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Kentucky Energy and Environment Cabinet–Kentucky Division of Water

Trends in Surface-Water Quality at Selected Ambient-Monitoring Network Stations in Kentucky, 1979–2004

Scientific Investigations Report 2009–5027

U.S. Department of the Interior
U.S. Geological Survey

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KEN SALAZAR, Secretary

U.S. Geological Survey
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U.S. Geological Survey, Reston, Virginia: 2009

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 This work was supported, in part, by a grant from the U.S. Environmental Protection Agency under §319(h) of the Clean Water Act through the Kentucky Division of Water, Grant # C9994861-05 KY.

Suggested citation:
Crain, Angela S., and Martin, Gary R., 2009, Trends in surface-water quality at selected ambient-network stations in Kentucky, 1979–2004: U.S. Geological Survey Scientific Investigations Report 2009–5027, 61 p.

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Conversion Factors, Abbreviations, and Acronyms

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
yard (yd)	0.9144	meter (m)
meter (m)	39.370	inch (in.)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Flow rate	
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meter per second per square kilometer [(m^3/s)/km^2]

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

$$°F=(1.8×°C)+32$$

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

$$°C=(°F-32)/1.8$$

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (µS/cm at 25°C).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Concentrations of chemical constituents in water are in milligrams per liter (mg/L), iron and manganese in water given in micrograms per liter, hardness given in milligrams per liter as $CaCO_3$.

Abbreviations and Acronyms

BMU	Basin Management Unit
KDOW	Kentucky Division of Water
LOC	line of organic correlation
NH4-N	ammonia-nitrogen
NLCD	National Land Cover Data
NO2 + NO3-N	nitrite plus nitrate-nitrogen
OLS	ordinary-least-squares
STORET	Storage and Retrieval water-quality database
TKN	total Kjeldahl nitrogen
TN	total nitrogen
TP	total phosphorus
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Trends in Surface-Water Quality at Selected Ambient-Monitoring Network Stations in Kentucky, 1979–2004

By Angela S. Crain and Gary R. Martin

Abstract

Increasingly complex water-management decisions require water-quality monitoring programs that provide data for multiple purposes, including trend analyses, to detect improvement or deterioration in water quality with time. Understanding surface-water-quality trends assists resource managers in identifying emerging water-quality concerns, planning remediation efforts, and evaluating the effectiveness of the remediation. This report presents the results of a study conducted by the U.S. Geological Survey, in cooperation with the Kentucky Energy and Environment Cabinet–Kentucky Division of Water, to analyze and summarize long-term water-quality trends of selected properties and water-quality constituents in selected streams in Kentucky's ambient stream water-quality monitoring network.

Trends in surface-water quality for 15 properties and water-quality constituents were analyzed at 37 stations with drainage basins ranging in size from 62 to 6,431 square miles. Analyses of selected physical properties (temperature, specific conductance, pH, dissolved oxygen, hardness, and suspended solids), for major ions (chloride and sulfate), for selected metals (iron and manganese), for nutrients (total phosphorus, total nitrogen, total Kjeldahl nitrogen, nitrite plus nitrate), and for fecal coliform were compiled from the Commonwealth's ambient water-quality monitoring network. Trend analyses were completed using the S-Plus statistical software program S-Estimate Trend (S-ESTREND), which detects trends in water-quality data. The trend-detection techniques supplied by this software include the Seasonal Kendall nonparametric methods for use with uncensored data or data censored with only one reporting limit and the Tobit-regression parametric method for use with data censored with multiple reporting limits. One of these tests was selected for each property and water-quality constituent and applied to all station records so that results of the trend procedure could be compared among stations. Flow-adjustment procedures were used with these techniques at all stations to remove the effects of streamflow on water-quality variability. Flow adjustments were used for all constituents, except temperature. A decreasing trend indicates a decrease in concentration of a particular constituent; whereas, an increasing trend indicates an increase in concentration and potential degradation in water quality.

Trend results varied statewide by station and by physical property and water-quality constituent. The results for all stations and all physical properties and water-quality constituents examined had at least one statistically significant (p-value <0.05) increasing or decreasing trend during the specified period of record. Water temperature and concentrations of dissolved oxygen had no significant decreasing trends at any station. Water temperature had one significant increasing trend at the South Fork Cumberland River near Blue Heron station. Specific conductance and concentrations of hardness had one significant decreasing trend at the South Fork Cumberland River near Blue Heron station. pH also had a significant decreasing trend at the Mud River near Gus station. Concentrations of total suspended solids had 1 increasing trend at the Kentucky River at High Bridge station and 10 decreasing trends with 5 of those stations located in the Cumberland River Basin.

Major ions analyzed for trends included chloride and sulfate. Concentrations of chloride at the 37 stations had increasing trends at 15 stations, decreasing trends at 3 stations, and no significant trend in concentration over time at 19 stations. Most of the increasing trends in concentrations of chloride are located in the northern part of Kentucky, possibly indicating an increase in the use of road salts for road deicing and (or) the result of resource extraction (oil, gas, and coal). Increasing trends of sulfate concentrations were detected at seven stations, all located in the Appalachian Region of eastern Kentucky, where water quality in streams is potentially affected by surface mining. Two stations with the largest median concentrations of sulfate had no trend.

Concentrations of total iron had statistically significant increasing (one station) and decreasing (four stations) trends scattered in the eastern part of Kentucky, where high concentrations of total iron are common. The Tygarts Creek near Lynn station had a significant increasing trend in total iron; although, an explanation for this increase is beyond the scope of this report. Five stations had median concentrations of total iron greater than 1,000 micrograms per liter, but none had a statistically significant trend. Concentrations of total manganese had increasing trends at 2 stations, decreasing trends at 13 stations, and no significant trend in concentration over time at 22 stations. All six monitoring stations in the Cumberland River Basin had decreasing concentrations of total manganese,

possibly because of a decline in coal extraction. The median concentration of total manganese exceeded the U.S. Environmental Protection Agency's secondary drinking-water standard (50 micrograms per liter) for total manganese at 29 stations. Eleven of these stations had decreasing trends, 2 stations had increasing trends, and 16 stations had no trend in concentrations of total manganese.

Trend analysis for all nitrogen constituents analyzed indicated no trends at 25 stations. Concentrations of total nitrogen had two significant increasing trends at the Little Sandy at Argillite station and at the Little River near Cadiz station. Trend analysis for concentrations of total phosphorus had 14 decreasing trends and 4 increasing trends. Three of the four stations with increasing trends in total phosphorus were located in the Kentucky River Basin; the other station, Green River near Woodbury, was located in the Green River Basin. Trends for concentrations of ammonia were not performed because concentrations of ammonia were highly censored (> 50 percent) for the majority of stations.

Trend analysis for concentrations of fecal coliform showed 16 significant decreasing trends and 3 significant increasing trends, statewide. Every major drainage basin had at least one station with a significant decreasing trend in concentration of fecal coliform, except the Middle Ohio–Little Miami River Basin. This basin only contains one ambient water-quality monitoring network station, (Kinniconick Creek near Tannery.

Introduction

The quality of water in Kentucky streams is an important natural resource for the Commonwealth of Kentucky with over 90,000 mi of streams (Kentucky Energy and Environment Cabinet, 2008a). Human health and the health of terrestrial and aquatic life are affected by the quality of water in Kentucky streams. Complex water-management decisions increasingly require water-quality monitoring programs that provide data for multiple purposes, including trend analyses to detect if water quality has improved, deteriorated, or remained constant (stable) with time.

The Kentucky Energy and Environment Cabinet–Kentucky Division of Water has the responsibility of monitoring the surface-water quality of Kentucky streams. This is a difficult and expensive task, considering the large number of constituents and stations that need to be monitored. Thus, the need to monitor trends in water quality must be balanced against the increasing costs of monitoring programs. A suitable way to assist with balancing costs is through the analysis of long-term water-quality data for trends.

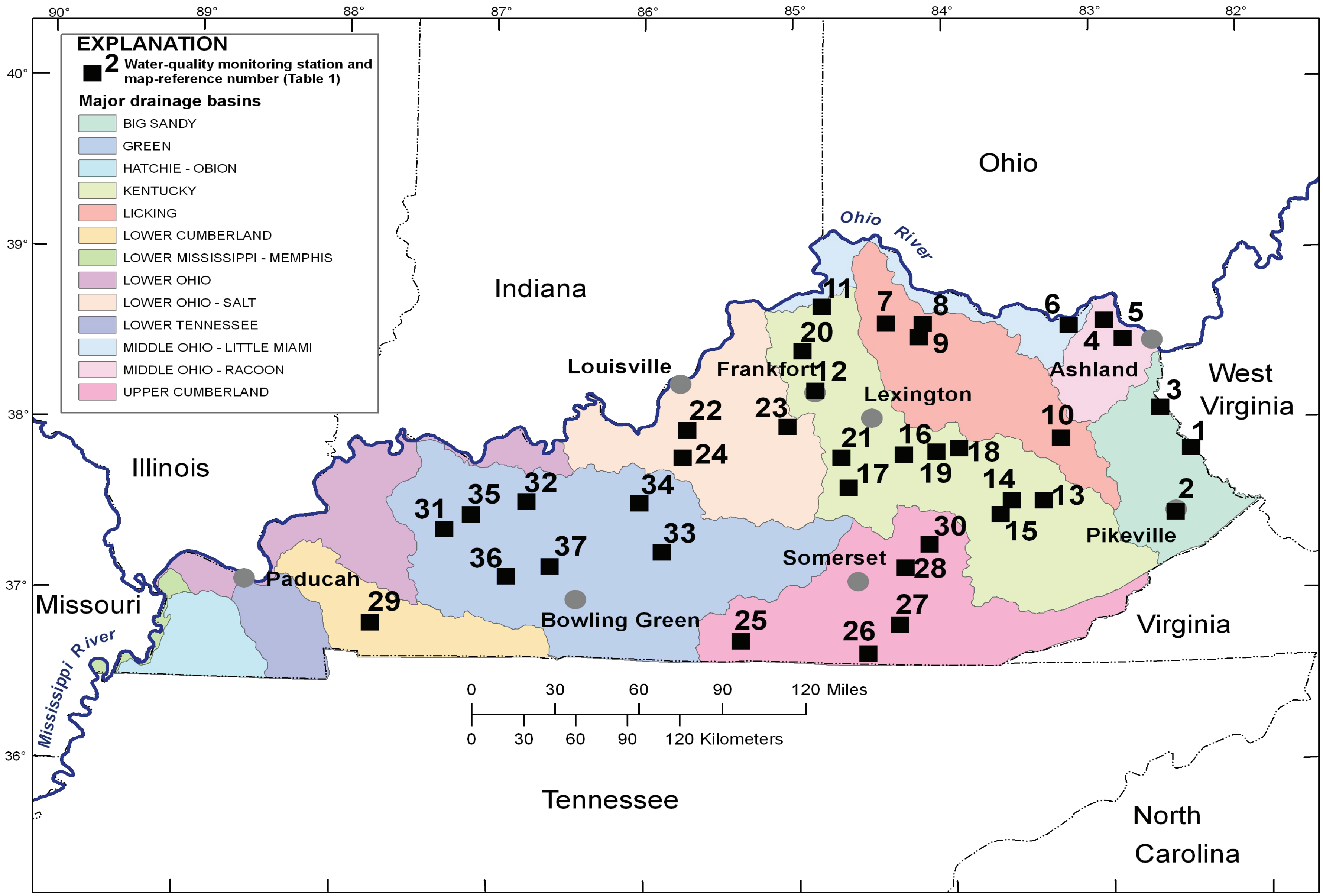
In 2005, the U.S. Geological Survey (USGS), in cooperation with the Kentucky Energy and Environment Cabinet–Kentucky Division of Water, initiated a study in the detection of trends to evaluate potential trends in selected water-quality properties and constituents at selected ambient water-quality monitoring network stations in Kentucky (fig. 1 and table 1). A trend in surface-water quality is a statistically significant change over time in the biological, chemical, or physical characteristics of water. Understanding surface-water-quality trends assists resource managers in identifying emerging water-quality concerns, planning remediation efforts, evaluating the effectiveness of the remediation, and possible modifications to the parameter suite.

