	
	E1.507	118.6
	E0.3851	
	E0.0309	7.7
	E0.0286	
Acifluorfen	E0.0269	27.8
	E0.0356	
Atrazine	0.00856	0.6
	0.00851	
	0.0051	3.4
	0.00493	
	1.02	2.1
	0.999	
	0.0464	2.0
	0.0455	
	0.0424	8.6
	0.0389	
	0.029	2.4
	0.0283	
	0.017	0.6
	0.0171	
	0.0149	0.0
	0.0149	
	0.682	4.7
	0.651	
	0.172	26.3
	0.224	
	0.0171	8.4
	0.0186	
	0.192	5.3
	0.182	
	0.032	13.4
	0.0366	
	0.0155	6.3
	0.0165	
	0.191	3.6
	0.198	
	0.0937	17.8
	0.112	
	0.00833	24.9
	0.0107	
	0.0521	22.5
	0.0653	
	0.0323	1.9
	0.0317	
	0.0408	5.3
	0.043	
	0.0266	1.1
	0.0263	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Atrazine (Continued)	0.0593	14.5
	0.0513	
	0.0556	1.6
	0.0565	
	0.311	0.3
	0.312	
	E136	13.3
	E119	
	0.166	0.6
	0.167	
	0.0783	5.0
	0.0745	
	0.0486	1.0
	0.0491	
	0.038	15.9
	0.0324	
	2.57	7.5
	2.77	
	1.92	8.1
	1.77	
	0.0485	4.4
	0.0464	
	0.0418	5.4
	0.0441	
Benfluralin	E0.00101	5.1
	E0.00096	
	E0.00357	3.0
	E0.00368	
	E0.00377	3.2
	E0.00365	
	<0.002	NC
	E0.00107	
Benomyl	E0.0179	17.3
	E0.0213	
Bentazon	E0.0041	19.8
	E0.005	
	E0.0052	17.5
	E0.0062	
	E0.028	NC
	<0.0193	
Caffeine	E0.0684	10.7
	E0.0761	
	0.1414	1.1
	0.1398	
	0.0997	10.8
	0.0895	

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Caffeine (Continued)	E0.017	20.6
	E0.0209	
	0.1088	10.5
	0.1208	
	E0.0376	NC
	<0.0805	
Carbaryl	E0.00316 (GC/MS)	1.3
	E0.00312 (GC/MS)	
	E0.0179 (GC/MS)	9.4
	E0.0163 (GC/MS)	
	E0.0287 (GC/MS)	2.5
	E0.028 (GC/MS)	
	E0.369	1.9
	E0.376 (GC/MS)	
	E0.0166 (GC/MS)	1.8
	E0.0163 (GC/MS)	
	E0.12 (GC/MS)	5.1
	E0.114 (GC/MS)	
	E0.0195 (GC/MS)	9.8
	E0.0215 (GC/MS)	
	E0.00213 (GC/MS)	19.1
	E0.00258 (GC/MS)	
	E0.00609 (GC/MS)	5.1
	E0.00641 (GC/MS)	
	E0.0279 (GC/MS)	21.4
	E0.0346 (GC/MS)	
	E0.00764 (GC/MS)	27.7
	E0.0101 (GC/MS)	
	E0.0348 (GC/MS)	32.8
	E0.025 (GC/MS)	
	E0.00774 (GC/MS)	NC
	<0.041 (GC/MS)	
	E0.00371 (GC/MS)	NC
	<0.041 (GC/MS)	
	E0.0078 (HPLC/MS)	0.0
	E0.0078 (HPLC/MS)	
	E0.0098 (HPLC/MS)	9.6
	E0.0089 (HPLC/MS)	
	0.0651 (HPLC/MS)	1.5
	0.0641 (HPLC/MS)	
	E0.0017 (HPLC/MS)	11.1
	E0.0019 (HPLC/MS)	
	E0.0042 (HPLC/MS)	NC
	<0.0628 (HPLC/MS)	
Clopyralid	E0.034	39.4
	E0.0228	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Chlorpyrifos	0.00825 0.00711	14.8
	E0.0035 E0.00349	0.3
	0.0299 0.0288	3.7
	0.0189 0.0173	8.8
	E0.00442 0.00615	32.7
	0.00473 0.00551	15.2
	E0.00388 E0.00394	1.5
	0.0246 0.025	1.6
	0.00808 0.0085	5.1
	0.0128 0.0149	15.2
	E0.00483 0.00625	25.6
	0.00529 E0.00308	52.8
	0.211 0.188	11.5
	0.0053 0.00504	5.0
Cyanazine	0.0176 0.0198	11.8
	0.0116 0.0105	10.0
	0.021 0.0188	11.1
	E0.00378 E0.00374	1.1
	E0.00636 <0.018	NC
	0.483 0.445	8.2
	0.0213 0.0193	9.9
Dacthal	E0.00186 <0.002	NC
p,p'-DDE	<0.006 E0.00208	NC

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Deethylatrazine	E0.00539 E0.0058	7.3
	E0.00623 E0.006	3.8
	E0.0629 E0.0606	3.7
	E0.00814 E0.00857	5.1
	E0.0188 E0.0196	4.2
	E0.0106 E0.0118	10.7
	E0.00537 E0.00611	12.9
	E0.0523 E0.0734	33.6
	E0.0162 E0.0217	29.0
	E0.0124 E0.014	12.1
	E0.0138 E0.0135	2.2
	E0.00549 E0.00581	5.7
	E0.00301 <0.002	NC
	E0.0205 E0.0244	17.4
	E0.012 E0.0148	20.9
	<0.006 E0.0049	NC
	E0.00582 E0.00746	24.7
	E0.00636 E0.00561	12.5
	E0.00891 E0.00872	2.2
	E0.00729 E0.00596	20.1
	E0.00648 E0.0057	12.8
	E0.0053 E0.0053	0.0
	E0.157 E0.158	0.6

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Deethylatrazine (Continued)	E1.3	50.0
	E0.78	
	E0.0317	4.9
	E0.0333	
	E0.0232	4.9
	E0.0221	
	E0.0192	29.3
	E0.0143	
	E0.00466	76.2
	E0.0104	
	E0.0634	22.1
	E0.0508	
	E0.489	8.1
	E0.451	
	E0.0125	11.0
	E0.0112	
	E0.00971	16.0
	E0.0114	
Deisopropylatrazine	E0.4797	4.5
	E0.5019	
	E0.0678	4.1
	E0.0651	
	E0.0416	10.5
	E0.0462	
	E0.0577	5.6
	E0.061	
	E0.6403	34.5
	E0.4518	
	E0.0217	28.5
	E0.0289	
	<0.0737	NC
	E0.0124	
	<0.0737	NC
	E0.0421	
Deethyldeisopropyl-atrazine	0.0775	6.9
	0.0723	
	E0.0462	0.7
	E0.0459	
	E0.0147	14.6
	E0.0127	
	0.0607	28.6
	E0.0455	
	E0.0243	16.6
	E0.0287	
	0.1268	98.7
	E0.043	
Deethyldeisopropyl-atrazine (Continued)	E0.0251	38.5
	E0.017	
Diazinon	0.0219	2.3
	0.0224	
	E0.0038	17.5
	0.00453	
	0.132	3.1
	0.128	
	0.305	7.3
	0.328	
	0.00877	6.6
	0.00821	
	0.0179	4.0
	0.0172	
	0.0082	6.7
	0.00877	
	0.0409	2.4
	0.0419	
	0.044	8.8
	0.0403	
	0.00464	17.3
	0.00552	
	0.00798	14.0
	0.00918	
	0.0323	3.1
	0.0313	
	0.0508	2.4
	0.0496	
	0.0172	0.6
	0.0173	
	0.0137	7.7
	0.0148	
	0.0414	25.9
	0.0537	
	0.00573	20.8
	0.00706	
	0.0073	36.6
	0.00504	
	0.00907	43.0
	0.00586	
	E0.00322	6.4
	E0.00302	
	E0.00331	17.4
	E0.00278	
	0.00481	NC
	<0.002	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Diazinon (Continued)	0.00524	NC
	<0.005	
	0.00768	NC
	<0.005	
	E0.00295	NC
	<0.002	
Dicamba	0.2124	15.0
	0.1828	
	E0.0843	12.1
	E0.0747	
	E0.0291	41.0
	E0.0441	
	E0.0708	NC
	<0.096	
Dichlorprop	0.0565	15.6
	E0.0483	
	E0.0234	2.6
	E0.0228	
	<0.05	NC
	0.1066	
Dieldrin	0.0132	1.5
	0.0134	
	0.0179	15.5
	0.0209	
	E0.0026	NC
	<0.001	
	0.013	6.0
	0.0138	
Diuron	E0.018	0.6
	E0.0181	
	E0.0184	2.7
	E0.0189	
	E0.0132	10.1
	E0.0146	
	E0.016	13.4
	E0.0183	
	E0.0486	1.6
	E0.0494	
	<0.0793	NC
	E0.013	
	E0.0156	18.2
	E0.013	
Fluometuron	E0.0035	9.0
	E0.0032	
	0.1558	2.3
	0.1595	
Fluometuron (Continued)	E0.0837	3.2
	E0.0811	
	E0.0238	7.9
	E0.022	
	E0.0111	50.8
	E0.0066	
	E0.0041	5.0
	E0.0039	
Imazaquin	E0.0488	2.6
	E0.0501	
	E0.0889	0.7
	E0.0895	
Imazethapyr	E0.1029	27.4
	E0.0781	
Imidacloprid	E0.0182	3.4
	E0.0176	
Lindane	E0.00244	NC
	<0.004	
Malathion	0.0863	0.1
	0.0864	
	0.0292	2.1
	0.0286	
	0.665	1.3
	0.674	
	0.00549	NC
	<0.005	
	E0.003	NC
	<0.027	
	0.014	17.1
	0.0118	
	0.0194	5.8
	0.0183	
MCPA	0.5944	1.9
	0.5835	
	E0.0379	8.1
	E0.0411	
	0.258	0.7
	0.2598	
	E0.041	4.5
	E0.0392	
Metalaxyl	E0.0177	5.0
	E0.0186	
	E0.0064	11.6
	E0.0057	
	E0.0033	3.1
	E0.0032	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Metalaxyl (Continued)	E0.0044	6.6
	E0.0047	
	E0.0174	11.4
	E0.0195	
	E0.0198	2.0
	E0.0194	
Metolachlor	0.00527	7.9
	0.00487	
	0.00553	1.5
	0.00545	
	0.0055	15.4
	0.00642	
	E0.00075	25.6
	E0.00097	
	0.00672	5.1
	0.00707	
	E0.00314	7.4
	E0.00338	
	E0.00332	7.0
	E0.00356	
	0.00674	13.6
	0.00772	
	E0.00364	27.3
	E0.00479	
	0.00655	4.8
	0.00624	
	0.0092	6.5
	0.00982	
	0.0364	3.1
	0.0353	
	1.93	65.7
	0.975	
	0.0986	8.2
	0.107	
	0.0913	2.8
	0.0888	
	0.0321	4.0
	0.0334	
	<0.013	NC
	0.0247	
	0.0675	7.2
	0.0628	
	0.0862	5.9
	0.0813	
	0.0214	2.4
	0.0209	
Metolachlor (Continued)	0.00514	6.0
	0.00546	
Metribuzin	0.00606	1.7
	E0.00596	
	0.018	1.1
	0.0178	
	0.0072	4.3
	0.0069	
Pendimethalin	0.0305	3.2
	0.0315	
	0.0132	3.0
	0.0136	
	0.034	18.2
	0.0408	
	0.0202	7.2
	0.0188	
	0.0101	7.6
	0.0109	
	0.0246	9.7
	0.0271	
	E0.00835	22.8
	0.0105	
	0.26	20.1
	0.318	
	E0.0128	NC
	<0.01	
	E0.0082	3.7
	E0.0079	
Prometon	<0.018	NC
	E0.00297	
	E0.00956	4.7
	E0.00912	
	E0.0129	6.7
	E0.0138	
	E0.0106	16.9
	E0.00895	
	E0.00412	1.7
	E0.00419	
	E0.00836	21.7
	E0.0104	
	E0.00304	21.7
	E0.00378	
	E0.00352	19.5
	E0.00428	
	<0.018	NC
	E0.00574	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Prometon (Continued)	E0.0101	5.8
	E0.0107	
	<0.018	NC
	E0.00462	
	E0.00381	5.6
	E0.00403	
	E0.00357	40.4
	E0.00538	
	E0.00698	1.6
	E0.00687	
	<0.018	NC
	E0.00877	
	E0.00925	10.6
	E0.00832	
	E0.0027	25.9
	E0.00208	
	E0.0063	10.5
	E0.007	
	E0.014	37.2
	0.0204	
	E0.00717	4.6
	E0.00685	
Pronamide	0.00547	16.4
	0.00464	
	0.0045	5.2
	0.00474	
	0.00638	27.7
	0.00843	
	0.00452	17.6
	E0.00379	
	0.02	NC
	<0.0041	
Propanil	E0.00458	NC
	<0.011	
Propoxur	E0.0054	16.0
	E0.0046	
Simazine	0.00763	6.4
	0.00716	
	0.0116	1.7
	0.0114	
	7.13	2.4
	7.3	
	0.668	0.1
	0.667	
	0.0134	23.3
	E0.0106	

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Simazine (Continued)	0.0554	6.7
	0.0518	
	0.0247	2.0
	0.0242	
	1.62	2.5
	1.58	
	1.99	3.1
	1.93	
	0.0291	29.3
	0.0391	
	0.0208	15.5
	0.0243	
	0.309	4.3
	0.296	
	1.14	7.6
	1.23	
	0.829	0.8
	0.836	
	0.304	2.6
	0.312	
	0.0976	19.8
	0.119	
	<0.011	NC
	E0.00715	
	0.0851	20.9
	0.105	
	0.0423	6.8
	0.0395	
	0.045	9.9
	0.0497	
	0.0288	4.6
	0.0275	
	0.0732	17.0
	0.0617	
	0.0178	9.1
	0.0195	
	0.0261	7.1
	0.0243	
	0.898	NC
	<0.011	
	0.0228	7.7
	0.0211	
	0.0201	8.3
	0.0185	
Sulfometuron-methyl	E0.0674	1.8
	E0.0662	

Appendix 1. Concentrations and relative percentage differences for pesticides detected in 46 replicate samples from the Mobile River Basin, 1999–2001—Continued

[µg/L, micrograms per liter; E, estimated; <, less than; NC, not calculated; GC/MS, analyzed by gas chromatography/mass spectrometry; HPLC/MS, analyzed by high-performance liquid chromatography/mass spectrometry]

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Tebuthiuron	0.0559	6.1
	0.0594	
	0.0531	8.4
	0.0488	
	0.0598	27.2
	0.0455	
	E0.00433	5.5
	E0.0041	
	E0.00961	16.2
	0.0113	
	0.014	3.6
	0.0135	
	E0.00924	6.7
	E0.00864	
	<0.016	NC
	E0.00726	
	E0.00603	3.2
	E0.00584	
	E0.00827	17.9
	E0.00691	
	E0.0065	8.0
	E0.006	
	E0.0075	23.7
	E0.00591	
	0.0131	90.4
	0.0347	
	E0.0189	23.8
	E0.024	
Terbuthylazine	E0.00684	63.5
	E0.0132	
Triallate	E0.00201	38.2
	E0.00296	