Trends in surface-water quality for 15 properties and water-quality constituents were analyzed at 37 stations with drainage basins ranging in size from 62 to 6,431 mi^2. Analyses of selected physical properties (temperature, specific conductance, pH, dissolved oxygen, hardness, and suspended solids), major ions (chloride, sulfate), selected metals (iron, manganese), nutrients, and fecal coliform were compiled from the Commonwealth's ambient water-quality monitoring network. Trend analyses were completed using the S-Plus statistical program S-Estimate Trend (S-ESTREND), which detects trends in water-quality data. The trend-detection techniques supplied by this program include the Seasonal Kendall nonparametric methods for use with uncensored data or data censored with only one reporting limit (Hirsch and others, 1982) and the Tobit-regression parametric method for use with data censored with multiple reporting limits (Cohn, 1988). One of these tests was selected for each property and water-quality constituent and applied to all station records so that results of the trend procedure could be compared among stations.

Purpose and Scope

This report presents the results of long-term trend analysis of surface-water quality for 15 water-quality properties and constituents at 37 ambient water-quality stations in Kentucky. Water-quality records for these stations were retrieved from U.S. Environmental Protection Agency's (USEPA's) Legacy Data Center and Modernized Storage and Retrieval (STORET) database, screened, and analyzed for select periods of record during the water years 1979–2004 (U.S. Environmental Protection Agency, 2004). The selected water-quality monitoring stations cover all of the major river basins in Kentucky.

Detailed analyses of how the detected trends relate to hydrogeology, land-use changes, population distribution, hydrologic modifications, and pollution sources is beyond the scope of this report; however, some supporting information is presented to provide assistance in the interpretation of detected trends.



Base from U.S. Geological Survey digital data, 2002, 1:2,000,000
Lambert Conformal Conic projection
Standard parallels 37.083°N and 38.667°N, central meridian 85.75°W

Figure 1. Location of water-quality stations in the statewide ambient-monitoring network selected for trends analysis, 1979–2004.

Table 1. Station information for selected Kentucky ambient water-quality monitoring network stations for trend analysis.

[KDOW, Kentucky Division of Water; USGS, U.S. Geological Survey; mi², square mile; WV, West Virginia]

Map reference number (figure 1)	KDOW station name	KDOW station number	USGS station number	Drainage area (mi²)	Latitude (decimal degrees)	Longitude (decimal degrees)	Major drainage basin
1	Tug Fork at Kermit, WV	PRI002	03214500	1,280	37.838	-82.410	Big Sandy
2	Levisa Fork near Pikeville	PRI006	03209500	1,238	37.464	-82.526	Big Sandy
3	Levisa Fork near Louisa	PRI064	03215000	2,326	38.081	-82.600	Big Sandy
4	Tygarts Creek at Load	PRI048	03217000	242	38.599	-82.953	Middle Ohio-Racoon
5	Little Sandy at Argillite	PRI049	03216500	522	38.491	-82.834	Middle Ohio-Racoon
6	Kinniconick Creek near Tannery	PRI063	03237250	175	38.574	-83.188	Middle Ohio-Little Miami
7	South Fork Licking River at Morgan	PRI059	03252500	839	38.603	-84.401	Licking
8	North Fork Licking River at Milford	PRI060	03251400	290	38.597	-84.156	Licking
9	Licking River at Claysville	PRI061	03249500	1,993	38.521	-84.183	Licking
10	Licking River at West Liberty	PRI062	03248640	327	37.915	-83.262	Licking
11	Eagle Creek at Glencoe	PRI022	03291500	437	38.706	-84.826	Kentucky
12	Kentucky River at Frankfort (Lock 4)	PRI024	03287500	5,412	38.213	-84.873	Kentucky
13	North Fork Kentucky River at Jackson	PRI031	03280000	1,101	37.551	-83.384	Kentucky
14	Middle Fork Kentucky River at Tallega	PRI032	03281000	537	37.555	-83.594	Kentucky
15	South Fork Kentucky River at Booneville	PRI033	03281500	722	37.475	-83.671	Kentucky
16	Beech Fork near Maud	PRI041	03300400	436	37.833	-84.296	Kentucky
17	Dix River near Danville	PRI045	03285000	318	37.642	-84.661	Kentucky
18	Red River at Clay City	PRI046	03283500	362	37.865	-83.933	Kentucky
19	Kentucky River near Trapp	PRI058	03282300	3,246	37.847	-84.081	Kentucky
20	Kentucky River near Lockport (Lock 2)	PRI066	03290500	6,180	38.445	-84.957	Kentucky
21	Kentucky River at High Bridge (Lock 7)	PRI067	03286500	5,036	37.819	-84.706	Kentucky
22	Salt River at Shepherdsville	PRI029	03298500	1,197	37.985	-85.718	Lower Ohio-Salt
23	Salt River near Glensboro	PRI052	03295400	172	38.002	-85.060	Lower Ohio-Salt
24	Rolling Fork near Lebanon Junction	PRI057	03310500	1,375	37.823	-85.748	Lower Ohio-Salt
25	Cumberland River near Burkesville	PRI007	03414110	6,053	36.746	-85.372	Upper Cumberland

Table 1. Station information for selected Kentucky ambient water-quality monitoring network stations for trend analysis. —Continued

[KDOW, Kentucky Division of Water; USGS, U.S. Geological Survey; mi², square mile; WV, West Virginia]

Map reference number (figure 1)	KDOW station name	KDOW station number	USGS station number	Drainage area (mi²)	Latitude (decimal degrees)	Longitude (decimal degrees)	Major drainage basin
26	South Fork Cumberland River at Blue Heron	PRI008	03410500	954	36.670	-84.549	Upper Cumberland
27	Cumberland River at Cumberland Falls	PRI009	03404500	562	36.836	-84.340	Upper Cumberland
28	Rockcastle River at Billows	PRI010	03406500	604	37.171	-84.297	Upper Cumberland
29	Little River near Cadiz	PRI043	03438000	244	36.841	-87.778	Lower Cumberland
30	Horse Lick Creek near Lamero	PRI051	03405842	62	37.304	-84.139	Upper Cumberland
31	Pond River near Sacramento	PRI012	03321060	523	37.395	-87.305	Green
32	Rough River near Dundee	PRI014	03319000	757	37.563	-86.771	Green
33	Green River at Munfordville	PRI018	03308500	1,673	37.269	-85.885	Green
34	Nolin River at White Mills	PRI021	03310300	357	37.555	-86.031	Green
35	Green River near Island	PRI055	03316500	6,431	37.484	-87.134	Green
36	Mud River near Gus	PRI056	03316275	268	37.123	-86.901	Green
37	Green River near Woodbury	PRI103	03315500	5,404	37.183	-86.616	Green

Description of Study Area

Kentucky is located in the south-central United States and ranks 37th in land size, with 39,732 mi^2. Kentucky is bordered by seven states: Indiana, Ohio, West Virginia, Virginia, Tennessee, Missouri, and Illinois (fig. 1). The northern border is formed by the Ohio River, the western border is formed by the Mississippi River, and the eastern border is formed by the Tug Fork and Big Sandy River.

Natural and human factors affect the physical, chemical, and biological quality of surface and ground water in Kentucky. These factors and their combinations also can affect the potential for the contamination of surface and ground water and may explain regional water-quality differences or similarities in short- and long-term trends.

Population

The population of Kentucky increased from 3.66 million in 1990 to 4.04 million in 2000, which is an increase of 9.4 percent (U.S. Census Bureau, 2003). Kentucky ranked 25 out of 50 States in population density in 2000 with about 102 people per square mile (U.S. Census Bureau, 2003). More than half the population of Kentucky is concentrated in what is referred to as the Golden Triangle—the land area between Louisville, Lexington, and the Northern Kentucky region (near Covington, Kentucky (fig. 2). Some of the highest growth rates experienced by counties occurred in this area from 1980 to 2000—Anderson County (34 percent), Boone County (47 percent), Gallatin County (38 percent), Grant County (40 percent), Oldham County (40 percent), Shelby County (30 percent), and Spencer County (50 percent). Only five other counties outside this area experienced similar growth rates—Bullitt County (29 percent) located just south of Louisville, Ky.; Garrard County (27 percent) located southwest of Lexington, Ky.; Jessamine County (33 percent) located southwest of Lexington, Ky.; Laurel County (26 percent) located three counties west of Hazard, Ky.; and Trigg County (25 percent) located just west of Hopkinsville, Ky.