Pesticide	Concentration in replicates (µg/L)	Relative percent difference
Triclopyr	0.1161	25.4
	E0.0899	
	<0.1008	NC
	E0.0379	
	E0.0958	36.9
	0.1391	
	E0.0943	4.9
	E0.099	
	E0.0876	10.5
	E0.0789	
Trifluralin	E0.00373	106.4
	E0.00114	
	E0.0012	0.0
	E0.0012	
	0.00698	13.0
	0.00795	
	E0.00363	4.8
	E0.00346	
	0.00478	1.3
	0.00472	
	0.0135	NC
	<0.002	
	E0.00507	3.7
	E0.00526	
	<0.009	NC
	E0.00265	
	<0.009	NC
	E0.00358	
	0.00838	NC
	<0.002	

APPENDIX 2 Summary Statistics for Nutrients, Organic Carbon, and Suspended Sediment

Appendix 2. Summary statistics for nutrients, organic carbon, and suspended sediment in surface-water samples collected from the Mobile River Basin, 1999–2001

[NWIS, National Water Information System; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated]

Alabama River at Claiborne, Alabama—January 1999 to December 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	34	0.09	<0.020	0.026*	0.08	0.03	<0.040	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	31	0.34	0.16	0.225	0.334	0.26	0.21	0.19	0.166
625	Total ammonia plus organic nitrogen as N, mg/L	34	0.62	0.28	0.432	0.605	0.49	0.43	0.38	0.28
631	Dissolved nitrite plus nitrate as N, mg/L	34	0.29	<0.050	0.130*	0.25	0.18	0.12	0.07	<0.050
613	Dissolved nitrite as N, mg/L	34	0.019	<0.006	0.006*	0.014	0.005	<0.010	<0.010	<0.008
600	Total nitrogen, mg/L	29	0.87	0.4	0.574	0.825	0.59	0.55	0.53	0.435
666	Dissolved phosphorus as P, mg/L	31	0.05	0.01	0.027	0.049	0.033	0.024	0.019	0.012
671	Dissolved orthophosphate as P, mg/L	34	0.04	<0.010	0.018*	0.04	0.02	0.02	0.01	<0.010
665	Total phosphorus as P, mg/L	34	0.173	0.051	0.077	0.146	0.08	0.074	0.061	0.052
681	Dissolved organic carbon, mg/L	31	7	3.3	4.413	6.16	5	4.3	3.8	3.3
689	Suspended organic carbon, mg/L	24	1.3	0.4	0.675	1.3	0.8	0.6	0.5	0.4
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	34	97	35	79.971	96.25	92	84	73	47.75
80154	Suspended sediment concentration, mg/L	34	167	2	28.882	132.5	21.75	13	10.5	5

Black Warrior River below Bankhead Lock and Dam near Bessemer, Alabama—January 1999 to December 2000

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	24	0.14	<0.020	0.043*	0.12	0.06	0.03	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	24	0.36	0.11	0.206	0.355	0.248	0.2	0.148	0.11
625	Total ammonia plus organic nitrogen as N, mg/L	24	0.57	0.14	0.31	0.532	0.36	0.315	0.222	0.157
631	Dissolved nitrite plus nitrate as N, mg/L	24	1.13	0.05	0.599	1.125	0.885	0.585	0.308	0.067
613	Dissolved nitrite as N, mg/L	24	0.03	<0.010	0.009*	0.027	0.01	<0.010	<0.010	<0.010
600	Total nitrogen, mg/L	23	1.7	0.45	0.932	1.64	1.2	0.9	0.68	0.462
666	Dissolved phosphorus as P, mg/L	24	0.043	<0.004	0.013*	0.029	0.017	0.011	0.004	<0.004
671	Dissolved orthophosphate as P, mg/L	24	0.03	<0.010	0.009*	0.02	0.01	<0.010	<0.010	<0.010
665	Total phosphorus as P, mg/L	24	0.137	0.015	0.036	0.119	0.042	0.029	0.02	0.015
681	Dissolved organic carbon, mg/L	23	3.7	1.9	2.583	3.68	2.8	2.5	2.3	1.9
689	Suspended organic carbon, mg/L	23	0.8	0.2	0.522	0.8	0.7	0.5	0.3	0.2
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	24	99	58	82.375	98	91.75	82.5	75.75	59.75
80154	Suspended sediment concentration, mg/L	24	63	2	6.75	51	5	4	3	2

Appendix 2. Summary statistics for nutrients, organic carbon, and suspended sediment in surface-water samples collected from the Mobile River Basin, 1999–2001—Continued

[NWIS, National Water Information System; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated]

Bogue Chitto Creek near Memphis, Alabama—January 1999 to December 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	55	1.63	<0.020	0.088*	0.47	0.07	<0.040	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	52	3.2	0.1	0.717	1.915	0.752	0.64	0.49	0.356
625	Total ammonia plus organic nitrogen as N, mg/L	55	4.2	0.45	1.16	3.14	1.2	0.95	0.76	0.548
631	Dissolved nitrite plus nitrate as N, mg/L	55	7.94	<0.050	1.195*	5	1.65	0.44	<0.050	<0.050
613	Dissolved nitrite as N, mg/L	55	0.49	<0.006	0.044*	0.155	0.048	0.016	<0.010	<0.006
600	Total nitrogen, mg/L	37	10	0.81	3.082	9.55	3.95	2.4	1.4	0.828
666	Dissolved phosphorus as P, mg/L	52	0.27	0.009	0.061	0.2	0.092	0.031	0.017	0.011
671	Dissolved orthophosphate as P, mg/L	55	0.23	<0.010	0.046*	0.17	0.07	0.02	<0.020	<0.010
665	Total phosphorus as P, mg/L	55	2.22	0.037	0.276	1.264	0.32	0.131	0.075	0.048
681	Dissolved organic carbon, mg/L	52	11	4.9	7.754	11	8.775	7.4	6.525	5.6
689	Suspended organic carbon, mg/L	41	4.6	0.3	2.01	4	3.25	1.6	1	0.61
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	53	99	18	80.868	99	96	91	70.5	21.7
80154	Suspended sediment concentration, mg/L	53	2450	3	171.774	933	105	26	11.5	4

Cahaba River at Centreville, Alabama—January 1999 to September 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	41	0.05	<0.020	0.015*	0.03	<0.040	<0.020	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	41	0.52	0.07	0.151	0.28	0.17	0.13	0.11	0.07
625	Total ammonia plus organic nitrogen as N, mg/L	41	1.2	0.11	0.308	0.92	0.34	0.24	0.195	0.121
631	Dissolved nitrite plus nitrate as N, mg/L	41	0.79	<0.050	0.335*	0.64	0.44	0.32	0.19	<0.050
613	Dissolved nitrite as N, mg/L	41	0.01	<0.006	--	0.006	<0.010	<0.010	<0.010	<0.006
600	Total nitrogen, mg/L	38	1.4	0.31	0.66	1.115	0.812	0.615	0.5	0.31
666	Dissolved phosphorus as P, mg/L	41	0.085	<0.004	0.026*	0.061	0.032	0.021	0.013	<0.004
671	Dissolved orthophosphate as P, mg/L	41	0.07	<0.010	0.022*	0.06	0.03	0.02	<0.020	<0.010
665	Total phosphorus as P, mg/L	41	0.27	0.008	0.068	0.196	0.088	0.049	0.03	0.022
681	Dissolved organic carbon, mg/L	41	9.9	1.5	2.476	4.59	2.6	2.1	1.7	1.5
689	Suspended organic carbon, mg/L	36	5.6	0.2	0.944	5.345	0.975	0.45	0.3	0.2
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	40	98	30	86.05	96	92.75	89.5	83	62.1
80154	Suspended sediment concentration, mg/L	40	348	3	38.1	272.7	26.5	10	6.25	3

Appendix 2. Summary statistics for nutrients, organic carbon, and suspended sediment in surface-water samples collected from the Mobile River Basin, 1999–2001—Continued

[NWIS, National Water Information System; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated]

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 1999 to December 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	74	0.7	<0.020	0.033*	0.09	0.03	<0.040	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	71	2	0.05	0.214	0.39	0.22	0.17	0.14	0.09
625	Total ammonia plus organic nitrogen as N, mg/L	74	2.8	0.06	0.328	0.873	0.305	0.25	0.198	0.12
631	Dissolved nitrite plus nitrate as N, mg/L	74	3.43	0.16	1.497	3.243	2.023	1.365	0.718	0.382
613	Dissolved nitrite as N, mg/L	74	0.019	<0.010	0.008*	0.016	0.008	<0.010	<0.010	<0.010
600	Total nitrogen, mg/L	70	3.7	0.63	1.823	3.5	2.25	1.6	1.1	0.727
666	Dissolved phosphorus as P, mg/L	70	0.42	0.005	0.152	0.34	0.208	0.143	0.061	0.022
671	Dissolved orthophosphate as P, mg/L	74	0.39	0.01	0.134	0.33	0.183	0.11	0.05	0.01
665	Total phosphorus as P, mg/L	73	0.5	0.033	0.182	0.403	0.23	0.177	0.09	0.049
681	Dissolved organic carbon, mg/L	69	6	1.2	2.219	4.55	2.4	1.9	1.6	1.25
689	Suspended organic carbon, mg/L	57	6	<0.200	0.608*	2.1	0.4	0.3	0.2	<0.200
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	70	98	68	88.557	97	94	90	83	76.65
80154	Suspended sediment concentration, mg/L	71	243	2	24.732	151.8	17	8	5	3.6

Chattooga River above Gaylesville, Alabama—January 1999 to December 2000

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	25	0.09	<0.020	0.038*	0.08	0.06	0.03	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	25	0.44	0.12	0.254	0.425	0.305	0.26	0.19	0.123
625	Total ammonia plus organic nitrogen as N, mg/L	25	0.67	0.2	0.366	0.64	0.41	0.35	0.28	0.2
631	Dissolved nitrite plus nitrate as N, mg/L	25	0.75	0.06	0.377	0.711	0.46	0.36	0.275	0.105
613	Dissolved nitrite as N, mg/L	25	0.042	<0.010	0.009*	0.022	0.01	<0.010	<0.010	<0.010
600	Total nitrogen, mg/L	25	1.1	0.4	0.742	1.07	0.86	0.71	0.625	0.448
666	Dissolved phosphorus as P, mg/L	25	0.54	0.009	0.24	0.531	0.385	0.219	0.11	0.019
671	Dissolved orthophosphate as P, mg/L	25	0.43	0.02	0.205	0.43	0.33	0.2	0.085	0.023
665	Total phosphorus as P, mg/L	24	0.53	0.008	0.257	0.515	0.403	0.197	0.147	0.027
681	Dissolved organic carbon, mg/L	25	6.6	1.7	3.208	5.97	3.95	3	2.5	1.7
689	Suspended organic carbon, mg/L	24	1.2	<0.200	0.420*	1.1	0.5	0.3	0.3	<0.200
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	25	97	16	81.32	97	92.5	87	79	23.2
80154	Suspended sediment concentration, mg/L	25	88	2	20.76	87.4	20	12	8.5	2.6

Appendix 2. Summary statistics for nutrients, organic carbon, and suspended sediment in surface-water samples collected from the Mobile River Basin, 1999–2001—Continued

[NWIS, National Water Information System; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated]

Pintlalla Creek at Liberty Church Road near Pintlalla, Alabama—January 1999 to December 2000

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	24	0.13	<0.020	0.029*	0.07	0.03	<0.020	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	24	0.66	0.23	0.363	0.658	0.425	0.31	0.27	0.233
625	Total ammonia plus organic nitrogen as N, mg/L	24	1	0.13	0.514	0.983	0.587	0.435	0.373	0.177
631	Dissolved nitrite plus nitrate as N, mg/L	24	0.35	<0.050	0.068*	0.17	0.09	<0.050	<0.050	<0.050
613	Dissolved nitrite as N, mg/L	24	0.018	<0.006	--	0.015	<0.010	<0.010	<0.010	<0.006
600	Total nitrogen, mg/L	11	1.3	0.2	0.675	1.3	0.94	0.58	0.53	0.2
666	Dissolved phosphorus as P, mg/L	24	0.36	0.01	0.05	0.304	0.045	0.026	0.019	0.01
671	Dissolved orthophosphate as P, mg/L	24	0.33	<0.010	0.036*	0.1	0.03	0.01	0.01	<0.010
665	Total phosphorus as P, mg/L	24	0.5	0.045	0.115	0.428	0.118	0.084	0.062	0.047
681	Dissolved organic carbon, mg/L	24	16	4.7	8.337	15.75	9.35	7.2	6.625	4.975
689	Suspended organic carbon, mg/L	23	3.5	0.2	0.865	3.38	1	0.4	0.2	0.2
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	24	99	61	87.208	99	93.75	88	85	61.75
80154	Suspended sediment concentration, mg/L	24	100	4	20.375	91.25	17.25	10.5	8	4.25

Threemile Branch at North Boulevard at Montgomery, Alabama—January 1999 to September 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	35	0.43	<0.020	0.047*	0.39	0.04	<0.040	<0.020	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	35	1.3	0.08	0.248	0.892	0.26	0.17	0.12	0.08
625	Total ammonia plus organic nitrogen as N, mg/L	35	2.2	0.08	0.432	2.04	0.34	0.23	0.17	0.104
631	Dissolved nitrite plus nitrate as N, mg/L	35	1.26	0.15	0.678	1.204	1.01	0.66	0.34	0.198
613	Dissolved nitrite as N, mg/L	35	0.038	<0.010	0.011*	0.019	0.013	0.01	<0.010	<0.010
600	Total nitrogen, mg/L	33	2.5	0.46	1.127	2.43	1.3	1.1	0.74	0.53
666	Dissolved phosphorus as P, mg/L	35	0.29	<0.006	0.037*	0.15	0.022	0.011	0.006	<0.006
671	Dissolved orthophosphate as P, mg/L	35	0.24	<0.010	0.024*	0.13	0.02	<0.020	<0.010	<0.010
665	Total phosphorus as P, mg/L	35	0.66	0.015	0.097	0.548	0.062	0.041	0.021	0.016
681	Dissolved organic carbon, mg/L	35	17.8	0.9	3.474	15.64	4.6	1.8	1.4	0.98
689	Suspended organic carbon, mg/L	26	2	<0.200	0.421*	1	0.4	0.3	0.2	<0.200
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	35	97	16	75.886	96.2	91	80	67	24
80154	Suspended sediment concentration, mg/L	35	1940	1	92.229	821.601	7	4	3	1.8

Appendix 2. Summary statistics for nutrients, organic carbon, and suspended sediment in surface-water samples collected from the Mobile River Basin, 1999–2001—Continued

[NWIS, National Water Information System; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated]