Physiography and Geology

The physiography of Kentucky can be generalized as a series of dissected plateaus and gently rolling terrain separated by faults (McDowell, 1986). The western and central parts of Kentucky have rolling terrain, whereas the eastern part of Kentucky has rugged terrain with high relief. The maximum land-surface altitude in Kentucky is the peak of Black Mountain (4,145 ft above sea level.) in Harlan County near the Kentucky–Virginia border; the lowest land-surface altitude is the Mississippi River at 260 ft above sea level (McGrain and Currens, 1978).

Kentucky lies within eight distinct physiographic regions that reflect the underlying geology: (1) Eastern Coal Field (also known as the Cumberland Plateau); (2) Inner Bluegrass; (3) Outer Bluegrass; (4) the Knobs; (5) Eastern Pennyroyal (also known as the Mississippian Plateau); (6) Western Pennyroyal (also known as the Mississippian Plateau); (7) Western Coal Field; (8) Purchase region (also known as the Mississippian Embayment) (fig. 3).

The Eastern Coal Field is part of a larger physiographic region known as the Cumberland Plateau, which extends from Pennsylvania to Alabama. It is characterized by very rugged terrain consisting of narrow valleys and narrow, steep-sided ridges. Rocks of the region are of Pennsylvanian age and are mainly sandstone, siltstone, and shale with numerous interbedded coal seams.

The Bluegrass physiographic region is restricted to the north-central part of the Commonwealth where Ordovician and Silurian age limestones and shales are exposed at the surface. The Bluegrass region is subdivided into the Inner-Bluegrass and Outer-Bluegrass regions. The Inner-Bluegrass region is characterized by gently rolling upland and abundant sinkholes underlain by thick-bedded phosphatic limestone of Ordovician age (Smoot and others, 1995). The Outer-Bluegrass region is underlain by thin-bedded limestones of late Ordovician age and includes considerable interbedded shale of Silurian age (McFarlan, 1943, p. 172). The topography in this region resembles the Inner Bluegrass except near streams, where it is dissected and rugged (Smoot and others, 1995).

The Knobs physiographic region is shaped like a crescent separating the Bluegrass region from the Eastern- and Western-Coal Field regions and consists of isolated, steeply sloping, cone-shaped hills. These hills are erosional remnants and are capped by erosionally resistant limestones and sandstones of Mississippian age and overlain shales of Devonian age.

Much of the Eastern and Western Pennyroyal regions are characterized by karst topography. Numerous karst features are present in this region, including sinkholes, caves, springs, and sinking streams. The regions are predominantly underlain by Mississippian age limestone.

The Western Coal Field region is similar to the Eastern Coal Field region in that it consists of bedrock of mostly Pennsylvanian age. The region is characterized by hilly upland with low to moderately high relief dissected by streams in poorly drained and often swampy bottomlands (McDowell, 1986).

The Purchase region is located in western Kentucky and is characterized by flat, low plains dissected by low-gradient streams. This region is underlain by unconsolidated Cretaceous-age sand, gravel, silt, and clay deposits, which are easily eroded. Stream bottoms are underlain by Quaternary alluvium (McDowell, 1986).

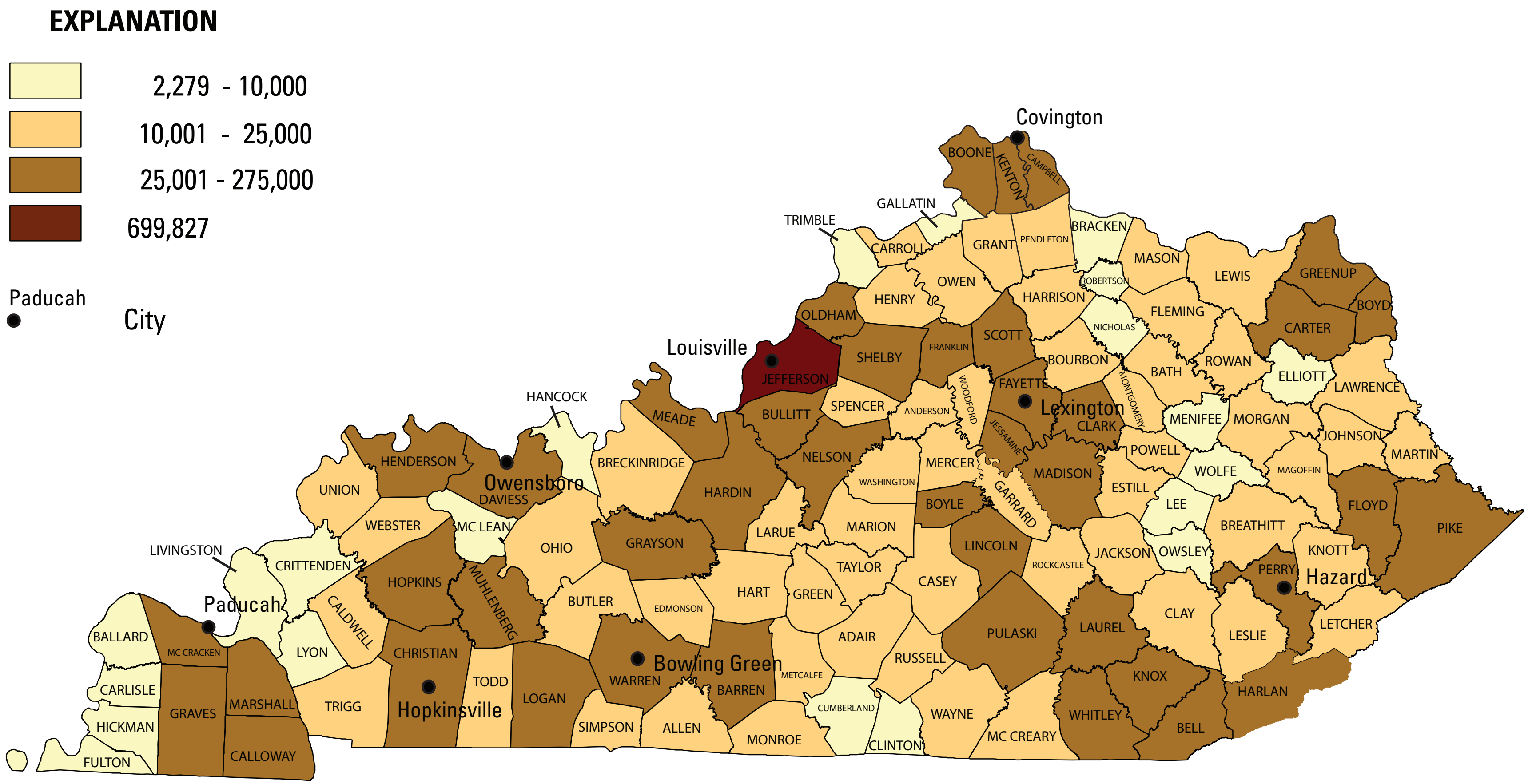


Figure 2. Total population in Kentucky, 2005. County population data from the Population Division, U.S. Census Bureau, 2006..

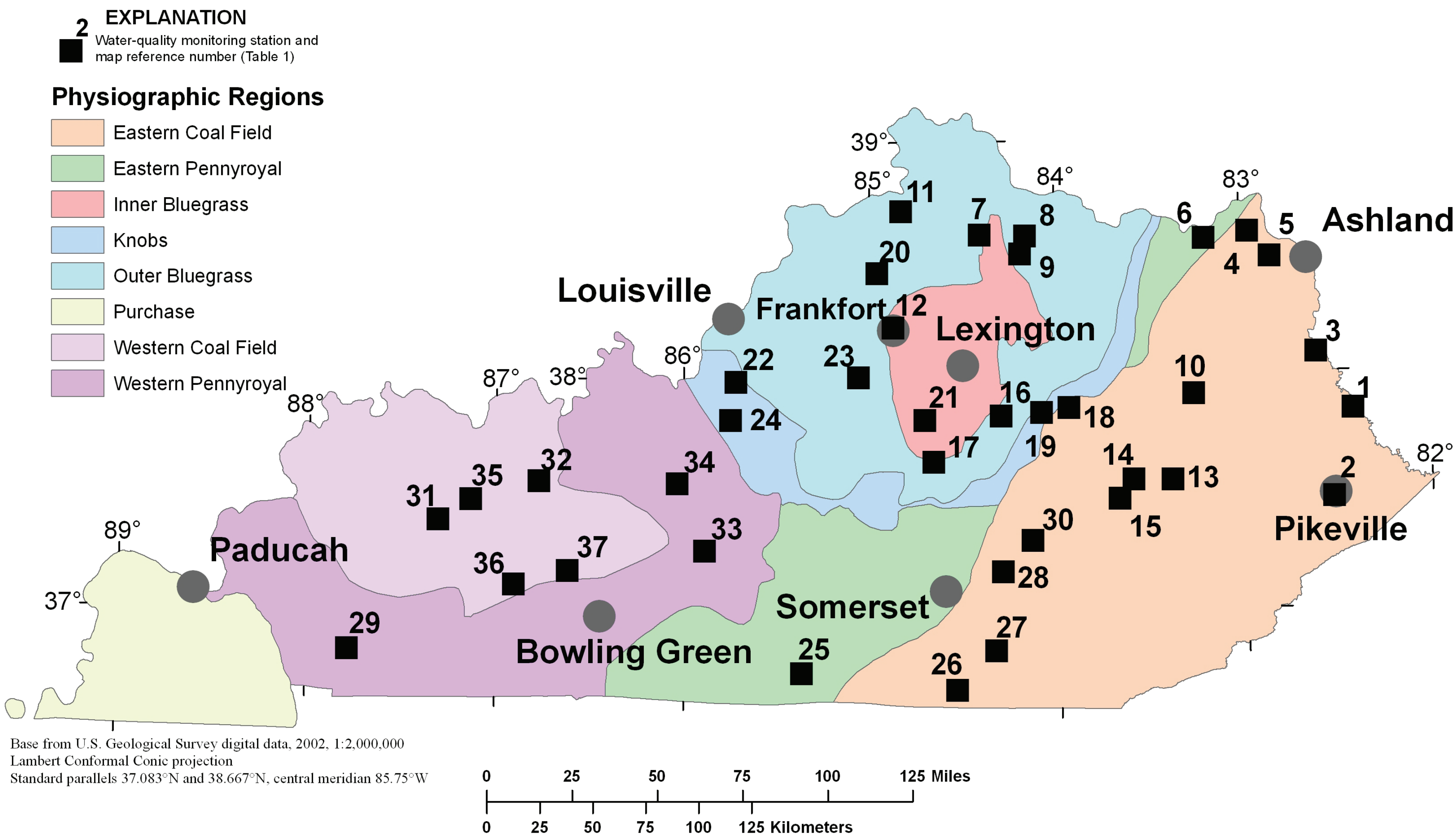


Figure 3. Physiographic regions of Kentucky and location of selected stations for trends analysis, 1979–2004.