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama—January 1999 to December 2001

NWIS parameter code	Compound	Number of samples	Maximum	Minimum	Mean	95%	75%	50%	25%	5%
608	Dissolved ammonia as N, mg/L	34	0.11	<0.020	0.032*	0.06	0.04	0.03	<0.040	<0.020
623	Dissolved ammonia plus organic nitrogen as N, mg/L	31	0.66	0.16	0.256	0.468	0.27	0.24	0.21	0.166
625	Total ammonia plus organic nitrogen as N, mg/L	34	3.6	0.25	0.548	1.725	0.507	0.42	0.358	0.303
631	Dissolved nitrite plus nitrate as N, mg/L	34	0.83	<0.050	0.259*	0.56	0.32	0.27	0.15	<0.050
613	Dissolved nitrite as N, mg/L	34	0.048	<0.008	0.010*	0.031	0.009	<0.010	<0.010	<0.010
600	Total nitrogen, mg/L	31	3.8	0.4	0.838	2.48	0.85	0.72	0.57	0.424
666	Dissolved phosphorus as P, mg/L	31	0.042	0.008	0.023	0.041	0.033	0.022	0.015	0.008
671	Dissolved orthophosphate as P, mg/L	34	0.03	<0.010	0.017*	0.03	0.02	0.02	<0.020	<0.010
665	Total phosphorus as P, mg/L	34	0.38	0.04	0.1	0.282	0.119	0.073	0.064	0.051
681	Dissolved organic carbon, mg/L	31	6.7	2.7	4.703	6.46	5.1	4.7	4.2	3
689	Suspended organic carbon, mg/L	24	3.3	0.2	0.796	2.85	0.975	0.6	0.5	0.225
70331	Suspended sediment, percent finer than 0.062 mm (percentage)	33	98	53	83.152	96.6	91.5	90	74	53.7
80154	Suspended sediment concentration, mg/L	33	507	5	69.879	368.4	61.5	21	17	8.5

APPENDIX 3 Summary Statistics for Pesticides

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Alabama River at Claiborne, Alabama—January 1999 to December 2001										
NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	18	<0.003	<0.002	--	<0.003	<0.003	<0.002	<0.002	<0.002
49260	Acetochlor	18	<0.004	<0.002	--	<0.004	<0.004	<0.002	<0.002	<0.002
46342	Alachlor	18	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	18	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
39632	Atrazine	18	0.142	0.017	0.045	0.142	0.056	0.038	0.029	0.017
82673	Benfluralin	18	<0.010	<0.002	--	<0.010	<0.010	<0.002	<0.002	<0.002
04028	Butylate	18	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	18	<0.041	<0.003	--	<0.041	<0.041	<0.003	<0.003	<0.003
82674	Carbofuran (E)	18	<0.020	<0.003	--	<0.020	<0.020	<0.010	<0.003	<0.003
38933	Chlorpyrifos	18	0.005	<0.004	--	0.005	<0.005	<0.005	<0.004	<0.004
04041	Cyanazine	18	<0.018	<0.004	--	<0.018	<0.018	<0.009	<0.004	<0.004
82682	Dacthal (DCPA)	18	0.002	<0.002	--	0.002	<0.003	<0.003	<0.002	<0.002
04040	Deethylatrazine (E)	18	0.01	<0.006	0.006*	0.01	0.006	0.005	0.003	<0.006
34653	*p,p'*-DDE	18	<0.006	<0.002	--	<0.006	<0.006	<0.002	<0.002	<0.002
39572	Diazinon	18	0.01	<0.002	0.004*	0.01	0.006	0.003	<0.005	<0.002
39381	Dieldrin	18	<0.005	<0.001	--	<0.005	<0.005	<0.001	<0.001	<0.001
82677	Disulfoton	18	<0.021	<0.017	--	<0.021	<0.021	<0.017	<0.017	<0.017
82668	EPTC	18	<0.030	<0.002	--	<0.030	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	18	<0.009	<0.004	--	<0.009	<0.009	<0.004	<0.004	<0.004
82672	Ethoprop	18	<0.005	<0.003	--	<0.005	<0.005	<0.003	<0.003	<0.003
04095	Fonofox	18	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	18	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	18	<0.035	<0.002	--	<0.035	<0.035	<0.002	<0.002	<0.002
39532	Malathion	18	0.014	<0.005	--	0.014	<0.027	<0.027	<0.005	<0.005
82686	Methyl azinphos (E)	18	<0.050	<0.001	--	<0.050	<0.050	<0.001	<0.001	<0.001
82667	Methyl parathion	18	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	18	0.022	<0.002	0.008*	0.022	0.009	0.007	0.002	<0.013
82630	Metribuzin	18	0.006	<0.004	--	0.006	<0.006	<0.004	<0.004	<0.004
82671	Molinate	18	<0.010	<0.002	--	<0.010	<0.004	<0.004	<0.002	<0.002
82684	Napropamide	18	<0.007	<0.003	--	<0.007	<0.007	<0.003	<0.003	<0.003
39542	Parathion	18	<0.007	<0.004	--	<0.007	<0.007	<0.004	<0.004	<0.004
82669	Pebulate	18	<0.004	<0.002	--	<0.004	<0.004	<0.002	<0.002	<0.002
82683	Pendimethalin	18	<0.010	<0.004	--	<0.010	<0.010	<0.010	<0.004	<0.004
82687	*cis*-Permethrin	18	<0.006	<0.005	--	<0.006	<0.006	<0.005	<0.005	<0.005
82664	Phorate	18	<0.011	<0.002	--	<0.011	<0.011	<0.002	<0.002	<0.002
04037	Prometon	18	0.009	<0.015	0.005*	0.009	0.006	0.003	<0.018	<0.015
82676	Pronamide	18	0.005	<0.003	--	0.005	<0.004	<0.004	<0.003	<0.003
04024	Propachlor	18	<0.010	<0.007	--	<0.010	<0.010	<0.007	<0.007	<0.007
82679	Propanil	18	<0.011	<0.004	--	<0.011	<0.011	<0.004	<0.004	<0.004
82685	Propargite	18	<0.200	<0.013	--	<0.200	<0.023	<0.023	<0.013	<0.013
04035	Simazine	18	0.122	0.014	0.045	0.122	0.06	0.037	0.021	0.014
82670	Tebuthiuron	18	0.011	<0.010	0.008*	0.011	0.008	<0.016	<0.016	<0.010

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Alabama River at Claiborne, Alabama—January 1999 to December 2001 (Continued)

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82665	Terbacil (E)	18	<0.040	<0.007	--	<0.040	<0.034	<0.007	<0.007	<0.007
82675	Terbufos	18	<0.017	<0.013	--	<0.017	<0.017	<0.013	<0.013	<0.013
82681	Thiobencarb	18	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
82678	Triallate	18	<0.010	<0.001	--	<0.010	<0.002	<0.002	<0.001	<0.001
82661	Trifluralin	18	0.014	<0.002	--	0.014	<0.009	<0.009	<0.002	<0.002

Alabama River at Claiborne, Alabama—January 2000 to December 2001

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	9	0.127	<0.077	0.068*	0.127	0.064	0.042	<0.077	<0.077
50470	2,4-D methyl ester	9	<0.086	<0.086	--	<0.086	<0.086	<0.086	<0.086	<0.086
38746	2,4-DB (E)	9	<0.054	<0.054	--	<0.054	<0.054	<0.054	<0.054	<0.054
50355	2-hydroxyatrazine (E)	9	0.014	<0.193	--	0.014	<0.193	<0.193	<0.193	<0.193
61692	3,4-chlorophenyl-1-methyl urea	9	<0.091	<0.091	--	<0.091	<0.091	<0.091	<0.091	<0.091
49308	3-hydroxycarbofuran	9	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
50295	3-ketocarbofuran (E)	9	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	9	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
49312	Aldicarb (E)	9	<0.082	<0.082	--	<0.082	<0.082	<0.082	<0.082	<0.082
49313	Aldicarb sulfone (E)	9	<0.160	<0.160	--	<0.160	<0.160	<0.160	<0.160	<0.160
49314	Aldicarb sulfoxide (E)	8	<0.027	<0.027	--	<0.027	<0.027	<0.027	<0.027	<0.027
50299	Bendiocarb	9	<0.061	<0.061	--	<0.061	<0.061	<0.061	<0.061	<0.061
50300	Benomyl	9	<0.022	<0.022	--	<0.022	<0.022	<0.022	<0.022	<0.022
61693	Bensulfuron-methyl	9	<0.048	<0.048	--	<0.048	<0.048	<0.048	<0.048	<0.048
38711	Bentazon (E)	9	<0.019	<0.019	--	<0.019	<0.019	<0.019	<0.019	<0.019
04029	Bromacil (E)	9	<0.081	<0.081	--	<0.081	<0.081	<0.081	<0.081	<0.081
49311	Bromoxynil (E)	9	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
50305	Caffeine	9	0.027	<0.080	--	0.027	0.023	<0.080	<0.080	<0.080
49310	Carbaryl	9	<0.063	<0.063	--	<0.063	<0.063	<0.063	<0.063	<0.063
49309	Carbofuran	9	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
61188	Chloramben, methyl ester (E)	9	0.045	<0.114	--	0.045	<0.114	<0.114	<0.114	<0.114
50306	Chlorimuron, ethyl	9	<0.037	<0.037	--	<0.037	<0.037	<0.037	<0.037	<0.037
49306	Chlorothalonil (E)	9	<0.049	<0.049	--	<0.049	<0.049	<0.049	<0.049	<0.049
49305	Clopyralid	9	<0.041	<0.041	--	<0.041	<0.041	<0.041	<0.041	<0.041
04031	Cycloate (E)	9	<0.054	<0.054	--	<0.054	<0.054	<0.054	<0.054	<0.054
49304	Dacthal mono-acid	9	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
04039	Deethyldeisopropyl-atrazine (E)	9	0.019	<0.060	--	0.019	<0.060	<0.060	<0.060	<0.060
04038	Deisopropylatrazine (E)	9	0.019	<0.074	--	0.019	0.008	<0.074	<0.074	<0.074
38442	Dicamba	9	<0.096	<0.096	--	<0.096	<0.096	<0.096	<0.096	<0.096
49302	Dichlorprop	9	<0.050	<0.050	--	<0.050	<0.050	<0.050	<0.050	<0.050
49301	Dinoseb	9	<0.043	<0.043	--	<0.043	<0.043	<0.043	<0.043	<0.043
04033	Diphenamid	9	<0.058	<0.058	--	<0.058	<0.058	<0.058	<0.058	<0.058

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Alabama River at Claiborne, Alabama—January 2000 to December 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter: Maximum	Minimum	Mean	95%	75%	50%	25%	5%
49300	Diuron	9	0.032	<0.079	0.020*	0.032	0.021	0.016	0.013	<0.079
49297	Fenuron	9	<0.073	<0.073	--	<0.073	<0.073	<0.073	<0.073	<0.073
61694	Flumetsulam (E)	9	<0.087	<0.087	--	<0.087	<0.087	<0.087	<0.087	<0.087
38811	Fluometuron	9	0.006	<0.062	--	0.006	<0.062	<0.062	<0.062	<0.062
50356	Imazaquin (E)	9	<0.103	<0.103	--	<0.103	<0.103	<0.103	<0.103	<0.103
50407	Imazethapyr (E)	7	<0.088	<0.088	--	<0.088	<0.088	<0.088	<0.088	<0.088
61695	Imidacloprid	9	<0.106	<0.106	--	<0.106	<0.106	<0.106	<0.106	<0.106
38478	Linuron	9	<0.069	<0.069	--	<0.069	<0.069	<0.069	<0.069	<0.069
38482	MCPA	9	<0.058	<0.058	--	<0.058	<0.058	<0.058	<0.058	<0.058
38487	MCPB (E)	9	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
50359	Metalaxyl	9	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
38501	Methiocarb (E)	9	<0.079	<0.079	--	<0.079	<0.079	<0.079	<0.079	<0.079
49296	Methomyl (E)	9	<0.077	<0.077	--	<0.077	<0.077	<0.077	<0.077	<0.077
61696	Methomyl oxime (E)	9	<0.010	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	9	0.045	<0.114	--	0.045	<0.114	<0.114	<0.114	<0.114
49294	Neburon	9	<0.075	<0.075	--	<0.075	<0.075	<0.075	<0.075	<0.075
50364	Nicosulfuron	9	<0.065	<0.065	--	<0.065	<0.065	<0.065	<0.065	<0.065
49293	Norflurazon (E)	9	<0.077	<0.077	--	<0.077	<0.077	<0.077	<0.077	<0.077
49292	Oryzalin	9	<0.071	<0.071	--	<0.071	<0.071	<0.071	<0.071	<0.071
38866	Oxamyl	9	<0.016	<0.016	--	<0.016	<0.016	<0.016	<0.016	<0.016
50410	Oxamyl oxime (E)	9	<0.064	<0.064	--	<0.064	<0.064	<0.064	<0.064	<0.064
49291	Picloram	9	<0.071	<0.071	--	<0.071	<0.071	<0.071	<0.071	<0.071
49236	Propham	9	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
50471	Propiconazole	9	<0.064	<0.064	--	<0.064	<0.064	<0.064	<0.064	<0.064
38538	Propoxur	9	<0.059	<0.059	--	<0.059	<0.059	<0.059	<0.059	<0.059
38548	Siduron	9	<0.093	<0.093	--	<0.093	<0.093	<0.093	<0.093	<0.093
50337	Sulfometruron-methyl	9	<0.039	<0.039	--	<0.039	<0.039	<0.039	<0.039	<0.039
04032	Terbacil (E)	9	<0.095	<0.095	--	<0.095	<0.095	<0.095	<0.095	<0.095
61159	Tribenuron-methyl (E)	8	<0.068	<0.068	--	<0.068	<0.068	<0.068	<0.068	<0.068
49235	Triclopyr	9	<0.101	<0.101	--	<0.101	<0.101	<0.101	<0.101	<0.101

Black Warrior River below Bankhead Lock and Dam near Bessemer, Alabama—January 1999 to December 2000