The geographic location of a station greatly affects the water quality because of the characteristic geomorphology of each drainage basin. Of the 37 selected ambient-monitoring stations, 19 stations are located within the Eastern and Western Coal Field regions (fig. 3) where water quality is primarily affected by coal extraction (Leist and others 1981; Quinones and others, 1981). Thirteen stations are located within the Inner- and Outer-Bluegrass regions and the Knobs region, where water quality is primarily affected by activities associated with urbanization. Five ambient-network stations are located in the Eastern- and Western-Pennyroyal region. This region is characterized by karst topography, and the water quality is primarily affected by agricultural activities. None of the 37 selected ambient-network stations are located in the Purchase region where water quality is primarily affected by agriculture (Kleiss and others, 2000).

Land Use and Land Cover

The term “land use” implies human activity, and human activity implies a potential affect on the hydrology and quality of water in a watershed. The type and severity of water contamination often is directly associated with human activity; therefore, it can be qualified in terms of the intensity and type of land use in the source areas of water to streams. For example, the land use defined as agriculture indicates that the application of fertilizers is partially associated with human activity. Land use in Kentucky largely reflects the geology and physiography of the Commonwealth and the distribution of the population.

Land cover during 1992 and 2001 for Kentucky is shown in figures 4a and 4b, and classifications for the drainage area in each watershed are found in appendixes 1 and 2. The National Land Cover Data 1992 (NLCD 1992) and the National Land Cover Data 2001 (NLCD 2001) datasets were used to identify changes in land cover throughout Kentucky. The NLCD1992 land-cover data are an extension of the NLCD 1992 dataset classification scheme and protocols (U.S. Geological Survey, 2007a). The NLCD 1992 is a 21-class, 30-m resolution dataset primarily based on early 1990s Landsat Thematic Mapper™ imagery. Eight Anderson Level I land-cover classes were aggregated from the 21 classes (Anderson and others, 1976). For example, the land-cover classes “Deciduous Forest,” “Evergreen Forest,” and “Mixed Forest” were aggregated to “Forest” (table 2).

The NLCD 2001 land-cover data were based on the National Land Cover Data 2001 (NLCD 2001) dataset classification scheme and protocols (U.S. Geological Survey, 2007b). The NLCD 2001 is a 16-class, 30-m resolution dataset primarily based on Landsat-7 Enhanced Thematic Mapper Plus data for the period 1999–2002 (U.S. Geological Survey, 2007b). As with the NLCD 1992 dataset, the NLCD 2001 was aggregated to eight Anderson Level I classes (table 2). The aggregation of the data from Anderson Level II to Level I (table 2) was necessary for general comparisons between the NLCD 1992 and the NLCD 2001 datasets, because of minor differences between the two land-cover classification schemes. Table 3 presents the percent of land cover for Kentucky using the NLCD 1992 and 2001 datasets.

At the time of this study (2005), the USEPA’s Multi-Resolution Land Characteristics Consortium (MRLC) did not recommend comparing the two national land-cover datasets because of (1) different classification algorithms; (2) different resolutions of digital elevation models (DEMs); (3) improved impervious surface mapping of the NLCD 2001; (4) corrected atmospheric effects for the NLCD 2001 imagery; and (5) the different land-cover classes (U.S. Environmental Protection Agency, 2007). For this study, non-statistical comparisons between the 1992 and 2001 datasets are made to provide possible explanations in a few cases where there are significant trends.

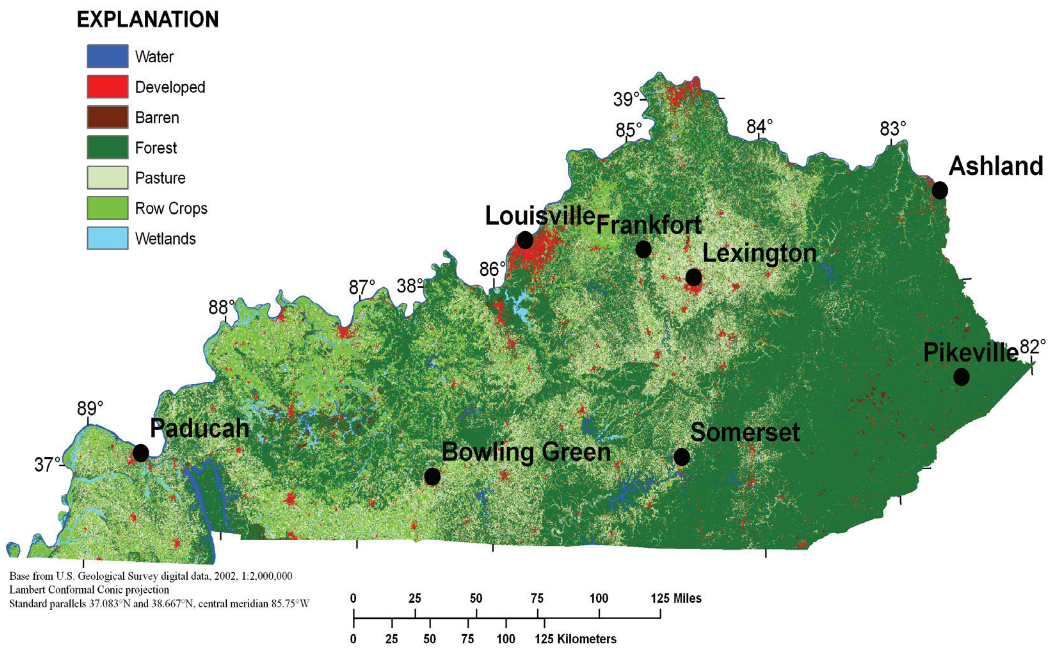
Climate

Kentucky has a temperate-continental climate characterized by well-defined winter and summer seasons that are accompanied by large annual temperature variations. Mean monthly temperatures in Kentucky range from about 23°F in the winter months to 87°F in the summer months (NState, 2008). Variations in seasonal temperatures reflect the polar continental air masses in the late fall and winter and the tropical maritime air masses in the early spring, summer, and early fall. The tropical maritime air masses originate from the Gulf of Mexico and Atlantic Ocean and often result in thunderstorms, tornados, and intense rainfall. Mean annual precipitation from 1979 to 2004 for Kentucky was 48.8 in. Yearly precipitation totals throughout Kentucky from 1979 to 2004 ranged from 37.2 in. in 1980 to 62.9 in. in 1979 (Kentucky Climate Center, 2007). The amount of precipitation generally decreases from south to north.

Hydrology

The hydrology of Kentucky is described by characterizing surface- and ground-water flow and surface-water/ground-water interactions. Variations in climate, physiography, land use, and geology cause localized variations in streamflow characteristics in Kentucky. High-flow conditions in streams generally occur in the spring, and low-flow conditions generally occur in late summer or early fall. However, flooding can occur at any time of the year. During dry periods, ground-water discharge to springs and streams constitutes the majority of streamflow in areas with karst topography.

a.



b.

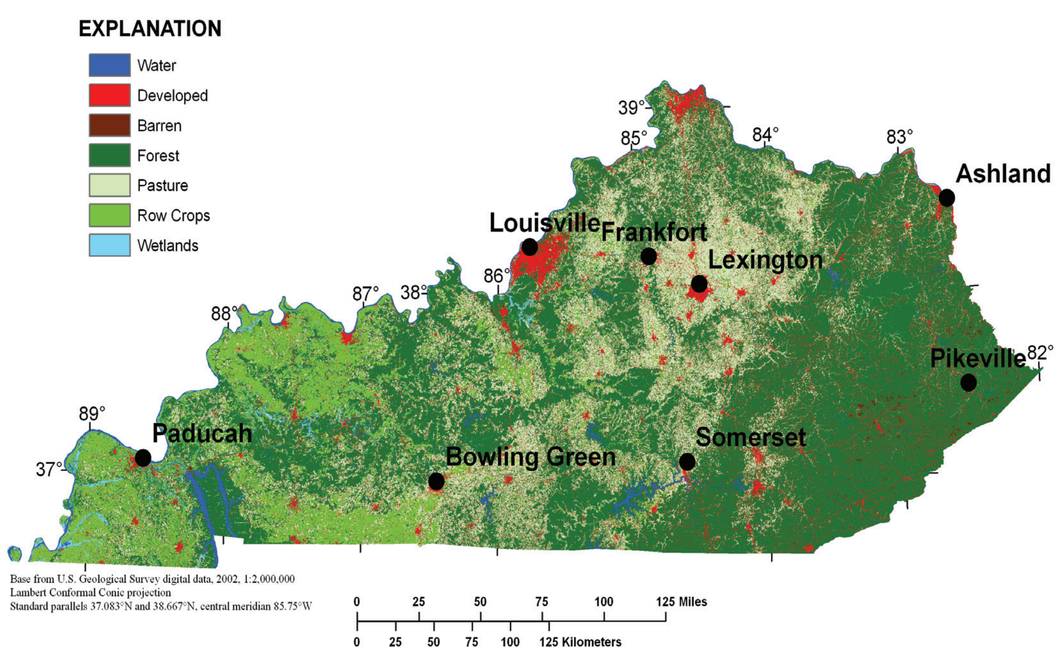


Figure 4. (**a.**) Land cover within Kentucky, 1992, and (**b.**) land cover within Kentucky, 2001.

Table 2. Classification scheme of Anderson level I and II systems used with the National Land Cover Data 1992 and 2001, in this study.

[NLCD, National Land Cover Data; --, not used]

Level I[1]	NLCD 1992 Level II[1]	NLCD 2001 Level II[1]
1 Developed	21 Developed, low intensity	21 Developed open space
	22 Developed, high intensity, residential	22 Developed, low intensity
	23 Developed, commercial, industrial	23 Developed, medium intensity
	85 Urban/recreational grasses	24 Developed, high intensity
2 Pasture	81 Pasture/hay	81 Pasture/hay
3 Row crops	82 Row crops	82 Cultivated crops
	83 Small grains	
4 Openland	--	--
5 Forest	41 Deciduous forest	41 Deciduous forest
	42 Evergreen forest	42 Evergreen forest
	43 Mixed forest	43 Mixed forest
		52 Shrub/shrub
		71 Grassland/herbaceous
6 Water	11 Open water	11 Open water
7 Wetlands	91 Woodland wetlands	90 Woodland wetlands
	92 Emergent wetland	95 Emergent wetland
8 Barren	31 Bare rock/sand/clay	31 Bare rock/sand/clay
	32 Quarries/strip mines/gravel	
	33 Transitional	

[1]Anderson and others, 1976.

Table 3. Percentage of land cover for Kentucky from the National Land Cover Data datasets, 1992 and 2001, using Anderson Level I classifications.

[NLCD, National Land Cover Data; --, not applicable; na, not available]

Anderson Level I[1]	NLCD 1992 (in percent)	NLCD 2001 (in percent)
1 Developed	2.35	7.06
2 Pasture/hay	20.5	22.0
3 Row crops	13.5	11.0
4 Openland	--	na
5 Forest	59.5	56.7
6 Water	1.89	1.83
7 Wetlands	1.75	1.07
8 Barren	.505	.292

[1]Anderson and others, 1976.

Data Collection

The Kentucky ambient stream water-quality monitoring network (fig. 1 and table 1) was designed to characterize background conditions of water-quality properties and constituents in streams, determine compliance with applicable surface-water-quality standards, provide data to support development of new or revised water-quality standards, and determine long-term trends in the surface-water quality of streams across Kentucky (Kentucky Energy and Environment Cabinet, 2005). The statewide ambient water-quality monitoring network stations are generally located in midstream or downstream reaches on major rivers or on their major tributaries, as well as stream-inflow and outflows from U.S. Army Corps of Engineers reservoirs. The ambient water-quality monitoring network stations also are located in streams where particular water-quality issues may be associated with local land uses (non-point sources or point sources). Many of the 37 stations were located at or near active, or formerly active, USGS streamflow-gaging stations. The use of streamflow information enhances the ability to understand water quality in relation to changing flow conditions.

Field measurements and water-quality samples were collected at a frequency of 12 times per year (monthly) for the majority of the stations from 1979 to 1998 (table 4). In 1998, field measurements and water-quality samples were reduced to a frequency of six times per year (every 2 months) every 4 of 5 years because a new monitoring network was implemented involving a 5-year rotating Basin Management Unit (BMU) scheme of monitoring. The Kentucky Division of Water also established about 30 rotating water-quality stations in each of five selected BMUs. The selected water-quality stations in each BMU are thoroughly monitored once every 5 years to provide more in-depth water-quality information; thus, trend analysis is not possible at these rotating watershed stations.

Table 4. Water-quality constituents and properties selected for trend analysis in Kentucky.

[USEPA, U.S. Environmental Protection Agency; STORET, Storage and Retrieval; °C, degrees Celsius; µS/cm, microsiemens per centimeter at 25 degrees Celsius; mg/L, milligrams per liter; $CaCO_3$, calcium carbonate; µg/L, micrograms per liter P, phosphorus; N, nitrogen]

Constituent	Units	USEPA STORET parameter code
Physical properties		
Temperature	°C	00010
Specific conductance	µS/cm	00094 and 00095
pH	Standard units	00400
Dissolved oxygen	mg/L	00300
Hardness	mg/L as $CaCO_3$	00900
Solids, residue on evaporation at 180°C (total suspended solids)	mg/L	00530
Major ions		
Chloride, total	mg/L	00940
Sulfate, total	mg/L	00946
Trace metals		
Iron, total	µg/L	01045
Manganese, total	µg/L	01055
Nitrogen and phosphorus		
Phosphorus, total	mg/L as P	00665
Nitrogen, total	mg/L as N	00600
Nitrogen, ammonia-plus-organic, (Kjeldahl nitrogen)	mg/L as N	00625
Nitrite plus nitrate, total	mg/L as N	00630
Ammonia, total	mg/L as N	00610
Bacteria		
Fecal coliform	colonies/100 milliliters	31616

Station Selection, Period of Record, and Data Screening

Station selection and the physical properties and water-quality constituents for trend analysis were selected in consultation with Kentucky Division of Water staff. Station selection was based on the availability of long-term water-quality data at a station. Stations selected were part of the Commonwealth's ambient water-quality monitoring network. The ambient stream water-quality monitoring network contains 70 stations; however, only 37 stations were included in this study. Trends were not analyzed at the remaining 33 ambient-water-quality monitoring network stations because of an insufficient amount of water-quality data and (or) the network stations were not located at or near active, or formerly active, USGS streamflow-gaging stations. Chemical constituents and physical properties represent major constituent groups and in some cases relate to potential sources of impairment of water quality in Kentucky streams.

Analysis of water-quality data focused on a comprehensive review of the water-quality data collected by the Kentucky Division of Water. Data from 1979–2004 were retrieved from the USEPA's STORET repository for water-quality and physical-property data. Streamflow data measured by the USGS was retrieved from the World Wide Web at *http://waterdata.usgs.gov/ky/nwis*. Other streamflow data were obtained by written communication from the U.S. Army Corps of Engineers.

Several quality-assurance measures were taken prior to data analysis. Boxplots and scatterplots were initially used to identify erroneous data. Water-quality data values also were checked to ensure that they fit into the context of other concentrations identified in a given sample. A water-quality value identified as suspect by any data-quality-assurance measure was evaluated individually, taking into account the collection location, time of year, and other samples collected at or near the station.

Concentrations of total nitrogen (TN) were computed from measured concentrations of dissolved nitrite plus nitrate-nitrogen (NO_2+NO_3-N) and total Kjeldahl nitrogen (TKN) (ammonia plus organic nitrogen). If the concentrations of NO_2+NO_3-N and TKN were greater than or equal to their respective method detection limit (MDL), their concentrations were summed to obtain TN. However, if the concentration of NO_2+NO_3-N or the concentration of TKN was less than an MDL, then the following rules were applied. If the NO_2+NO_3-N concentration was censored (MDL <0.01 mg/L), but the concentration of TKN was not censored, then the concentration of TN was computed as the sum of the TKN value and the censored value of NO_2+NO_3-N. If the concentration of NO_2+NO_3-N was not censored and the concentration of TKN was censored (<0.05 mg/L), the concentration of TN was computed as the sum of the NO_2+NO_3-N concentration and the censored value of TKN. If either the concentration of TKN or the concentration of NO_2+NO_3-N was missing, then the concentration of TN was not computed.

Estimates of Daily Mean Discharge

Daily mean discharges were estimated at 14 water-quality-sampling stations (table 5) where no discharge data were available or where the available discharge record was incomplete (missing) for a part of the water-quality-sampling period, 1979–2004. The discharges were estimated by use of a drainage-area-ratio adjustment and (or) regression methods. For stations lacking discharge records that were located on the same stream reach or in close proximity to a gaged station, the drainage-area-ratio adjustment was made to estimate the discharges at the nearby ungaged location. Extension in time (augmentation) of an existing short-term gage record (a short-term station) was accomplished by developing a regression relation between/among [if more than two] concurrent daily mean discharges at the short-term stations and at one or more nearby stations that are hydrologically similar and with discharge records through the sampling period (long-term stations). The final regression discharge estimates were made by use of the Maintenance of Variance Extension Type 1 (MOVE.1), as described by Hirsch (1982), in which a line of organic correlation (LOC) regression model was fit to the concurrent daily mean discharges (Insightful Corporation, 2005). The MOVE.1 method provides the estimated discharges with some of the variance characteristics of the observed discharge record. The MOVE.1 method is unlike ordinary-least-squares regression, which tends to 'smooth' the estimated discharge and provides lower variance than in the original observed discharges. The MOVE.1 regression estimates were computed by use of log-transformed values of the concurrent nonzero daily mean discharges as

$$Q_s = M_s + (S_s / S_l) \times (Q_l - M_l)\,, \qquad (1)$$

where

Q_s is the estimated daily mean discharge at the short-term stations;

Q_l is the observed daily mean discharge at the long-term stations;

M_s and M_l are the mean of the daily mean discharges for the concurrent period at the short- and long-term stations, respectively; and

S_s and S_l are the standard deviations of the daily mean discharges for the concurrent period at the short- and long-term stations, respectively.

Table 5. Estimates of daily mean discharge for ambient water-quality monitoring network stations with no available discharge or incomplete discharge records.