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter: Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	9	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
49260	Acetochlor	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
46342	Alachlor	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
39632	Atrazine	9	0.152	0.026	0.05	0.152	0.048	0.038	0.03	0.026
82673	Benfluralin	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
04028	Butylate	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	9	0.01	<0.003	--	0.01	0.007	<0.003	<0.003	<0.003
82674	Carbofuran (E)	9	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
38933	Chlorpyrifos	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Black Warrior River below Bankhead Lock and Dam near Bessemer, Alabama—January 1999 to December 2000 (Continued)										
NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
04041	Cyanazine	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82682	Dacthal (DCPA)	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
04040	Deethylatrazine (E)	9	0.01	0.004	0.008	0.01	0.01	0.008	0.007	0.004
34653	*p,p'*-DDE	9	0.004	<0.006	--	0.004	<0.006	<0.006	<0.006	<0.006
39572	Diazinon	9	0.011	<0.002	0.003*	0.011	0.004	0.002	<0.002	<0.002
39381	Dieldrin	9	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001
82677	Disulfoton	9	<0.017	<0.017	--	<0.017	<0.017	<0.017	<0.017	<0.017
82668	EPTC	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82672	Ethoprop	9	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
04095	Fonofox	9	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
39532	Malathion	9	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005
82686	Methyl azinphos (E)	9	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001
82667	Methyl parathion	9	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	9	0.022	0.001	0.006	0.022	0.006	0.005	0.003	0.001
82630	Metribuzin	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82671	Molinate	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82684	Napropamide	9	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39542	Parathion	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82669	Pebulate	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82683	Pendimethalin	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82687	*cis*-Permethrin	9	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	<0.005
82664	Phorate	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
04037	Prometon	9	0.01	<0.018	0.007*	0.01	0.008	0.007	0.005	<0.018
82676	Pronamide	9	0.003	<0.003	--	0.003	<0.003	<0.003	<0.003	<0.003
04024	Propachlor	9	<0.007	<0.007	--	<0.007	<0.007	<0.007	<0.007	<0.007
82679	Propanil	9	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82685	Propargite	8	<0.100	<0.013	--	<0.100	<0.013	<0.013	<0.013	<0.013
04035	Simazine	9	0.03	0.008	0.017	0.03	0.022	0.015	0.011	0.008
82670	Tebuthiuron	9	0.03	0.01	0.017	0.03	0.019	0.016	0.014	0.01
82665	Terbacil (E)	9	<0.007	<0.007	--	<0.007	<0.007	<0.007	<0.007	<0.007
82675	Terbufos	9	<0.013	<0.013	--	<0.013	<0.013	<0.013	<0.013	<0.013
82681	Thiobencarb	9	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82678	Triallate	9	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	<0.001
82661	Trifluralin	9	0.003	<0.002	--	0.003	<0.002	<0.002	<0.002	<0.002

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Bogue Chitto Creek near Memphis, Alabama—January 1999 to December 2001										
NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	52	<0.003	<0.002	--	<0.003	<0.003	<0.003	<0.002	<0.002
49260	Acetochlor	52	<0.007	<0.002	--	<0.004	<0.004	<0.002	<0.002	<0.002
46342	Alachlor	52	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	52	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
39632	Atrazine	52	201	0.038	13.415	152.8	3.715	0.535	0.105	0.047
82673	Benfluralin	52	0.001	<0.002	--	<0.010	<0.010	<0.002	<0.002	<0.002
04028	Butylate	52	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	52	0.035	<0.003	0.002*	0.008	<0.041	<0.003	<0.003	<0.003
82674	Carbofuran (E)	52	<0.040	<0.003	--	<0.020	<0.020	<0.003	<0.003	<0.003
38933	Chlorpyrifos	52	0.213	<0.004	0.017*	0.182	0.005	<0.005	<0.004	<0.004
04041	Cyanazine	52	5.54	<0.004	0.249*	1.03	0.082	0.008	<0.018	<0.004
82682	Dacthal (DCPA)	52	0.002	<0.002	--	<0.003	<0.003	<0.002	<0.002	<0.002
04040	Deethylatrazine (E)	52	2.33	0.005	0.398	1.858	0.449	0.123	0.036	0.022
34653	*p,p'*-DDE	52	<0.006	<0.002	--	<0.006	<0.006	<0.006	<0.002	<0.002
39572	Diazinon	52	0.011	<0.002	0.001*	0.005	<0.005	<0.002	<0.002	<0.002
39381	Dieldrin	52	<0.005	<0.001	--	<0.005	<0.005	<0.001	<0.001	<0.001
82677	Disulfoton	52	<0.021	<0.017	--	<0.021	<0.021	<0.017	<0.017	<0.017
82668	EPTC	52	<0.040	<0.002	--	<0.013	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	52	<0.009	<0.004	--	<0.009	<0.009	<0.004	<0.004	<0.004
82672	Ethoprop	52	<0.005	<0.003	--	<0.005	<0.005	<0.003	<0.003	<0.003
04095	Fonofox	52	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	52	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	52	<0.035	<0.002	--	<0.035	<0.035	<0.002	<0.002	<0.002
39532	Malathion	52	0.025	<0.005	--	0.015	<0.027	<0.005	<0.005	<0.005
82686	Methyl azinphos (E)	52	<0.050	<0.001	--	<0.050	<0.050	<0.001	<0.001	<0.001
82667	Methyl parathion	52	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	52	9.21	0.002	0.438	1.845	0.343	0.046	0.024	0.01
82630	Metribuzin	52	0.319	<0.004	--	0.089	<0.006	<0.004	<0.004	<0.004
82671	Molinate	52	13.9	<0.002	--	<0.020	<0.004	<0.004	<0.004	<0.002
82684	Napropamide	52	<0.007	<0.003	--	<0.007	<0.007	<0.003	<0.003	<0.003
39542	Parathion	52	<0.007	<0.004	--	<0.007	<0.007	<0.004	<0.004	<0.004
82669	Pebulate	52	<0.021	<0.002	--	<0.004	<0.004	<0.004	<0.002	<0.002
82683	Pendimethalin	52	0.26	<0.004	0.014*	0.069	<0.011	<0.004	<0.004	<0.004
82687	*cis*-Permethrin	52	<0.030	<0.005	--	<0.006	<0.006	<0.005	<0.005	<0.005
82664	Phorate	52	0.017	<0.002	--	<0.011	<0.011	<0.002	<0.002	<0.002
04037	Prometon	52	<0.018	<0.015	--	<0.018	<0.018	<0.018	<0.015	<0.015
82676	Pronamide	52	0.02	<0.003	--	<0.004	<0.004	<0.003	<0.003	<0.003
04024	Propachlor	52	<0.010	<0.007	--	<0.010	<0.010	<0.007	<0.007	<0.007
82679	Propanil	52	0.005	<0.004	--	<0.011	<0.011	<0.004	<0.004	<0.004
82685	Propargite	51	<0.130	<0.013	--	<0.090	<0.023	<0.013	<0.013	<0.013
04035	Simazine	51	0.898	<0.005	0.045*	0.081	0.033	0.023	<0.011	<0.005
82670	Tebuthiuron	52	0.087	<0.010	0.009*	0.013	0.007	<0.016	<0.010	<0.010
82665	Terbacil (E)	52	0.023	<0.007	--	<0.034	<0.034	<0.007	<0.007	<0.007

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Bogue Chitto Creek near Memphis, Alabama—January 1999 to December 2001 (Continued)										
NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82675	Terbufos	52	<0.017	<0.013	--	<0.017	<0.017	<0.013	<0.013	<0.013
82681	Thiobencarb	52	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
82678	Triallate	52	<0.002	<0.001	--	<0.002	<0.002	<0.001	<0.001	<0.001
82661	Trifluralin	52	0.039	<0.002	0.004*	0.021	<0.009	<0.002	<0.002	<0.002

Bogue Chitto Creek near Memphis, Alabama—January 2000 to December 2001										
NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	20	2.29	<0.022	0.216*	0.529	0.097	0.028	<0.077	<0.022
50470	2,4-D methyl ester	20	0.388	<0.009	--	0.069	<0.086	<0.086	<0.086	<0.009
38746	2,4-DB (E)	20	<0.054	<0.016	--	<0.054	<0.054	<0.054	<0.054	<0.016
50355	2-hydroxyatrazine (E)	20	3.42	<0.193	0.800*	2.085	1.048	0.46	0.162	<0.193
61692	3,4-chlorophenyl-1-methyl urea	20	0.037	<0.024	--	<0.091	<0.091	<0.091	<0.091	<0.024
49308	3-hydroxycarbofuran	20	<0.062	<0.006	--	<0.062	<0.062	<0.062	<0.062	<0.006
50295	3-ketocarbofuran (E)	20	<1.500	<0.072	--	<1.500	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	20	0.046	<0.007	--	0.027	<0.062	<0.062	<0.062	<0.007
49312	Aldicarb (E)	20	<0.082	<0.040	--	<0.082	<0.082	<0.082	<0.082	<0.040
49313	Aldicarb sulfone (E)	20	<0.160	<0.020	--	<0.160	<0.160	<0.160	<0.160	<0.020
49314	Aldicarb sulfoxide (E)	20	<0.027	<0.008	--	<0.027	<0.027	<0.027	<0.027	<0.008
50299	Bendiocarb	20	0.01	<0.025	--	<0.061	<0.061	<0.061	<0.061	<0.025
50300	Benomyl	20	<0.022	<0.004	--	<0.022	<0.022	<0.022	<0.022	<0.004
61693	Bensulfuron-methyl	20	<0.048	<0.016	--	<0.048	<0.048	<0.048	<0.048	<0.016
38711	Bentazon (E)	20	0.053	<0.011	0.010*	0.016	<0.019	<0.019	<0.019	<0.011
04029	Bromacil (E)	20	<0.081	<0.033	--	<0.081	<0.081	<0.081	<0.081	<0.033
49311	Bromoxynil (E)	20	<0.057	<0.017	--	<0.057	<0.057	<0.057	<0.057	<0.017
50305	Caffeine	20	0.039	<0.010	--	0.038	<0.080	<0.080	<0.080	<0.010
49310	Carbaryl	20	0.004	<0.028	--	<0.063	<0.063	<0.063	<0.063	<0.028
49309	Carbofuran	20	<0.057	<0.006	--	<0.057	<0.057	<0.057	<0.057	<0.006
61188	Chloramben, methyl ester (E)	20	0.036	<0.018	--	<0.114	<0.114	<0.114	<0.114	<0.018
50306	Chlorimuron, ethyl	20	<0.037	<0.010	--	<0.037	<0.037	<0.037	<0.037	<0.010
49306	Chlorothalonil (E)	20	<0.049	<0.035	--	<0.049	<0.049	<0.049	<0.049	<0.035
49305	Clopyralid	20	<0.041	<0.014	--	<0.041	<0.041	<0.041	<0.041	<0.014
04031	Cycloate (E)	20	<0.054	<0.013	--	<0.054	<0.054	<0.054	<0.054	<0.013
49304	Dacthal mono-acid	20	0.107	<0.012	--	<0.072	<0.072	<0.072	<0.072	<0.012
04039	Deethyldeisopropyl-atrazine (E)	20	0.127	<0.010	0.043*	0.078	0.049	<0.060	<0.060	<0.010
04038	Deisopropylatrazine (E)	20	0.64	<0.074	0.108*	0.391	0.103	0.018	<0.074	<0.074
38442	Dicamba	20	0.071	<0.013	--	<0.096	<0.096	<0.096	<0.096	<0.013
49302	Dichlorprop	20	<0.050	<0.014	--	<0.050	<0.050	<0.050	<0.050	<0.014
49301	Dinoseb	20	<0.043	<0.012	--	<0.043	<0.043	<0.043	<0.043	<0.012
04033	Diphenamid	20	<0.058	<0.026	--	<0.058	<0.058	<0.058	<0.058	<0.026
49300	Diuron	20	0.156	<0.015	0.022*	0.049	<0.079	<0.079	<0.079	<0.015
49297	Fenuron	20	<0.073	<0.032	--	<0.073	<0.073	<0.073	<0.073	<0.032

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Bogue Chitto Creek near Memphis, Alabama—January 2000 to December 2001 (Continued)

NWIS parame-ter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
61694	Flumetsulam (E)	20	0.056	<0.011	--	0.01	<0.087	<0.087	<0.087	<0.011
38811	Fluometuron	19	0.156	<0.031	0.039*	0.156	0.042	0.015	0.007	<0.062
50356	Imazaquin (E)	19	0.571	<0.016	0.051*	0.571	0.003	<0.103	<0.103	<0.016
50407	Imazethapyr (E)	18	0.103	<0.017	--	0.103	<0.088	<0.088	<0.088	<0.017
61695	Imidacloprid	20	<0.106	<0.007	--	<0.106	<0.106	<0.106	<0.106	<0.007
38478	Linuron	20	<0.069	<0.014	--	<0.069	<0.069	<0.069	<0.069	<0.014
38482	MCPA	20	<0.058	<0.016	--	<0.058	<0.058	<0.058	<0.058	<0.016
38487	MCPB (E)	20	<0.062	<0.015	--	<0.062	<0.062	<0.062	<0.062	<0.015
50359	Metalaxyl	20	0.039	<0.020	0.014*	0.02	0.005	<0.057	<0.057	<0.020
38501	Methiocarb (E)	20	<0.079	<0.008	--	<0.079	<0.079	<0.079	<0.079	<0.008
49296	Methomyl (E)	20	0.004	<0.004	--	<0.077	<0.077	<0.077	<0.077	<0.004
61696	Methomyl oxime (E)	20	<0.200	<0.010	--	<0.011	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	20	0.007	<0.025	--	<0.114	<0.114	<0.114	<0.114	<0.025
49294	Neburon	20	<0.075	<0.012	--	<0.075	<0.075	<0.075	<0.075	<0.012
50364	Nicosulfuron	20	0.216	<0.013	--	0.012	<0.065	<0.065	<0.065	<0.013
49293	Norflurazon (E)	20	<0.077	<0.016	--	<0.077	<0.077	<0.077	<0.077	<0.016
49292	Oryzalin	20	<0.071	<0.018	--	<0.071	<0.071	<0.071	<0.071	<0.018
38866	Oxamyl	20	<0.016	<0.012	--	<0.016	<0.016	<0.016	<0.016	<0.012
50410	Oxamyl oxime (E)	19	<0.064	<0.013	--	<0.064	<0.064	<0.064	<0.064	<0.013
49291	Picloram	20	<0.071	<0.020	--	<0.071	<0.071	<0.071	<0.071	<0.020
49236	Propham	20	<0.072	<0.010	--	<0.072	<0.072	<0.072	<0.072	<0.010
50471	Propiconazole	20	<0.064	<0.002	--	<0.064	<0.064	<0.064	<0.064	<0.002
38538	Propoxur	20	<0.059	<0.008	--	<0.059	<0.059	<0.059	<0.059	<0.008
38548	Siduron	20	<0.093	<0.017	--	<0.093	<0.093	<0.093	<0.093	<0.017
50337	Sulfometruron-methyl	20	<0.039	<0.009	--	<0.039	<0.039	<0.039	<0.039	<0.009
04032	Terbacil (E)	20	<0.095	<0.010	--	<0.095	<0.095	<0.095	<0.095	<0.010
61159	Tribenuron-methyl (E)	19	<0.068	<0.009	--	<0.068	<0.068	<0.068	<0.068	<0.009
49235	Triclopyr	20	0.094	<0.022	--	0.088	<0.101	<0.101	<0.101	<0.022

Cahaba River at Centreville, Alabama—January 1999 to September 2001

NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	40	<0.003	<0.002	--	<0.003	<0.003	<0.003	<0.003	<0.002
49260	Acetochlor	40	<0.004	<0.002	--	<0.004	<0.002	<0.002	<0.002	<0.002
46342	Alachlor	40	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	40	<0.005	<0.002	--	<0.005	<0.002	<0.002	<0.002	<0.002
39632	Atrazine	41	0.364	0.007	0.052	0.324	0.058	0.02	0.012	0.008
82673	Benfluralin	40	0.003	<0.002	--	<0.010	<0.002	<0.002	<0.002	<0.002
04028	Butylate	40	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	40	0.028	<0.003	0.004*	0.008	<0.041	<0.003	<0.003	<0.003
82674	Carbofuran (E)	40	<0.020	<0.003	--	<0.020	<0.003	<0.003	<0.003	<0.003
38933	Chlorpyrifos	40	0.025	<0.004	0.005*	0.017	0.005	<0.005	<0.004	<0.004
04041	Cyanazine	40	<0.018	<0.004	--	<0.018	<0.004	<0.004	<0.004	<0.004
82682	Dacthal (DCPA)	40	<0.003	<0.002	--	<0.003	<0.002	<0.002	<0.002	<0.002

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba River at Centreville, Alabama—January 1999 to September 2001 (Continued)											
NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
04040	Deethylatrazine (E)	40	0.021	<0.006	0.007*	0.017	0.008	0.005	0.004	<0.006
34653	*p,p'*-DDE	40	0.003	<0.002	--	<0.007	<0.006	<0.006	<0.006	<0.002
39572	Diazinon	40	0.051	<0.002	0.008*	0.025	0.01	0.003	<0.002	<0.002
39381	Dieldrin	40	<0.005	<0.001	--	<0.005	<0.001	<0.001	<0.001	<0.001
82677	Disulfoton	40	<0.021	<0.017	--	<0.021	<0.017	<0.017	<0.017	<0.017
82668	EPTC	40	<0.025	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	40	<0.009	<0.004	--	<0.009	<0.004	<0.004	<0.004	<0.004
82672	Ethoprop	40	<0.005	<0.003	--	<0.005	<0.003	<0.003	<0.003	<0.003
04095	Fonofox	40	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	40	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	40	<0.035	<0.002	--	<0.035	<0.002	<0.002	<0.002	<0.002
39532	Malathion	40	0.223	<0.005	--	<0.027	<0.005	<0.005	<0.005	<0.005
82686	Methyl azinphos (E)	40	<0.050	<0.001	--	<0.050	<0.001	<0.001	<0.001	<0.001
82667	Methyl parathion	40	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	40	0.013	<0.002	0.002*	0.007	<0.013	<0.002	<0.002	<0.002
82630	Metribuzin	40	<0.006	<0.004	--	<0.006	<0.004	<0.004	<0.004	<0.004
82671	Molinate	40	0.003	<0.002	--	<0.004	<0.004	<0.004	<0.004	<0.002
82684	Napropamide	40	<0.007	<0.003	--	<0.007	<0.003	<0.003	<0.003	<0.003
39542	Parathion	40	<0.007	<0.004	--	<0.007	<0.004	<0.004	<0.004	<0.004
82669	Pebulate	40	<0.004	<0.002	--	<0.004	<0.004	<0.004	<0.004	<0.002
82683	Pendimethalin	40	0.025	<0.004	0.004*	0.012	<0.010	<0.004	<0.004	<0.004
82687	*cis*-Permethrin	40	<0.006	<0.005	--	<0.006	<0.005	<0.005	<0.005	<0.005
82664	Phorate	40	<0.011	<0.002	--	<0.011	<0.002	<0.002	<0.002	<0.002
04037	Prometon	40	0.011	<0.015	0.006*	0.008	0.006	0.004	<0.018	<0.015
82676	Pronamide	40	0.033	<0.003	0.004*	0.01	0.004	<0.003	<0.003	<0.003
04024	Propachlor	40	<0.010	<0.007	--	<0.010	<0.007	<0.007	<0.007	<0.007
82679	Propanil	40	<0.011	<0.004	--	<0.011	<0.004	<0.004	<0.004	<0.004
82685	Propargite	37	<0.090	<0.013	--	<0.040	<0.023	<0.013	<0.013	<0.013
04035	Simazine	40	1.14	0.008	0.15	0.821	0.161	0.038	0.021	0.01
82670	Tebuthiuron	41	0.023	<0.010	0.010*	0.019	0.011	0.01	0.007	<0.010
82665	Terbacil (E)	40	<0.034	<0.007	--	<0.034	<0.007	<0.007	<0.007	<0.007
82675	Terbufos	40	<0.017	<0.013	--	<0.017	<0.013	<0.013	<0.013	<0.013
82681	Thiobencarb	40	<0.005	<0.002	--	<0.005	<0.002	<0.002	<0.002	<0.002
82678	Triallate	40	<0.002	<0.001	--	<0.002	<0.001	<0.001	<0.001	<0.001
82661	Trifluralin	40	0.005	<0.002	--	0.001	<0.009	<0.002	<0.002	<0.002

Cahaba River at Centreville, Alabama—January 2000 to September 2001										
NWIS parame-ter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	18	0.444	<0.022	0.074*	0.444	0.067	<0.077	<0.077	<0.077
50470	2,4-D methyl ester	18	0.016	<0.009	--	0.016	<0.086	<0.086	<0.086	<0.086
38746	2,4-DB (E)	18	<0.054	<0.016	--	<0.054	<0.054	<0.054	<0.054	<0.054
50355	2-hydroxyatrazine (E)	18	0.057	<0.193	0.016*	0.057	0.012	<0.193	<0.193	<0.193
61692	3,4-chlorophenyl-1-methyl urea	18	<0.091	<0.024	--	<0.091	<0.091	<0.091	<0.091	<0.091

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba River at Centreville, Alabama—January 2000 to September 2001 (Continued)											
NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter								
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
49308	3-hydroxycarbofuran	18	<0.062	<0.006	--	<0.062	<0.062	<0.062	<0.062	<0.062
50295	3-ketocarbofuran (E)	18	<1.500	<0.072	--	<1.500	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	18	<0.062	<0.007	--	<0.062	<0.062	<0.062	<0.062	<0.062
49312	Aldicarb (E)	18	<0.082	<0.040	--	<0.082	<0.082	<0.082	<0.082	<0.082
49313	Aldicarb sulfone (E)	18	<0.160	<0.020	--	<0.160	<0.160	<0.160	<0.160	<0.160
49314	Aldicarb sulfoxide (E)	17	<0.027	<0.008	--	<0.027	<0.027	<0.027	<0.027	<0.027
50299	Bendiocarb	18	<0.061	<0.025	--	<0.061	<0.061	<0.061	<0.061	<0.061
50300	Benomyl	18	0.009	<0.004	--	0.009	<0.022	<0.022	<0.022	<0.022
61693	Bensulfuron-methyl	18	<0.048	<0.016	--	<0.048	<0.048	<0.048	<0.048	<0.048
38711	Bentazon (E)	18	0.003	<0.011	--	0.003	<0.019	<0.019	<0.019	<0.019
04029	Bromacil (E)	18	0.011	<0.081	--	0.011	<0.081	<0.081	<0.081	<0.081
49311	Bromoxynil (E)	18	<0.057	<0.017	--	<0.057	<0.057	<0.057	<0.057	<0.057
50305	Caffeine	17	0.109	<0.080	0.041*	0.109	0.045	0.017	<0.080	<0.080
49310	Carbaryl	18	0.004	<0.028	--	0.004	<0.063	<0.063	<0.063	<0.063
49309	Carbofuran	18	<0.057	<0.006	--	<0.057	<0.057	<0.057	<0.057	<0.057
61188	Chloramben, methyl ester (E)	18	<0.114	<0.018	--	<0.114	<0.114	<0.114	<0.114	<0.114
50306	Chlorimuron, ethyl	18	<0.037	<0.010	--	<0.037	<0.037	<0.037	<0.037	<0.037
49306	Chlorothalonil (E)	18	0.627	<0.035	--	0.627	<0.049	<0.049	<0.049	<0.049
49305	Clopyralid	18	0.019	<0.014	--	0.019	<0.041	<0.041	<0.041	<0.041
04031	Cycloate (E)	18	<0.054	<0.013	--	<0.054	<0.054	<0.054	<0.054	<0.054
49304	Dacthal mono-acid	18	<0.072	<0.012	--	<0.072	<0.072	<0.072	<0.072	<0.072
04039	Deethyldeisopropyl-atrazine (E)	18	0.038	<0.010	0.020*	0.038	0.021	<0.150	<0.060	<0.060
04038	Deisopropylatrazine (E)	18	0.058	<0.044	0.021*	0.058	0.025	0.01	<0.074	<0.074
38442	Dicamba	18	0.029	<0.013	--	0.029	<0.096	<0.096	<0.096	<0.096
49302	Dichlorprop	18	0.016	<0.014	--	0.016	<0.050	<0.050	<0.050	<0.050
49301	Dinoseb	18	<0.043	<0.012	--	<0.043	<0.043	<0.043	<0.043	<0.043
04033	Diphenamid	18	<0.058	<0.026	--	<0.058	<0.058	<0.058	<0.058	<0.058
49300	Diuron	18	0.361	<0.079	0.057*	0.361	0.071	0.014	<0.079	<0.079
49297	Fenuron	18	<0.073	<0.032	--	<0.073	<0.073	<0.073	<0.073	<0.073
61694	Flumetsulam (E)	18	<0.087	<0.011	--	<0.087	<0.087	<0.087	<0.087	<0.087
38811	Fluometuron	18	<0.062	<0.031	--	<0.062	<0.062	<0.062	<0.062	<0.062
50356	Imazaquin (E)	16	0.153	<0.016	--	0.153	<0.103	<0.103	<0.103	<0.103
50407	Imazethapyr (E)	14	0.041	<0.017	--	0.041	<0.088	<0.088	<0.088	<0.088
61695	Imidacloprid	18	0.014	<0.007	--	0.014	<0.106	<0.106	<0.106	<0.106
38478	Linuron	18	<0.069	<0.014	--	<0.069	<0.069	<0.069	<0.069	<0.069
38482	MCPA	18	0.092	<0.016	0.032*	0.092	0.032	<0.058	<0.058	<0.058
38487	MCPB (E)	18	<0.062	<0.015	--	<0.062	<0.062	<0.062	<0.062	<0.062
50359	Metalaxyl	17	0.004	<0.057	--	0.004	<0.057	<0.057	<0.057	<0.057
38501	Methiocarb (E)	18	<0.079	<0.008	--	<0.079	<0.079	<0.079	<0.079	<0.079
49296	Methomyl (E)	18	<0.077	<0.004	--	<0.077	<0.077	<0.077	<0.077	<0.077
61696	Methomyl oxime (E)	18	<0.200	<0.010	--	<0.200	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	18	<0.114	<0.025	--	<0.114	<0.114	<0.114	<0.114	<0.114

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba River at Centreville, Alabama—January 2000 to September 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
49294	Neburon	18	<0.075	<0.012	--	<0.075	<0.075	<0.075	<0.075	<0.075
50364	Nicosulfuron	18	<0.065	<0.013	--	<0.065	<0.065	<0.065	<0.065	<0.065
49293	Norflurazon (E)	18	<0.077	<0.016	--	<0.077	<0.077	<0.077	<0.077	<0.077
49292	Oryzalin	18	0.067	<0.018	--	0.067	<0.071	<0.071	<0.071	<0.071
38866	Oxamyl	18	<0.016	<0.012	--	<0.016	<0.016	<0.016	<0.016	<0.016
50410	Oxamyl oxime (E)	18	<0.064	<0.013	--	<0.064	<0.064	<0.064	<0.064	<0.064
49291	Picloram	18	<0.071	<0.020	--	<0.071	<0.071	<0.071	<0.071	<0.071
49236	Propham	18	<0.072	<0.010	--	<0.072	<0.072	<0.072	<0.072	<0.072
50471	Propiconazole	18	<0.064	<0.021	--	<0.064	<0.064	<0.064	<0.064	<0.064
38538	Propoxur	18	<0.059	<0.008	--	<0.059	<0.059	<0.059	<0.059	<0.059
38548	Siduron	18	0.004	<0.017	--	0.004	<0.093	<0.093	<0.093	<0.093
50337	Sulfometruron-methyl	18	0.02	<0.009	--	0.02	<0.039	<0.039	<0.039	<0.039
04032	Terbacil (E)	18	<0.095	<0.010	--	<0.095	<0.095	<0.095	<0.095	<0.095
61159	Tribenuron-methyl (E)	18	<0.068	<0.009	--	<0.068	<0.068	<0.068	<0.068	<0.068
49235	Triclopyr	18	0.12	<0.022	0.062*	0.12	0.053	<0.101	<0.101	<0.101

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 1999 to December 2001

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	63	<0.003	<0.002	--	<0.003	<0.003	<0.003	<0.003	<0.002
49260	Acetochlor	63	<0.004	<0.002	--	<0.004	<0.002	<0.002	<0.002	<0.002
46342	Alachlor	63	0.018	<0.002	--	0.004	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	63	<0.005	<0.002	--	<0.005	<0.002	<0.002	<0.002	<0.002
39632	Atrazine	65	0.682	0.007	0.047	0.165	0.035	0.026	0.017	0.009
82673	Benfluralin	63	0.004	<0.002	--	<0.010	<0.010	<0.002	<0.002	<0.002
04028	Butylate	63	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	63	0.369	<0.003	0.017*	0.08	0.005	<0.003	<0.003	<0.003
82674	Carbofuran (E)	63	<0.020	<0.003	--	<0.020	<0.003	<0.003	<0.003	<0.003
38933	Chlorpyrifos	63	0.03	<0.004	0.004*	0.006	0.003	<0.004	<0.004	<0.004
04041	Cyanazine	63	<0.018	<0.004	--	<0.018	<0.004	<0.004	<0.004	<0.004
82682	Dacthal (DCPA)	63	<0.003	<0.002	--	<0.003	<0.002	<0.002	<0.002	<0.002
04040	Deethylatrazine (E)	64	0.093	0.005	0.014	0.046	0.012	0.011	0.009	0.006
34653	*p,p'*-DDE	63	<0.006	<0.002	--	<0.006	<0.006	<0.006	<0.006	<0.002
39572	Diazinon	63	0.087	<0.002	0.015*	0.046	0.015	0.008	0.005	<0.002
39381	Dieldrin	63	<0.005	<0.001	--	<0.005	<0.001	<0.001	<0.001	<0.001
82677	Disulfoton	63	<0.021	<0.017	--	<0.021	<0.017	<0.017	<0.017	<0.017
82668	EPTC	63	<0.005	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	63	<0.009	<0.004	--	<0.009	<0.004	<0.004	<0.004	<0.004
82672	Ethoprop	63	0.003	<0.003	--	<0.005	<0.003	<0.003	<0.003	<0.003
04095	Fonofox	63	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	63	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	63	<0.035	<0.002	--	<0.035	<0.002	<0.002	<0.002	<0.002
39532	Malathion	63	0.027	<0.005	0.004*	0.004	<0.027	<0.005	<0.005	<0.005
82686	Methyl azinphos (E)	63	<0.050	<0.001	--	<0.050	<0.001	<0.001	<0.001	<0.001