[USGS, U.S. Geological Survey, KDOW, Kentucky Division of Water; ---, no assigned USGS station number]

Map reference number (figure 1)	USGS station number	KDOW station number	KDOW station name	Area adjustment factor	USGS station number(s) used for estimating discharge	USGS station name(s) used for estimating discharge	Pearson correlation coefficient (s)
3	03212545	PRI064	Levisa Fork near Louisa	1.08	03212500	Levisa Fork at Paintsville	0.99
4	---	PRI048	Tygarts Creek at Load	None	03217000	Tygarts Creek at Greenup	.99
6	03237260	PRI063	Kinniconick Creek near Tannery	1.18	03237250	Kinniconick Creek near Tannery	.99
					03237255	Kinniconick Creek below Trace Creek at Tannery	
7	---	PRI059	South Fork Licking River at Morgan	1.35	03252500	South Fork Licking River at Cynthiana	.94
					03252300	Hinkston Creek near Carlisle	
					03253500	Licking River at Catawba	
8	03251400	PRI060	North Fork Licking near Milford	1.26	03251200	North Fork Licking near Mt. Olivet	.99
10	03248620	PRI062	Licking River at West Liberty	None	03248500	Licking River near Salyersville	.79-.81
					03283500	Red River at Clay City	
19	03282300	PRI058	Kentucky River near Trapp	None	03284000	Kentucky River at Lock 10 near Winchester	.78-.99
					03283500	Red River at Clay City	
24	03301630	PRI057	Rolling Fork near Lebanon Junction	1.06	03310500	Rolling Fork near Boston	.99
25	03414110	PRI007	Cumberland River near Burkesville	1.04	03414000	Cumberland River near Rowena	.99
					03413500	Lake Cumberland/Wolf Creek Dam outflow	
27	03404500	PRI009	Cumberland River at Cumberland Falls	None	03404000	Cumberland River at Williamsburg	.99
30	03405842	PRI051	Horse Lick Creek near Lamero	None	03404900	Lynn Camp Creek at Corbin	.99
31	03321060	PRI012	Pond River near Sacramento	None	03320500	Pond River at Apex (discharge and stage)	.93-.95
					03383000	Tradewater River at Olney	

Table 5. Estimates of daily mean discharge for ambient water-quality monitoring network stations with no available discharge or incomplete discharge records. —Continued

[USGS, U.S. Geological Survey, KDOW, Kentucky Division of Water; ---, no assigned USGS station number]

Map reference number (figure 1)	USGS station number	KDOW station number	KDOW station name	Area adjustment factor	USGS station number(s) used for estimating discharge	USGS station name(s) used for estimating discharge	Pearson correlation coefficient (s)
32	03319000	PRI014	Rough River near Dundee	None	03318005	Rough River Dam outflows	.91-.95
					03319600	Rough River at Hartford	
					03320500	Pond River at Apex	
					03310300	Nolin River at White Mills	
					03383000	Tradewater River at Olney	
36	---	PRI056	Mud River near Gus	None	03320500	Pond River at Apex (discharge and stage)	.91-.92
					03310300	Nolin River at White Mills	
37	03315500	PRI103	Green River near Woodbury	None	03316500	Green River at Paradise	.98

Some of the short-term stations had more than one long-term index station available to provide additional information for an improved discharge estimate (table 5). In these cases, an ordinary-least-squares multiple-linear regression (OLS) initially was developed to estimate the missing daily mean discharge from the concurrent daily mean discharges at two or three nearby, hydrologically similar long-term index stations. The nonzero, log-transformed discharge values were used for the multiple-linear regression. These OLS regression estimates were then 'post-processed' by use of a MOVE.1 LOC regression that related the OLS-regression-estimated discharges to the observed daily mean discharges at the short-term stations. The OLS-regression-estimated discharge record was used as the discharge record for the long-term index stations to fit the final LOC-regression model and for estimating discharge at the short-term stations. The drainage-area-adjustment ratio, if applicable, and the Pearson correlation coefficient of the log-transformed concurrent discharges used in the final MOVE.1 LOC-regression estimate are shown in table 5.

Trend Analyses

Trend analyses were completed using the S-Plus statistical program S-Estimate Trend (S-ESTREND) (Schertz and others, 1991), which detects trends in water-quality data. The S-ESTREND program is designed to detect a monotonic trend (tends to increase, decrease, or have no trend, but not, for example, change from an increase to a decrease) in concentration. The trend-detection techniques supplied by this program include the Seasonal Kendall nonparametric method for use with uncensored data or for data censored with only one reporting limit (Hirsch and others, 1982), and the Tobit-regression parametric method for use with data that are highly censored with multiple reporting limits (Cohn, 1988). One of these tests was selected for each property and water-quality constituent and applied to all station records so that the results of the trend procedure could be compared among stations. Trend results presented in this report were considered statistically significant when p-values were less than 0.05.

Seasonality can affect the concentrations of some water-quality constituents, because water in streams and land use may vary by season. Thus, seasonality may prevent the detection of trends (Schertz and others, 1991). The S-ESTREND program contains an automated procedure for determining the best seasonal choice for each constituent for a particular season (Schertz and others, 1991). Seasons are defined by dividing the selected record into the beginning 20 percent and the ending 20 percent of the record and comparing them to the middle 60 percent of the record. In this study, seasons were defined as 2, 3, 4, 6, or 12 possible seasons per year. The season definition for a constituent varied from station to station, because the sampling frequency of a constituent varied from station to station.

Uncensored Seasonal Kendall Test

The Seasonal Kendall test is a nonparametric procedure for detecting monotonic trends in water-quality data (Helsel and Hirsch, 2002). The uncensored Seasonal Kendall trend test requires that a minimum of 5 years of data are available, less than about 5 percent of the dataset is censored, and that there is only one censoring level (Hirsch and others, 1982). The uncensored Seasonal Kendall trend test is considered robust and is not sensitive to data outliers (Schertz and others, 1991). Additionally, this procedure allows water-quality data to be flow adjusted. The uncensored Seasonal Kendall trend procedure was used to test for trends for every physical property and water-quality constituent, except concentrations of TP, TKN, and fecal coliform (table 4).

Tobit-Regression Test

The Tobit-regression test is a parametric procedure for detecting monotonic trends in water-quality data (Cohn, 1988). This trend procedure is required when there are many censoring levels and (or) the data are highly censored (more than about 5 percent). A minimum of 5 years of data, defined by the first and last observation with the period of record, also must be present for use with this trend procedure. Flow and seasonality can be incorporated into the Tobit-regression model, in the S-ESTREND program. The Tobit-regression trend procedure provides a reliable estimate of the trend slope and statistical significance levels when a reasonable fit to the data is obtained and when assumptions such as the regression residuals are approximately normally distributed (Schertz and others, 1991). When using this procedure, trend residual results should be carefully examined for each station and constituent. The Tobit-regression analysis was used to test for trends in TP, TKN, and fecal-coliform data; this was necessary because in most instances those data were highly censored.

Flow-Adjusted Trends in Concentrations

Concentrations of water-quality constituents often correlate with streamflow. Concentrations of many water-quality constituents generally decrease, because of dilution, as streamflow increases; however, concentrations of other water-quality constituents that are contributed by runoff, such as suspended sediment and bacteria, will increase as streamflow increases (Schertz and others, 1991). Some constituents may exhibit combinations of both effects (Hirsch and others, 1982); thus, the technique of flow adjustment is used to understand actual changes in a water-quality constituent without the affect of trends on flow.

For this study, flow-adjusted monotonic trends in concentrations were estimated by use of the statistical program S-ESTREND (Schertz and others, 1991) in S-plus version 7.0 (Insightful Corporation, 2005; Slack and others, 2003). Use of the flow-adjustment technique removes the effects of streamflow on concentrations of water-quality constituents by computing a time series of flow-adjusted concentrations and evaluating those data for a trend. One of two flow-adjustment techniques was used to obtain a mathematical description of the relation between concentration and streamflow. The first technique regresses concentrations on various functional forms of streamflow. The second technique fits a smoothed loess line to concentration and streamflow or log transformations of these variables to improve the fit. Flow adjustments were used for all water-quality constituents and all physical properties, except temperature.

Issues with Long-Term Trend Analyses

There are two main issues that can create problems in the analysis of water-quality data when determining long-term trends: (1) effects of protocol and method changes used to collect and analyze the water-quality samples; and (2) frequency changes in sampling.

Documentation of changes in sampling location, field methods, and analytical laboratory methods that affect water-quality data have improved over the years. Likewise, the documentation of changes in analytical laboratory methods and reporting levels for constituents has not always been adequate; thus, results of some trend analyses can be affected. This is especially true if many of the concentrations are near to or less than the minimum reporting level for the analytical methods. An attempt was made to minimize these effects by using the S-ESTREND program.

Any changes in frequency or sample timing potentially can affect results of water-quality analysis. For example, if sampling frequency increases, there may be an increased chance of collecting samples during extreme rainfall events, during droughts, or both. This increased chance of sampling extreme hydrologic events possibly could result in a large range of water quality that is not evident with fewer samples. Statistical programs such as S-ESTREND require sufficient data with suitable distribution throughout the period of interest to meet the requirements of the program for reliable statistical analysis. As previously stated in this report, field measurements and water-quality samples were collected at a frequency of 12 times per year for the majority of the stations from 1979 to 1998; In 1998, the frequency of sampling was reduced to six times per year (every 2 months). A new monitoring network was implemented involving a rotating Basin Management Unit (BMU) scheme of monitoring where selected water-quality stations in each BMU are intensely monitored once every 5 years to provide more in-depth water-quality information.

Trends in Surface-Water Quality

Summary statistics of the physical properties and selected water-quality constituents and trend results are listed in table 6 (at end of report). The statistics and trend results are summarized for variable periods of record during the study period 1979–2004 for each physical property and water-quality constituent at the 37 stations. The results include number of observations, number of censored values, period of record, minimum values, median values and percentiles, maximum values, direction of trend, trend slopes expressed as percent, and p-values.

Table 7 summarizes the direction of trend for water-quality data of watersheds represented by the selected water-quality monitoring network stations. A negative slope indicates a downward trend (decreasing concentration with time), and a positive slope indicates an upward trend (increasing concentration with time). Only statistically significant trends are reported in tables 6 and 7. A significant monotonic trend does not indicate how the increase or decrease occurred. A more detailed investigation at each station is necessary to provide a complete explanation as to the cause of a particular trend.

Physical Properties

Data were analyzed for six physical properties including temperature, specific conductance, pH, dissolved oxygen, hardness, and total dissolved solids. Water temperature is an important physical property of water, because it can affect many beneficial uses of water. Elevations in water temperature can result in accelerated biodegradation of organic material thereby reducing oxygen levels in the stream. In addition, increased water temperature reduces the solubility of oxygen. Results of this study indicated no trends in temperature at 36 stations (fig. 5). The South Fork Cumberland River near Blue Heron station (map number 26) had an increasing trend in temperature (p-value = 0.04).