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 1999 to December 2001 (Continued)										
NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82667	Methyl parathion	63	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	63	0.012	<0.002	0.002*	0.005	<0.013	<0.002	<0.002	<0.002
82630	Metribuzin	63	<0.006	<0.004	--	<0.006	<0.004	<0.004	<0.004	<0.004
82671	Molinate	63	0.006	<0.002	--	<0.004	<0.004	<0.004	<0.004	<0.002
82684	Napropamide	63	<0.007	<0.003	--	<0.007	<0.003	<0.003	<0.003	<0.003
39542	Parathion	63	<0.007	<0.004	--	<0.007	<0.004	<0.004	<0.004	<0.004
82669	Pebulate	63	<0.004	<0.002	--	<0.004	<0.004	<0.004	<0.004	<0.002
82683	Pendimethalin	63	0.045	<0.004	0.007*	0.029	<0.010	<0.004	<0.004	<0.004
82687	*cis*-Permethrin	63	<0.006	<0.005	--	<0.006	<0.005	<0.005	<0.005	<0.005
82664	Phorate	63	<0.011	<0.002	--	<0.011	<0.002	<0.002	<0.002	<0.002
04037	Prometon	63	0.014	<0.015	0.006*	0.01	0.006	0.003	<0.018	<0.015
82676	Pronamide	63	0.066	<0.003	--	<0.015	<0.004	<0.003	<0.003	<0.003
04024	Propachlor	63	<0.010	<0.007	--	<0.010	<0.007	<0.007	<0.007	<0.007
82679	Propanil	63	0.008	<0.004	--	<0.011	<0.004	<0.004	<0.004	<0.004
82685	Propargite	55	<0.130	<0.013	--	<0.040	<0.023	<0.013	<0.013	<0.013
04035	Simazine	63	1.99	0.018	0.232	1.498	0.188	0.062	0.029	0.02
82670	Tebuthiuron	64	0.032	<0.006	0.006*	0.014	<0.077	<0.010	<0.010	<0.010
82665	Terbacil (E)	63	<0.034	<0.007	--	<0.034	<0.007	<0.007	<0.007	<0.007
82675	Terbufos	63	<0.017	<0.013	--	<0.017	<0.013	<0.013	<0.013	<0.013
82681	Thiobencarb	63	<0.005	<0.002	--	<0.005	<0.002	<0.002	<0.002	<0.002
82678	Triallate	63	<0.002	<0.001	--	<0.002	<0.001	<0.001	<0.001	<0.001
82661	Trifluralin	63	0.007	<0.002	0.002*	0.005	<0.009	<0.002	<0.002	<0.002

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 2000 to December 2001										
NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	25	0.628	<0.022	0.105*	0.488	0.05	<0.077	<0.077	<0.022
50470	2,4-D methyl ester	25	0.081	<0.009	--	0.023	<0.086	<0.086	<0.086	<0.009
38746	2,4-DB (E)	25	<0.054	<0.016	--	<0.054	<0.054	<0.054	<0.054	<0.016
50355	2-hydroxyatrazine (E)	25	0.083	<0.193	0.021*	0.055	0.022	0.009	<0.193	<0.193
61692	3,4-chlorophenyl-1-methyl urea	25	<0.091	<0.024	--	<0.091	<0.091	<0.091	<0.091	<0.024
49308	3-hydroxycarbofuran	25	<0.062	<0.006	--	<0.062	<0.062	<0.062	<0.062	<0.006
50295	3-ketocarbofuran (E)	25	<1.500	<0.072	--	<1.500	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	25	<0.062	<0.007	--	<0.062	<0.062	<0.062	<0.062	<0.007
49312	Aldicarb (E)	25	<0.100	<0.040	--	<0.082	<0.082	<0.082	<0.082	<0.040
49313	Aldicarb sulfone (E)	25	<0.160	<0.020	--	<0.160	<0.160	<0.160	<0.160	<0.020
49314	Aldicarb sulfoxide (E)	24	<0.027	<0.008	--	<0.027	<0.027	<0.027	<0.027	<0.008
50299	Bendiocarb	25	<0.061	<0.025	--	<0.061	<0.061	<0.061	<0.061	<0.025
50300	Benomyl	25	0.039	<0.004	--	0.018	<0.022	<0.022	<0.022	<0.004
61693	Bensulfuron-methyl	25	<0.048	<0.016	--	<0.048	<0.048	<0.048	<0.048	<0.016
38711	Bentazon (E)	24	<0.019	<0.011	--	<0.019	<0.019	<0.019	<0.019	<0.011
04029	Bromacil (E)	25	0.031	<0.033	--	<0.081	<0.081	<0.081	<0.081	<0.033
49311	Bromoxynil (E)	25	<0.057	<0.017	--	<0.057	<0.057	<0.057	<0.057	<0.017

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 2000 to December 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
50305	Caffeine	25	0.392	<0.010	0.085*	0.289	0.141	0.038	0.011	<0.010
49310	Carbaryl	25	0.065	<0.003	0.008*	0.01	<0.063	<0.063	<0.063	<0.028
49309	Carbofuran	25	<0.057	<0.006	--	<0.057	<0.057	<0.057	<0.057	<0.006
61188	Chloramben, methyl ester (E)	25	<0.114	<0.018	--	<0.114	<0.114	<0.114	<0.114	<0.018
50306	Chlorimuron, ethyl	25	<0.037	<0.010	--	<0.037	<0.037	<0.037	<0.037	<0.010
49306	Chlorothalonil (E)	25	<0.049	<0.035	--	<0.049	<0.049	<0.049	<0.049	<0.035
49305	Clopyralid	25	0.04	<0.014	--	0.034	<0.041	<0.041	<0.041	<0.014
04031	Cycloate (E)	25	<0.054	<0.013	--	<0.054	<0.054	<0.054	<0.054	<0.013
49304	Dacthal mono-acid	25	<0.072	<0.012	--	<0.072	<0.072	<0.072	<0.072	<0.012
04039	Deethyldeisopropyl-atrazine (E)	25	0.078	<0.010	0.025*	0.061	0.021	<0.060	<0.060	<0.010
04038	Deisopropylatrazine (E)	25	1.027	<0.044	0.090*	0.48	0.041	0.011	<0.074	<0.044
38442	Dicamba	25	0.212	<0.013	--	0.091	<0.096	<0.096	<0.096	<0.013
49302	Dichlorprop	25	0.056	<0.014	--	0.03	<0.050	<0.050	<0.050	<0.014
49301	Dinoseb	25	<0.043	<0.012	--	<0.043	<0.043	<0.043	<0.043	<0.012
04033	Diphenamid	25	0.007	<0.002	--	<0.058	<0.058	<0.058	<0.058	<0.026
49300	Diuron	25	0.065	<0.015	0.027*	0.06	0.02	<0.079	<0.079	<0.015
49297	Fenuron	25	<0.073	<0.032	--	<0.073	<0.073	<0.073	<0.073	<0.032
61694	Flumetsulam (E)	25	<0.087	<0.011	--	<0.087	<0.087	<0.087	<0.087	<0.011
38811	Fluometuron	25	0.005	<0.031	--	0.005	<0.062	<0.062	<0.062	<0.031
50356	Imazaquin (E)	23	0.215	<0.009	0.038*	0.157	<0.103	<0.103	<0.103	<0.016
50407	Imazethapyr (E)	21	<0.088	<0.017	--	<0.088	<0.088	<0.088	<0.088	<0.017
61695	Imidacloprid	25	0.04	<0.007	0.024*	0.036	<0.106	<0.106	<0.106	<0.007
38478	Linuron	25	<0.069	<0.014	--	<0.069	<0.069	<0.069	<0.069	<0.014
38482	MCPA	25	0.594	<0.016	0.063*	0.258	0.034	<0.058	<0.058	<0.016
38487	MCPB (E)	25	<0.062	<0.015	--	<0.062	<0.062	<0.062	<0.062	<0.015
50359	Metalaxyl	25	0.018	<0.002	0.007*	0.012	0.003	<0.057	<0.057	<0.020
38501	Methiocarb (E)	25	<0.079	<0.008	--	<0.079	<0.079	<0.079	<0.079	<0.008
49296	Methomyl (E)	25	<0.077	<0.004	--	<0.077	<0.077	<0.077	<0.077	<0.004
61696	Methomyl oxime (E)	25	<0.200	<0.010	--	<0.011	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	25	<0.200	<0.025	--	<0.114	<0.114	<0.114	<0.114	<0.025
49294	Neburon	25	0.003	<0.012	--	<0.075	<0.075	<0.075	<0.075	<0.012
50364	Nicosulfuron	25	<0.065	<0.013	--	<0.065	<0.065	<0.065	<0.065	<0.013
49293	Norflurazon (E)	25	<0.077	<0.016	--	<0.077	<0.077	<0.077	<0.077	<0.016
49292	Oryzalin	25	0.127	<0.018	--	0.111	<0.071	<0.071	<0.071	<0.018
38866	Oxamyl	25	<0.016	<0.012	--	<0.016	<0.016	<0.016	<0.016	<0.012
50410	Oxamyl oxime (E)	24	<0.064	<0.013	--	<0.064	<0.064	<0.064	<0.064	<0.013
49291	Picloram	25	<0.071	<0.020	--	<0.071	<0.071	<0.071	<0.071	<0.020
49236	Propham	25	<0.072	<0.010	--	<0.072	<0.072	<0.072	<0.072	<0.010
50471	Propiconazole	25	<0.064	<0.004	--	<0.064	<0.064	<0.064	<0.064	<0.009
38538	Propoxur	25	0.005	<0.003	--	0.004	<0.059	<0.059	<0.059	<0.008
38548	Siduron	25	0.007	<0.017	--	0.003	<0.093	<0.093	<0.093	<0.017
50337	Sulfometruron-methyl	25	0.067	<0.009	--	0.02	<0.039	<0.039	<0.039	<0.009

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Cahaba Valley Creek at Cross Creek Road at Pelham, Alabama—January 2000 to December 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
04032	Terbacil (E)	25	<0.100	<0.010	--	<0.095	<0.095	<0.095	<0.095	<0.010
61159	Tribenuron-methyl (E)	24	<0.068	<0.009	--	<0.068	<0.068	<0.068	<0.068	<0.009
49235	Triclopyr	25	0.116	<0.022	--	0.038	<0.101	<0.101	<0.101	<0.022

Chattooga River above Gaylesville, Alabama—January 1999 to December 2000

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	2	<0.003	<0.003	--	--	--	--	--	--
49260	Acetochlor	2	<0.002	<0.002	--	--	--	--	--	--
46342	Alachlor	2	<0.002	<0.002	--	--	--	--	--	--
34253	*Alpha*-HCH	2	<0.002	<0.002	--	--	--	--	--	--
39632	Atrazine	2	0.011	0.01	--	--	--	--	--	--
82673	Benfluralin	2	<0.002	<0.002	--	--	--	--	--	--
04028	Butylate	2	<0.002	<0.002	--	--	--	--	--	--
82680	Carbaryl (E)	2	0.005	<0.003	--	--	--	--	--	--
82674	Carbofuran (E)	2	<0.003	<0.003	--	--	--	--	--	--
38933	Chlorpyrifos	2	<0.004	<0.004	--	--	--	--	--	--
04041	Cyanazine	2	<0.004	<0.004	--	--	--	--	--	--
82682	Dacthal (DCPA)	2	<0.002	<0.002	--	--	--	--	--	--
04040	Deethylatrazine (E)	2	0.005	0.004	--	--	--	--	--	--
34653	*p,p'*-DDE	2	<0.006	<0.006	--	--	--	--	--	--
39572	Diazinon	2	0.006	<0.002	--	--	--	--	--	--
39381	Dieldrin	2	<0.001	<0.001	--	--	--	--	--	--
82677	Disulfoton	2	<0.017	<0.017	--	--	--	--	--	--
82668	EPTC	2	<0.002	<0.002	--	--	--	--	--	--
82663	Ethalfluralin	2	<0.004	<0.004	--	--	--	--	--	--
82672	Ethoprop	2	<0.003	<0.003	--	--	--	--	--	--
04095	Fonofox	2	<0.003	<0.003	--	--	--	--	--	--
39341	Lindane	2	<0.004	<0.004	--	--	--	--	--	--
82666	Linuron	2	<0.002	<0.002	--	--	--	--	--	--
39532	Malathion	2	<0.005	<0.005	--	--	--	--	--	--
82686	Methyl azinphos (E)	2	<0.001	<0.001	--	--	--	--	--	--
82667	Methyl parathion	2	<0.006	<0.006	--	--	--	--	--	--
39415	Metolachlor	2	0.004	<0.007	--	--	--	--	--	--
82630	Metribuzin	2	<0.004	<0.004	--	--	--	--	--	--
82671	Molinate	2	<0.004	<0.004	--	--	--	--	--	--
82684	Napropamide	2	<0.003	<0.003	--	--	--	--	--	--
39542	Parathion	2	<0.004	<0.004	--	--	--	--	--	--
82669	Pebulate	2	<0.004	<0.004	--	--	--	--	--	--
82683	Pendimethalin	2	<0.004	<0.004	--	--	--	--	--	--
82687	*cis*-Permethrin	2	<0.005	<0.005	--	--	--	--	--	--
82664	Phorate	2	<0.002	<0.002	--	--	--	--	--	--
04037	Prometon	2	0.007	0.006	--	--	--	--	--	--
82676	Pronamide	2	<0.003	<0.003	--	--	--	--	--	--

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
Chattooga River above Gaylesville, Alabama—January 1999 to December 2000 (Continued)										
04024	Propachlor	2	<0.007	<0.007	--	--	--	--	--	--
82679	Propanil	2	<0.004	<0.004	--	--	--	--	--	--
82685	Propargite	2	<0.030	<0.013	--	--	--	--	--	--
04035	Simazine	2	0.02	<0.005	--	--	--	--	--	--
82670	Tebuthiuron	2	0.011	<0.010	--	--	--	--	--	--
82665	Terbacil (E)	2	<0.007	<0.007	--	--	--	--	--	--
82675	Terbufos	2	<0.013	<0.013	--	--	--	--	--	--
82681	Thiobencarb	2	<0.002	<0.002	--	--	--	--	--	--
82678	Triallate	2	<0.001	<0.001	--	--	--	--	--	--
82661	Trifluralin	2	<0.002	<0.002	--	--	--	--	--	--

NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
Pintlalla Creek at Liberty Church Road near Pintlalla, Alabama—January 1999 to December 2000										
82660	2,6-diethylaniline	3	<0.003	<0.003	--	--	--	--	--	--
49260	Acetochlor	3	<0.002	<0.002	--	--	--	--	--	--
46342	Alachlor	3	<0.002	<0.002	--	--	--	--	--	--
34253	*Alpha*-HCH	3	<0.002	<0.002	--	--	--	--	--	--
39632	Atrazine	3	0.006	<0.001	--	--	--	--	--	--
82673	Benfluralin	3	<0.002	<0.002	--	--	--	--	--	--
04028	Butylate	3	<0.002	<0.002	--	--	--	--	--	--
82680	Carbaryl (E)	3	0.004	<0.003	--	--	--	--	--	--
82674	Carbofuran (E)	3	<0.003	<0.003	--	--	--	--	--	--
38933	Chlorpyrifos	3	<0.004	<0.004	--	--	--	--	--	--
04041	Cyanazine	3	<0.004	<0.004	--	--	--	--	--	--
82682	Dacthal (DCPA)	3	<0.002	<0.002	--	--	--	--	--	--
04040	Deethylatrazine (E)	3	<0.002	<0.002	--	--	--	--	--	--
34653	*p,p'*-DDE	3	<0.006	<0.006	--	--	--	--	--	--
39572	Diazinon	3	<0.002	<0.002	--	--	--	--	--	--
39381	Dieldrin	3	<0.001	<0.001	--	--	--	--	--	--
82677	Disulfoton	3	<0.017	<0.017	--	--	--	--	--	--
82668	EPTC	3	<0.002	<0.002	--	--	--	--	--	--
82663	Ethalfluralin	3	<0.004	<0.004	--	--	--	--	--	--
82672	Ethoprop	3	<0.003	<0.003	--	--	--	--	--	--
04095	Fonofox	3	<0.003	<0.003	--	--	--	--	--	--
39341	Lindane	3	<0.004	<0.004	--	--	--	--	--	--
82666	Linuron	3	<0.002	<0.002	--	--	--	--	--	--
39532	Malathion	3	<0.005	<0.005	--	--	--	--	--	--
82686	Methyl azinphos (E)	3	<0.001	<0.001	--	--	--	--	--	--
82667	Methyl parathion	3	<0.006	<0.006	--	--	--	--	--	--
39415	Metolachlor	3	<0.002	<0.002	--	--	--	--	--	--
82630	Metribuzin	3	<0.004	<0.004	--	--	--	--	--	--
82671	Molinate	3	<0.004	<0.004	--	--	--	--	--	--
82684	Napropamide	3	<0.003	<0.003	--	--	--	--	--	--

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Pintlalla Creek at Liberty Church Road near Pintlalla, Alabama—January 1999 to December 2000 (Continued)

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39542	Parathion	3	<0.004	<0.004	--	--	--	--	--	--
82669	Pebulate	3	<0.004	<0.004	--	--	--	--	--	--
82683	Pendimethalin	3	<0.004	<0.004	--	--	--	--	--	--
82687	*cis*-Permethrin	3	<0.005	<0.005	--	--	--	--	--	--
82664	Phorate	3	<0.002	<0.002	--	--	--	--	--	--
04037	Prometon	3	<0.018	<0.018	--	--	--	--	--	--
82676	Pronamide	3	<0.003	<0.003	--	--	--	--	--	--
4024	Propachlor	3	<0.007	<0.007	--	--	--	--	--	--
82679	Propanil	3	<0.004	<0.004	--	--	--	--	--	--
82685	Propargite	3	<0.013	<0.013	--	--	--	--	--	--
04035	Simazine	3	<0.005	<0.005	--	--	--	--	--	--
82670	Tebuthiuron	3	<0.010	<0.010	--	--	--	--	--	--
82665	Terbacil (E)	3	<0.007	<0.007	--	--	--	--	--	--
82675	Terbufos	3	<0.013	<0.013	--	--	--	--	--	--
82681	Thiobencarb	3	<0.002	<0.002	--	--	--	--	--	--
82678	Triallate	3	<0.001	<0.001	--	--	--	--	--	--
82661	Trifluralin	3	<0.002	<0.002	--	--	--	--	--	--

Threemile Branch at North Boulevard at Montgomery, Alabama—January 1999 to September 2001

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	28	<0.003	<0.002	--	<0.003	<0.003	<0.003	<0.002	<0.002
49260	Acetochlor	28	<0.004	<0.002	--	<0.004	<0.004	<0.002	<0.002	<0.002
46342	Alachlor	28	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	28	0.02	<0.002	--	0.001	<0.005	<0.002	<0.002	<0.002
39632	Atrazine	28	4.83	0.004	0.346	3.286	0.122	0.035	0.006	0.004
82673	Benfluralin	28	0.003	<0.002	--	0.001	<0.010	<0.010	<0.002	<0.002
04028	Butylate	28	<0.150	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	28	0.422	<0.003	0.039*	0.275	0.024	<0.041	<0.041	<0.003
82674	Carbofuran (E)	28	0.017	<0.003	--	0.003	<0.020	<0.010	<0.003	<0.003
38933	Chlorpyrifos	28	0.127	0.004	0.018	0.1	0.019	0.007	0.005	0.004
04041	Cyanazine	28	<0.018	<0.004	--	<0.018	<0.018	<0.004	<0.004	<0.004
82682	Dacthal (DCPA)	28	<0.003	<0.002	--	<0.003	<0.003	<0.002	<0.002	<0.002
04040	Deethylatrazine (E)	28	0.214	<0.006	0.020*	0.084	0.008	0.006	0.004	<0.006
34653	*p,p'*-DDE	28	<0.006	<0.002	--	<0.006	<0.006	<0.006	<0.002	<0.002
39572	Diazinon	28	1.01	<0.002	0.098*	0.364	0.064	0.022	0.008	<0.005
39381	Dieldrin	28	0.024	<0.001	0.012*	0.022	0.015	0.012	<0.020	<0.001
82677	Disulfoton	28	<0.021	<0.017	--	<0.021	<0.021	<0.017	<0.017	<0.017
82668	EPTC	28	<0.025	<0.002	--	<0.010	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	28	<0.009	<0.004	--	<0.009	<0.009	<0.004	<0.004	<0.004
82672	Ethoprop	28	<0.005	<0.003	--	<0.005	<0.005	<0.003	<0.003	<0.003
04095	Fonofox	28	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	28	0.009	<0.004	0.003*	0.005	<0.004	<0.004	<0.004	<0.004
82666	Linuron	28	<0.035	<0.002	--	<0.035	<0.035	<0.002	<0.002	<0.002

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Threemile Branch at North Boulevard at Montgomery, Alabama—January 1999 to September 2001 (Continued)										
NWIS parame-ter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39532	Malathion	28	9.58	<0.005	0.430*	0.665	0.076	0.014	<0.027	<0.005
82686	Methyl azinphos (E)	28	<0.050	<0.001	--	<0.050	<0.050	<0.001	<0.001	<0.001
82667	Methyl parathion	28	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	28	0.014	<0.013	0.005*	0.012	0.006	0.004	0.002	<0.013
82630	Metribuzin	28	<0.006	<0.004	--	<0.006	<0.006	<0.004	<0.004	<0.004
82671	Molinate	28	0.01	<0.002	--	<0.020	<0.004	<0.004	<0.002	<0.002
82684	Napropamide	28	<0.007	<0.003	--	<0.007	<0.007	<0.003	<0.003	<0.003
39542	Parathion	28	<0.007	<0.004	--	<0.007	<0.007	<0.004	<0.004	<0.004
82669	Pebulate	28	<0.020	<0.002	--	<0.004	<0.004	<0.004	<0.002	<0.002
82683	Pendimethalin	28	0.365	<0.004	0.030*	0.284	0.013	<0.010	<0.004	<0.004
82687	*cis*-Permethrin	28	<0.006	<0.005	--	<0.006	<0.006	<0.005	<0.005	<0.005
82664	Phorate	28	<0.011	<0.002	--	<0.011	<0.011	<0.002	<0.002	<0.002
04037	Prometon	28	0.044	<0.015	0.012*	0.029	0.018	0.005	<0.018	<0.015
82676	Pronamide	28	<0.008	<0.003	--	<0.004	<0.004	<0.003	<0.003	<0.003
04024	Propachlor	28	<0.010	<0.007	--	<0.010	<0.010	<0.007	<0.007	<0.007
82679	Propanil	28	<0.011	<0.004	--	<0.011	<0.011	<0.004	<0.004	<0.004
82685	Propargite	27	<0.040	<0.013	--	<0.023	<0.023	<0.023	<0.013	<0.013
04035	Simazine	28	7.13	<0.005	0.405*	1.06	0.129	0.013	0.007	<0.011
82670	Tebuthiuron	28	0.489	<0.010	0.065*	0.091	0.06	0.051	0.032	<0.010
82665	Terbacil (E)	28	0.036	<0.007	--	<0.034	<0.034	<0.007	<0.007	<0.007
82675	Terbufos	28	<0.017	<0.013	--	<0.017	<0.017	<0.013	<0.013	<0.013
82681	Thiobencarb	28	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
82678	Triallate	28	0.002	<0.001	--	<0.002	<0.002	<0.001	<0.001	<0.001
82661	Trifluralin	28	0.004	<0.002	0.002*	0.003	<0.009	<0.009	<0.002	<0.002

Threemile Branch at North Boulevard at Montgomery, Alabama—January 2000 to September 2001										
NWIS parame-ter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	14	74.6	<0.077	5.759*	74.572	0.568	0.308	<0.077	<0.077
50470	2,4-D methyl ester	14	0.266	<0.009	0.093*	0.266	0.067	<0.086	<0.086	<0.086
38746	2,4-DB (E)	14	0.02	<0.054	--	0.02	<0.054	<0.054	<0.054	<0.054
50355	2-hydroxyatrazine (E)	14	0.418	<0.008	0.080*	0.418	0.048	<0.193	<0.193	<0.193
61692	3,4-chlorophenyl-1-methyl urea	14	<0.091	<0.024	--	<0.091	<0.091	<0.091	<0.091	<0.091
49308	3-hydroxycarbofuran	14	<0.062	<0.006	--	<0.062	<0.062	<0.062	<0.062	<0.062
50295	3-ketocarbofuran (E)	14	<1.500	<0.072	--	<1.500	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	14	0.008	<0.007	--	0.008	<0.062	<0.062	<0.062	<0.062
49312	Aldicarb (E)	14	<0.082	<0.040	--	<0.082	<0.082	<0.082	<0.082	<0.082
49313	Aldicarb sulfone (E)	14	<0.160	<0.020	--	<0.160	<0.160	<0.160	<0.160	<0.160
49314	Aldicarb sulfoxide (E)	14	<0.027	<0.008	--	<0.027	<0.027	<0.027	<0.027	<0.027
50299	Bendiocarb	14	0.006	<0.025	--	0.006	<0.061	<0.061	<0.061	<0.061
50300	Benomyl	14	<0.022	<0.004	--	<0.022	<0.022	<0.022	<0.022	<0.022
61693	Bensulfuron-methyl	14	<0.048	<0.016	--	<0.048	<0.048	<0.048	<0.048	<0.048
38711	Bentazon (E)	14	0.005	<0.011	--	0.005	<0.019	<0.019	<0.019	<0.019

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Threemile Branch at North Boulevard at Montgomery, Alabama—January 2000 to September 2001 (Continued)										
NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
04029	Bromacil (E)	14	0.15	<0.081	0.098*	0.15	0.119	0.093	0.053	<0.081
49311	Bromoxynil (E)	14	<0.057	<0.017	--	<0.057	<0.057	<0.057	<0.057	<0.057
50305	Caffeine	14	5.25	<0.080	0.660*	5.247	0.562	0.064	<0.080	<0.080
49310	Carbaryl	14	0.093	<0.028	0.019*	0.093	0.009	<0.063	<0.063	<0.063
49309	Carbofuran	14	<0.057	<0.006	--	<0.057	<0.057	<0.057	<0.057	<0.057
61188	Chloramben, methyl ester (E)	14	<0.114	<0.018	--	<0.114	<0.114	<0.114	<0.114	<0.114
50306	Chlorimuron, ethyl	14	<0.037	<0.010	--	<0.037	<0.037	<0.037	<0.037	<0.037
49306	Chlorothalonil (E)	14	1.84	<0.035	--	1.839	<0.049	<0.049	<0.049	<0.049
49305	Clopyralid	14	<0.041	<0.014	--	<0.041	<0.041	<0.041	<0.041	<0.041
04031	Cycloate (E)	14	<0.054	<0.013	--	<0.054	<0.054	<0.054	<0.054	<0.054
49304	Dacthal mono-acid	14	<0.072	<0.012	--	<0.072	<0.072	<0.072	<0.072	<0.072
04039	Deethyldeisopropyl-atrazine (E)	14	0.062	<0.010	0.018*	0.062	0.01	<0.060	<0.060	<0.060
04038	Deisopropylatrazine (E)	14	0.359	<0.044	--	0.359	<0.074	<0.074	<0.074	<0.074
38442	Dicamba	14	0.638	<0.096	--	0.638	<0.096	<0.096	<0.096	<0.096
49302	Dichlorprop	14	<0.050	<0.014	--	<0.050	<0.050	<0.050	<0.050	<0.050
49301	Dinoseb	14	0.004	<0.012	--	0.004	<0.043	<0.043	<0.043	<0.043
04033	Diphenamid	14	<0.058	<0.026	--	<0.058	<0.058	<0.058	<0.058	<0.058
49300	Diuron	14	2.19	<0.015	0.344*	2.188	0.032	<0.079	<0.079	<0.079
49297	Fenuron	14	<0.073	<0.032	--	<0.073	<0.073	<0.073	<0.073	<0.073
61694	Flumetsulam (E)	14	<0.087	<0.011	--	<0.087	<0.087	<0.087	<0.087	<0.087
38811	Fluometuron	14	0.025	<0.031	--	0.025	<0.062	<0.062	<0.062	<0.062
50356	Imazaquin (E)	14	5.89	<0.016	--	5.891	0.094	<0.103	<0.103	<0.103
50407	Imazethapyr (E)	14	<0.088	<0.017	--	<0.088	<0.088	<0.088	<0.088	<0.088
61695	Imidacloprid	14	0.237	<0.007	--	0.237	<0.106	<0.106	<0.106	<0.106
38478	Linuron	14	<0.069	<0.014	--	<0.069	<0.069	<0.069	<0.069	<0.069
38482	MCPA	14	0.634	<0.016	0.132*	0.634	0.14	<0.058	<0.058	<0.058
38487	MCPB (E)	14	<0.062	<0.015	--	<0.062	<0.062	<0.062	<0.062	<0.062
50359	Metalaxyl	14	<0.057	<0.020	--	<0.057	<0.057	<0.057	<0.057	<0.057
38501	Methiocarb (E)	14	<0.079	<0.008	--	<0.079	<0.079	<0.079	<0.079	<0.079
49296	Methomyl (E)	14	<0.077	<0.004	--	<0.077	<0.077	<0.077	<0.077	<0.077
61696	Methomyl oxime (E)	14	<0.011	<0.010	--	<0.011	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	14	<0.114	<0.025	--	<0.114	<0.114	<0.114	<0.114	<0.114
49294	Neburon	14	<0.075	<0.012	--	<0.075	<0.075	<0.075	<0.075	<0.075
50364	Nicosulfuron	14	<0.065	<0.013	--	<0.065	<0.065	<0.065	<0.065	<0.065
49293	Norflurazon (E)	14	<0.077	<0.016	--	<0.077	<0.077	<0.077	<0.077	<0.077
49292	Oryzalin	14	0.089	<0.018	--	0.089	<0.071	<0.071	<0.071	<0.071
38866	Oxamyl	14	<0.016	<0.012	--	<0.016	<0.016	<0.016	<0.016	<0.016
50410	Oxamyl oxime (E)	14	<0.064	<0.013	--	<0.064	<0.064	<0.064	<0.064	<0.064
49291	Picloram	14	<0.071	<0.020	--	<0.071	<0.071	<0.071	<0.071	<0.071
49236	Propham	14	<0.072	<0.010	--	<0.072	<0.072	<0.072	<0.072	<0.072
50471	Propiconazole	14	<0.064	<0.021	--	<0.064	<0.064	<0.064	<0.064	<0.064
38538	Propoxur	14	0.03	<0.008	--	0.03	<0.059	<0.059	<0.059	<0.059