Specific conductance is a measure of the ability of a water solution to conduct an electrical current, and its measurement can be used to estimate the amount of dissolved matter in water. Specific conductance increased at 13 stations, mostly in the eastern-half of Kentucky, and decreased at only 1 station (South Fork Cumberland River at Blue Heron (map number 26)) (fig. 6). The remaining stations had no change in specific conductance.

The pH of a water sample is used to define the amount of hydrogen-ion activity in the sample and is a measure of acid-base equilibrium achieved by various dissolved compounds, salts, and gases (Hem, 1985). pH is a useful index because it has a major affect on the degree of toxicity and solubility of many compounds; thus, knowledge of the pH of stream water potentially can provide insight into detrimental effects on aquatic systems.

Table 7. Summary of trends results of water-quality data of watersheds represented by selected ambient water-quality monitoring network stations in Kentucky, 1979–2004.

[KDOW, Kentucky Division of Water; --, no trend; ↑, increasing trend; ↓, decreasing trend; na, not available]

Map reference number (figure 1)	KDOW station number	Temperature	Specific conductance	pH	Dissolved oxygen	Hardness	Total suspended solids	Total chloride	Total sulfate	Total iron	Total manganese	Total phosphorus	Total nitrogen	Total Kjeldahl nitrogen	Total nitrite plus nitrate	Ammonia	Fecal coliform
		Trend direction															
Big Sandy																	
1	PRI002	--	↑	↑	↑	↑	--	--	↑	--	↓	↓	--	↓	--	na	↓
2	PRI006	--	↑	↑	↑	↑	↓	↑	↑	↓	↓	↓	--	↓	↑	na	↓
3	PRI064	--	↑	--	--	↑	--	↑	↑	--	--	--	--	--	--	na	↓
Middle Ohio-Racoon																	
4	PRI048	--	--	↑	--	--	--	↑	--	↑	--	--	--	↓	--	na	↓
5	PRI049	--	--	↑	--	--	↓	--	↑	--	↓	--	↑	↓	↑	na	--
Middle Ohio-Little Miami																	
6	PRI063	--	--	↑	--	↑	--	↑	--	--	--	--	--	--	--	na	--
Licking																	
7	PRI059	--	--	--	↑	--	--	--	--	--	--	--	--	--	--	na	--
8	PRI060	--	--	--	--	--	--	↑	--	↓	↓	↓	--	--	--	na	↓
9	PRI061	--	↑	↑	↑	--	--	↑	--	--	--	--	--	--	--	na	--
10	PRI062	--	--	↑	--	--	--	↑	--	--	↑	--	--	--	--	na	↓
Kentucky																	
11	PRI022	--	--	--	--	--	↓	↑	--	--	--	--	↓	↓	--	na	--
12	PRI024	--	↑	--	--	↑	--	↓	--	--	--	--	↓	↓	--	na	↓
13	PRI031	--	↑	--	--	↑	--	↑	--	--	--	--	↓	↓	--	na	↓
14	PRI032	--	↑	↑	--	↑	--	--	↑	--	--	↑	↓	--	--	na	↓
15	PRI033	--	--	↑	--	--	--	--	--	--	↓	--	--	--	--	na	--
16	PRI041	--	--	--	--	↑	↓	↑	--	--	↓	--	--	↓	--	na	--
17	PRI045	--	↑	↑	↑	--	--	↑	--	--	--	↓	--	↓	--	na	--
18	PRI046	--	--	--	↑	↑	--	--	--	--	--	↑	--	↓	--	na	↓
19	PRI058	--	--	--	↑	↑	--	--	↑	--	--	--	--	--	--	na	↑
20	PRI066	--	↑	--	--	--	--	--	--	--	--	↑	--	--	--	na	--
21	PRI067	--	--	--	--	--	↑	--	--	--	--	--	--	--	--	na	--

Table 7. Summary of trends results of water-quality data of watersheds represented by selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[KDOW, Kentucky Division of Water; --, no trend; ↑, increasing trend; ↓, decreasing trend; na, not available]

Map reference number (figure 1)	KDOW station number	Temperature	Specific conductance	pH	Dissolved oxygen	Hardness	Total suspended solids	Total chloride	Total sulfate	Total iron	Total manganese	Total phosphorus	Total nitrogen	Total Kjeldahl nitrogen	Total nitrite plus nitrate	Ammonia	Fecal coliform
Lower Ohio-Salt																	
22	PRI029	--	↑	--	--	--	--	--	--	--	--	↓	↓	↓	↓	na	--
23	PRI052	--	--	--	↑	--	--	↑	--	↓	--	↓	--	--	--	na	↓
24	PRI057	--	--	--	--	--	--	↑	--	--	↑	--	--	--	--	na	--
Cumberland (Upper and Lower)																	
25	PRI007	--	↑	--	--	--	↓	--	--	--	↓	↓	↓	↓	↓	na	↓
26	PRI008	↑	↓	↑	↑	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	na	↓
27	PRI009	--	↑	↑	--	↑	↓	--	↑	--	↓	↓	↓	↓	--	na	↓
28	PRI010	--	--	↑	↑	--	↓	--	↓	--	↓	↓	↓	↓	--	na	--
29	PRI043	--	--	--	--	↑	↓	↑	--	--	↓	↓	↑	↓	↑	na	--
30	PRI051	--	--	--	↑	--	↓	--	↓	--	↓	--	--	--	↓	na	↑
Green																	
31	PRI012	--	--	--	--	--	--	--	--	--	↓	--	--	--	--	na	--
32	PRI014	--	--	↑	--	--	--	--	↓	--	--	↓	↓	↓	↓	na	↓
33	PRI018	--	--	--	--	--	--	↓	--	--	--	↓	--	↓	--	na	--
34	PRI021	--	↑	--	--	↑	--	↑	--	--	--	--	--	↓	↑	na	↓
35	PRI055	--	--	--	↑	--	--	--	--	--	--	--	--	--	--	na	--
36	PRI056	--	--	↓	--	--	--	--	↓	--	--	↓	--	--	--	na	--
37	PRI103	--	--	--	--	--	--	--	--	--	--	↑	--	--	--	na	↑

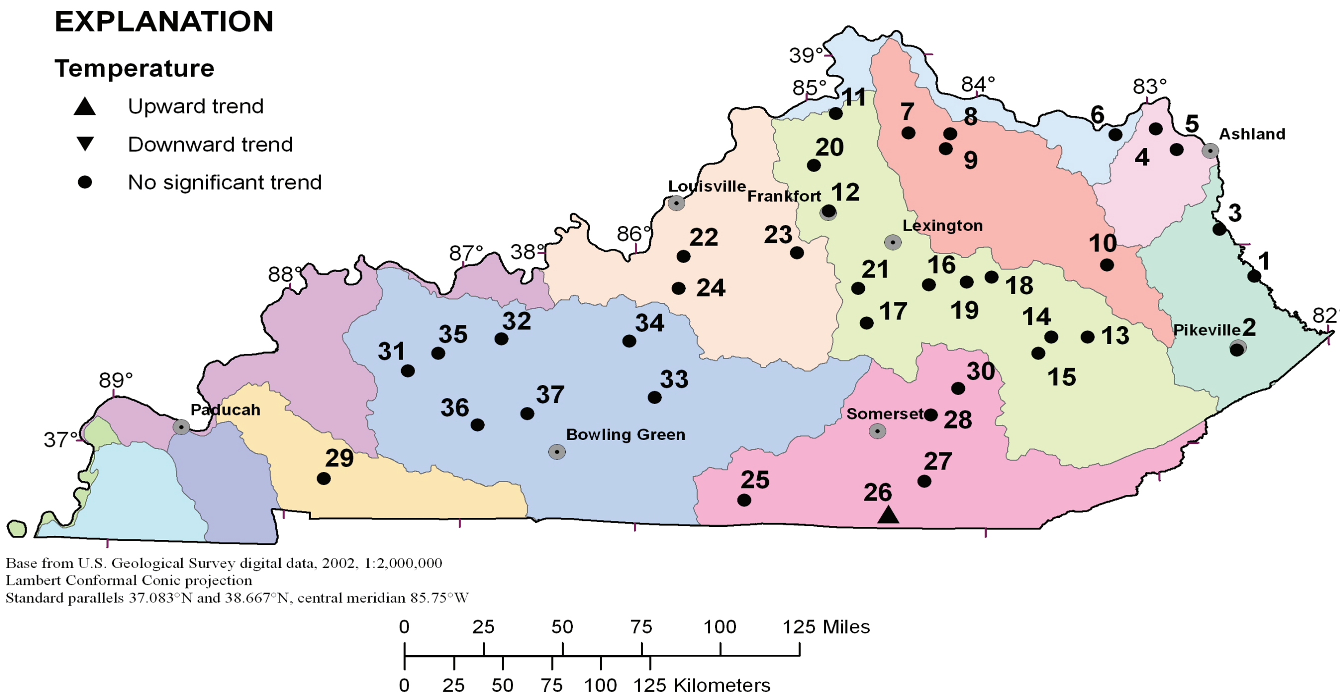


Figure 5. Trends in water temperature at selected water-quality stations, 1979–2004.