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Threemile Branch at North Boulevard at Montgomery, Alabama—January 2000 to September 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
38548	Siduron	14	<0.093	<0.017	--	<0.093	<0.093	<0.093	<0.093	<0.093
50337	Sulfometruron-methyl	14	0.051	<0.009	--	0.051	0.017	<0.039	<0.039	<0.039
04032	Terbacil	14	<0.095	<0.010	--	<0.095	<0.095	<0.095	<0.095	<0.095
61159	Tribenuron-methyl (E)	14	<0.068	<0.009	--	<0.068	<0.068	<0.068	<0.068	<0.068
49235	Triclopyr	14	0.088	<0.022	--	0.088	<0.101	<0.101	<0.101	<0.101

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama—January 1999 to December 2001

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
82660	2,6-diethylaniline	19	<0.003	<0.002	--	<0.003	<0.003	<0.003	<0.002	<0.002
49260	Acetochlor	19	0.016	<0.002	--	0.016	<0.004	<0.002	<0.002	<0.002
46342	Alachlor	19	0.013	<0.002	--	0.013	<0.002	<0.002	<0.002	<0.002
34253	*Alpha*-HCH	19	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
39632	Atrazine	19	2.86	0.018	0.295	2.86	0.225	0.102	0.042	0.018
82673	Benfluralin	19	<0.010	<0.002	--	<0.010	<0.010	<0.002	<0.002	<0.002
04028	Butylate	19	<0.002	<0.002	--	<0.002	<0.002	<0.002	<0.002	<0.002
82680	Carbaryl (E)	19	0.025	<0.003	--	0.025	<0.041	<0.041	<0.003	<0.003
82674	Carbofuran (E)	19	<0.020	<0.003	--	<0.020	<0.020	<0.003	<0.003	<0.003
38933	Chlorpyrifos	19	0.007	<0.004	--	0.007	<0.005	<0.005	<0.004	<0.004
04041	Cyanazine	19	0.021	<0.004	--	0.021	<0.018	<0.018	<0.004	<0.004
82682	Dacthal (DCPA)	19	<0.003	<0.002	--	<0.003	<0.003	<0.002	<0.002	<0.002
04040	Deethylatrazine (E)	19	0.073	<0.006	0.013*	0.073	0.014	0.011	0.003	<0.006
34653	*p,p'*-DDE	19	0.001	<0.002	--	0.001	<0.006	<0.006	<0.002	<0.002
39572	Diazinon	19	0.018	<0.002	0.006*	0.018	0.008	0.004	<0.002	<0.002
39381	Dieldrin	19	<0.005	<0.001	--	<0.005	<0.005	<0.001	<0.001	<0.001
82677	Disulfoton	19	<0.021	<0.017	--	<0.021	<0.021	<0.017	<0.017	<0.017
82668	EPTC	19	0.009	<0.002	--	0.009	<0.002	<0.002	<0.002	<0.002
82663	Ethalfluralin	19	<0.009	<0.004	--	<0.009	<0.009	<0.004	<0.004	<0.004
82672	Ethoprop	19	<0.005	<0.003	--	<0.005	<0.005	<0.003	<0.003	<0.003
04095	Fonofox	19	<0.003	<0.003	--	<0.003	<0.003	<0.003	<0.003	<0.003
39341	Lindane	19	<0.004	<0.004	--	<0.004	<0.004	<0.004	<0.004	<0.004
82666	Linuron	19	<0.035	<0.002	--	<0.035	<0.035	<0.002	<0.002	<0.002
39532	Malathion	19	<0.027	<0.005	--	<0.027	<0.027	<0.005	<0.005	<0.005
82686	Methyl azinphos (E)	19	<0.050	<0.001	--	<0.050	<0.050	<0.001	<0.001	<0.001
82667	Methyl parathion	19	<0.006	<0.006	--	<0.006	<0.006	<0.006	<0.006	<0.006
39415	Metolachlor	19	0.634	0.003	0.052	0.634	0.039	0.013	0.006	0.003
82630	Metribuzin	19	0.012	<0.004	--	0.012	<0.006	<0.006	<0.004	<0.004
82671	Molinate	19	<0.004	<0.002	--	<0.004	<0.004	<0.004	<0.002	<0.002
82684	Napropamide	19	<0.007	<0.003	--	<0.007	<0.007	<0.003	<0.003	<0.003
39542	Parathion	19	<0.007	<0.004	--	<0.007	<0.007	<0.004	<0.004	<0.004
82669	Pebulate	19	<0.004	<0.002	--	<0.004	<0.004	<0.004	<0.002	<0.002
82683	Pendimethalin	19	0.01	<0.004	--	0.01	<0.010	<0.010	<0.004	<0.004
82687	*cis*-Permethrin	19	<0.006	<0.005	--	<0.006	<0.006	<0.005	<0.005	<0.005
82664	Phorate	19	<0.011	<0.002	--	<0.011	<0.011	<0.002	<0.002	<0.002

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama—January 1999 to December 2001 (Continued)

NWIS parameter code	Compound (GC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
04037	Prometon	19	0.014	<0.015	0.007*	0.014	0.009	0.005	<0.018	<0.015
82676	Pronamide	19	<0.004	<0.003	--	<0.004	<0.004	<0.003	<0.003	<0.003
04024	Propachlor	19	<0.010	<0.007	--	<0.010	<0.010	<0.007	<0.007	<0.007
82679	Propanil	19	<0.011	<0.004	--	<0.011	<0.011	<0.004	<0.004	<0.004
82685	Propargite	18	<0.023	<0.013	--	<0.023	<0.023	<0.013	<0.013	<0.013
04035	Simazine	19	0.037	<0.005	0.015*	0.037	0.021	0.013	0.008	<0.010
82670	Tebuthiuron	19	0.026	<0.016	0.013*	0.026	0.013	0.011	0.008	<0.016
82665	Terbacil (E)	19	<0.034	<0.007	--	<0.034	<0.034	<0.020	<0.007	<0.007
82675	Terbufos	19	<0.017	<0.013	--	<0.017	<0.017	<0.013	<0.013	<0.013
82681	Thiobencarb	19	<0.005	<0.002	--	<0.005	<0.005	<0.002	<0.002	<0.002
82678	Triallate	19	<0.002	<0.001	--	<0.002	<0.002	<0.001	<0.001	<0.001
82661	Trifluralin	19	0.008	<0.002	--	0.008	<0.009	<0.009	<0.002	<0.002

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama—January 2000 to December 2001

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
39732	2,4-D	8	0.089	<0.077	--	0.089	0.048	<0.077	<0.077	<0.077
50470	2,4-D methyl ester	8	<0.086	<0.086	--	<0.086	<0.086	<0.086	<0.086	<0.086
38746	2,4-DB (E)	8	<0.054	<0.054	--	<0.054	<0.054	<0.054	<0.054	<0.054
50355	2-hydroxyatrazine (E)	8	0.058	<0.193	0.032*	0.058	0.031	0.018	<0.193	<0.193
61692	3,4-chlorophenyl-1-methyl urea	8	<0.091	<0.091	--	<0.091	<0.091	<0.091	<0.091	<0.091
49308	3-hydroxycarbofuran	8	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
50295	3-ketocarbofuran (E)	8	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
49315	Acifluorfen	8	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
49312	Aldicarb (E)	8	<0.082	<0.082	--	<0.082	<0.082	<0.082	<0.082	<0.082
49313	Aldicarb sulfone (E)	8	<0.160	<0.160	--	<0.160	<0.160	<0.160	<0.160	<0.160
49314	Aldicarb sulfoxide (E)	7	<0.027	<0.027	--	<0.027	<0.027	<0.027	<0.027	<0.027
50299	Bendiocarb	8	<0.061	<0.061	--	<0.061	<0.061	<0.061	<0.061	<0.061
50300	Benomyl	8	<0.022	<0.022	--	<0.022	<0.022	<0.022	<0.022	<0.022
61693	Bensulfuron-methyl	8	<0.048	<0.048	--	<0.048	<0.048	<0.048	<0.048	<0.048
38711	Bentazon (E)	8	0.028	<0.019	--	0.028	<0.019	<0.019	<0.019	<0.019
04029	Bromacil (E)	8	<0.081	<0.081	--	<0.081	<0.081	<0.081	<0.081	<0.081
49311	Bromoxynil (E)	8	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
50305	Caffeine	8	0.021	<0.080	--	0.021	0.015	<0.080	<0.080	<0.080
49310	Carbaryl	8	<0.063	<0.063	--	<0.063	<0.063	<0.063	<0.063	<0.063
49309	Carbofuran	8	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
61188	Chloramben, methyl ester (E)	8	<0.114	<0.114	--	<0.114	<0.114	<0.114	<0.114	<0.114
50306	Chlorimuron, ethyl	8	<0.037	<0.037	--	<0.037	<0.037	<0.037	<0.037	<0.037
49306	Chlorothalonil (E)	8	<0.049	<0.049	--	<0.049	<0.049	<0.049	<0.049	<0.049
49305	Clopyralid	8	<0.041	<0.041	--	<0.041	<0.041	<0.041	<0.041	<0.041
04031	Cycloate (E)	8	<0.054	<0.054	--	<0.054	<0.054	<0.054	<0.054	<0.054

Appendix 3. Summary statistics for pesticides in surface-water samples collected from the Mobile River Basin , 1999–2001—Continued

[NWIS, National Water Information System; GC/MS, gas chromatography/mass spectrometry; <, less than; --, no value; *, value is estimated by using a log-probability regression to predict values of data below the detection limit; E, estimated concentration; HPLC/MS, high-performance liquid chromatography/mass spectrometry]

Tombigbee River below Coffeeville Lock and Dam near Coffeeville, Alabama—January 2000 to December 2001 (Continued)

NWIS parameter code	Compound (HPLC/MS)	Number of samples	Concentration, in micrograms per liter							
			Maximum	Minimum	Mean	95%	75%	50%	25%	5%
49304	Dacthal mono-acid	8	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
04039	Deethyldeisopropyl-atrazine (E)	8	0.016	<0.060	--	0.016	<0.060	<0.060	<0.060	<0.060
04038	Deisopropylatrazine (E)	8	0.011	<0.074	--	0.011	<0.074	<0.074	<0.074	<0.074
38442	Dicamba	8	<0.096	<0.096	--	<0.096	<0.096	<0.096	<0.096	<0.096
49302	Dichlorprop	8	<0.050	<0.050	--	<0.050	<0.050	<0.050	<0.050	<0.050
49301	Dinoseb	8	<0.043	<0.043	--	<0.043	<0.043	<0.043	<0.043	<0.043
04033	Diphenamid	8	<0.058	<0.058	--	<0.058	<0.058	<0.058	<0.058	<0.058
49300	Diuron	8	0.034	<0.079	0.023*	0.034	0.03	0.016	0.011	0.011
49297	Fenuron	8	<0.073	<0.073	--	<0.073	<0.073	<0.073	<0.073	<0.073
61694	Flumetsulam (E)	8	<0.087	<0.087	--	<0.087	<0.087	<0.087	<0.087	<0.087
38811	Fluometuron	8	0.024	<0.062	--	0.024	<0.062	<0.062	<0.062	<0.062
50356	Imazaquin (E)	8	<0.103	<0.103	--	<0.103	<0.103	<0.103	<0.103	<0.103
50407	Imazethapyr (E)	6	<0.088	<0.088	--	<0.088	<0.088	<0.088	<0.088	<0.088
61695	Imidacloprid	8	<0.106	<0.106	--	<0.106	<0.106	<0.106	<0.106	<0.106
38478	Linuron	8	<0.069	<0.069	--	<0.069	<0.069	<0.069	<0.069	<0.069
38482	MCPA	8	<0.058	<0.058	--	<0.058	<0.058	<0.058	<0.058	<0.058
38487	MCPB (E)	8	<0.062	<0.062	--	<0.062	<0.062	<0.062	<0.062	<0.062
50359	Metalaxyl	8	<0.057	<0.057	--	<0.057	<0.057	<0.057	<0.057	<0.057
38501	Methiocarb (E)	8	<0.079	<0.079	--	<0.079	<0.079	<0.079	<0.079	<0.079
49296	Methomyl (E)	8	<0.077	<0.077	--	<0.077	<0.077	<0.077	<0.077	<0.077
61696	Methomyl oxime (E)	8	<0.010	<0.010	--	<0.010	<0.010	<0.010	<0.010	<0.010
61697	Metsulfuron-methyl (E)	8	<0.114	<0.114	--	<0.114	<0.114	<0.114	<0.114	<0.114
49294	Neburon	8	<0.075	<0.075	--	<0.075	<0.075	<0.075	<0.075	<0.075
50364	Nicosulfuron	8	<0.065	<0.065	--	<0.065	<0.065	<0.065	<0.065	<0.065
49293	Norflurazon (E)	8	<0.077	<0.077	--	<0.077	<0.077	<0.077	<0.077	<0.077
49292	Oryzalin	8	<0.071	<0.071	--	<0.071	<0.071	<0.071	<0.071	<0.071
38866	Oxamyl	8	<0.016	<0.016	--	<0.016	<0.016	<0.016	<0.016	<0.016
50410	Oxamyl oxime (E)	8	<0.064	<0.064	--	<0.064	<0.064	<0.064	<0.064	<0.064
49291	Picloram	8	<0.071	<0.071	--	<0.071	<0.071	<0.071	<0.071	<0.071
49236	Propham	8	<0.072	<0.072	--	<0.072	<0.072	<0.072	<0.072	<0.072
50471	Propiconazole	8	<0.064	<0.064	--	<0.064	<0.064	<0.064	<0.064	<0.064
38538	Propoxur	8	<0.059	<0.059	--	<0.059	<0.059	<0.059	<0.059	<0.059
38548	Siduron	8	<0.093	<0.093	--	<0.093	<0.093	<0.093	<0.093	<0.093
50337	Sulfometruron-methyl	8	0.021	<0.039	--	0.021	<0.039	<0.039	<0.039	<0.039
04032	Terbacil	8	0.026	<0.095	--	0.026	<0.095	<0.095	<0.095	<0.095
61159	Tribenuron-methyl (E)	7	<0.068	<0.068	--	<0.068	<0.068	<0.068	<0.068	<0.068
49235	Triclopyr	8	<0.101	<0.101	--	<0.101	<0.101	<0.101	<0.101	<0.101