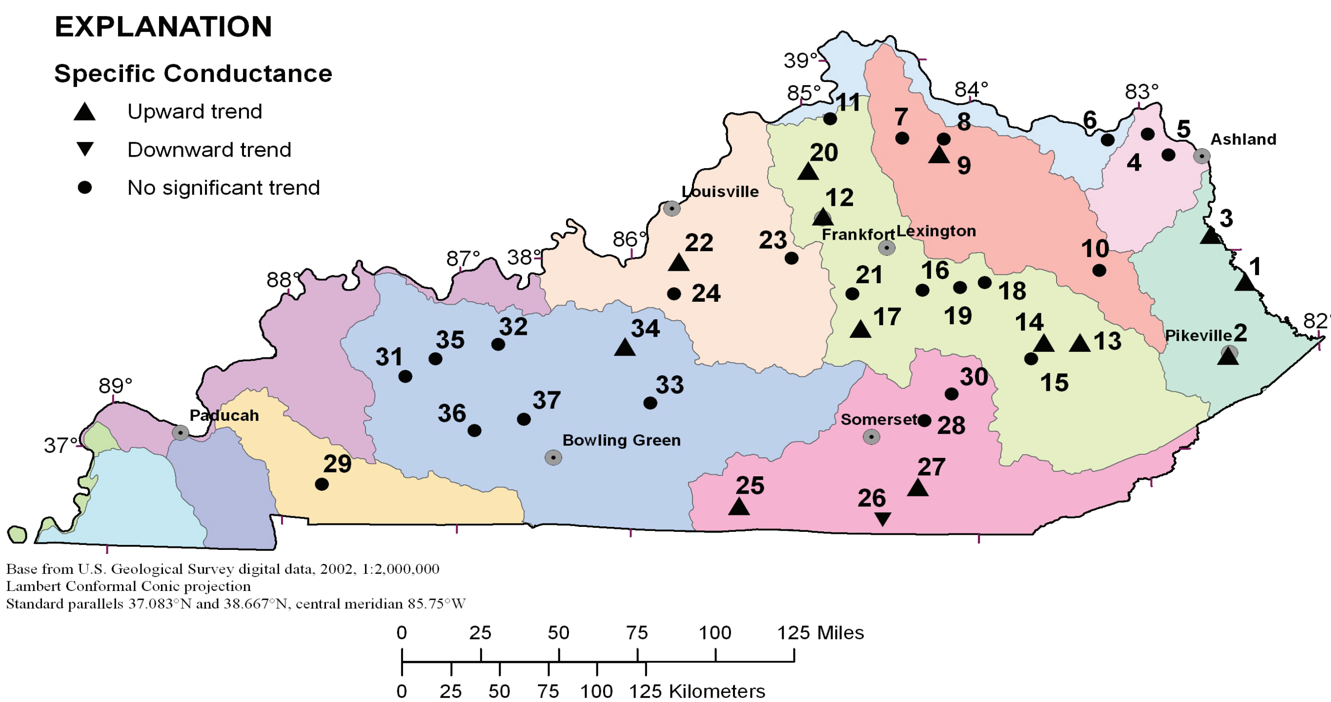


Figure 6. Trends in specific conductance of water samples at selected water-quality stations, 1979–2004.

The pH of uncontaminated stream water generally ranges from 6.5 to 8.5 standard units (Hem, 1985) and can exhibit diurnal fluctuations caused by photosynthetic/respiratory activity in algal populations. Trends in pH had increases at 14 stations throughout Kentucky and a decrease at 1 station, the Mud River at Gus (map number 36) (fig. 7).

Dissolved oxygen (DO) is necessary in aquatic systems for the survival and growth of many aquatic organisms and it often used as an indicator of the health of surface-water bodies (Lewis, 2006). Sources of DO in water include aeration and photosynthetic activities of instream aquatic plants and algal populations. DO values exhibit diurnal fluctuations, because of the photosynthetic activities. Regular water-quality sampling by the Commonwealth generally occurs during daylight hours; thus, trends in DO should be evaluated with this in mind. DO concentrations increased at 12 stations and did not show a change at the remaining 25 stations (fig. 8). The Rolling Fork near Lebanon Junction station (map number 12), the Pond River near Sacramento station (map number 13), and the Mud River near Gus station (PRI036) have the lowest median concentrations (<8.0 mg/L) of DO and no trend.

Hardness commonly is defined by the presence of calcium and magnesium and by a variety of other metals. General guidelines for classification of waters are as follows: 0 to 60 mg/L (milligrams per liter) as calcium carbonate is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and more than 180 mg/L as very hard. Limestone and other carbonate rocks are a natural source of hardness. Hardness concentrations increased at 13 stations, decreased at 1 station, and did not change at 23 stations (fig. 9). The South Fork Cumberland River at Blue Heron station (map number 26) had a decreased trend in concentrations of hardness. This station had one of the lowest median concentrations of hardness (48 mg/L) of the 37 stations and had a decreasing trend in specific conductance.

One of the leading causes of stream impairment in the United States is sediment (siltation) (U.S. Environmental Protection Agency, 2002). Excessive sediment affects stream habitat by eliminating important habitat areas for aquatic organisms, increases water-supply treatment costs, and decreases the usability of ponds and reservoirs. Sediment also can reduce the clarity of water, which affects photosynthesis, and can facilitate the transport of many constituents, such as nutrients, metals, and bacteria. Concentrations of total suspended solids (TSS) increased at 1 station (Beech Fork at Maud (map number 16)), decreased at 10 stations, and did not change at 26 stations (fig. 10). A potential cause for the increased trend of TSS at the Beech Fork at Maud station (map number 16) could be the change in land cover. The amount of developed land cover in the watershed upstream from this station increased about eight times from 1992 to 2001 (appendixes 1 and 2). All 5 stations located in the Upper Cumberland River Basin had decreasing trends in concentrations of TSS. This decline in concentrations of TSS spanned 2 decades, indicating a regional cause (possibly a decline in coal extraction). The drainage basins in five of six of these stations primarily are forested. Stations with the largest median concentrations of TSS had no trends and included Rolling Fork near Lebanon Junction (map number 12), Pond River near Sacramento (map number 13), and Rough River near Dundee (map number 14) (table 6).

Chloride and Sulfate

Major ions analyzed for trends in this study include chloride and sulfate. Chloride is present in all natural waters in generally low concentrations; exceptions include streams receiving inflows of high-chloride ground water or industrial waste (Hem, 1985). Chloride exhibits a conservative behavior and does not form important solute complexes with other ions unless concentrations of chloride are extremely high. Concentrations of chloride at the 37 stations had increasing trends at 15 stations, decreasing trends at 3 stations, and no significant trend in concentration over time at 19 stations (fig. 11). Two stations with decreasing trends of concentrations of chloride are located in south-central Kentucky; one station with a decreasing trend of concentrations of chloride is located in the northern part of Kentucky (Frankfort, Kentucky). Most of the increasing trends in concentrations of chloride are located in the northern part of Kentucky. Possible explanations for increasing trends in concentrations of chloride at the northern stations are an increase in the use of road salts for road deicing and (or) the result of resource extraction (oil, gas, and coal).

Sulfate is an oxidized form of sulfur and is naturally occurring in the environment. Sulfur is widely distributed in reduced form (metallic sulfides) in igneous and sedimentary rocks. The process of weathering these rocks and the oxidation of sulfur forms sulfate ions that enter surface waters. Concentrations of sulfate in streams may be increased by human activities, and may be larger in streams located in surface-mining areas than in unmined areas. Also, emissions of sulfur dioxide during the combustion of fossil fuels may increase concentrations of sulfate in streams (Smith and Alexander, 1986). Increasing trends of concentrations of sulfate were detected at 7 of the 37 stations (fig. 12). All seven of these stations were located in the Appalachian Region of eastern Kentucky where water quality in streams is potentially affected by surface mining. Five of the 37 stations had decreasing trends, including 3 stations in the Cumberland River Basin and 2 stations in the Green River Basin. Two stations with the largest median concentrations of sulfate (North Fork Kentucky River at Jackson (PRI013) and Pond River near Sacramento (map number 13)) had no trend in concentrations of sulfate (table 6).

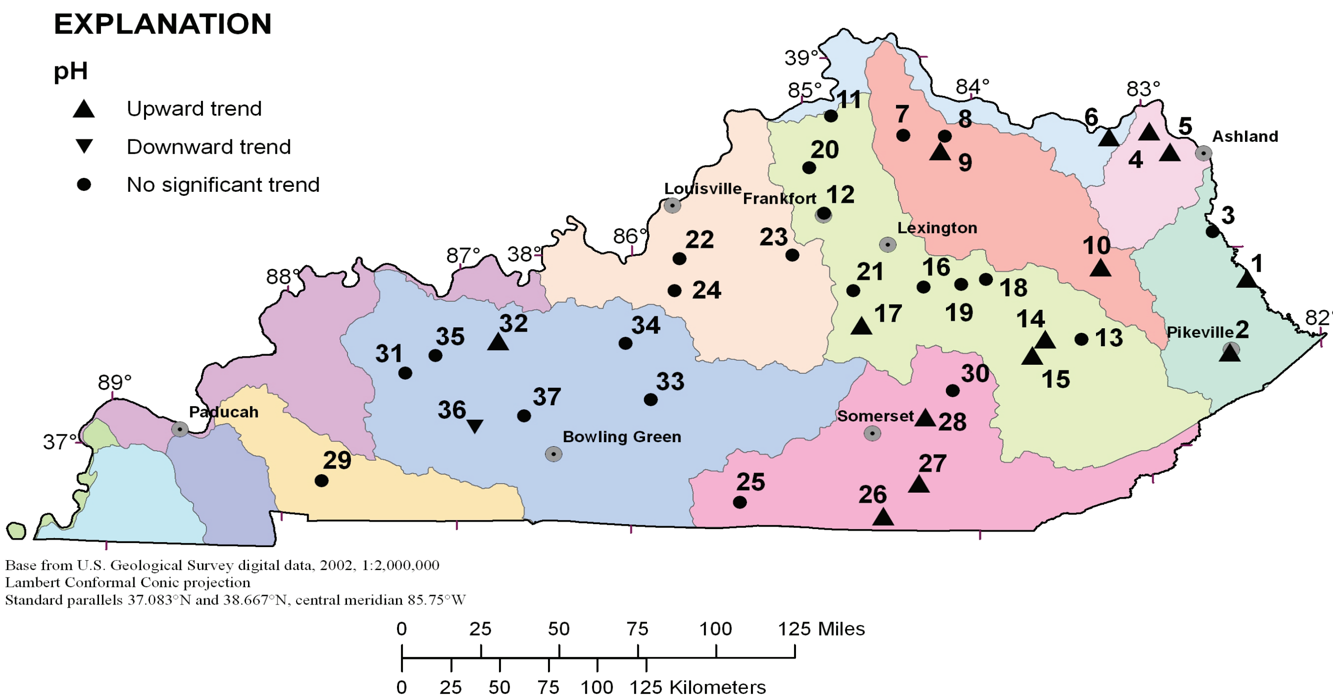


Figure 7. Trends in pH of water samples at selected water-quality stations, 1979–2004.

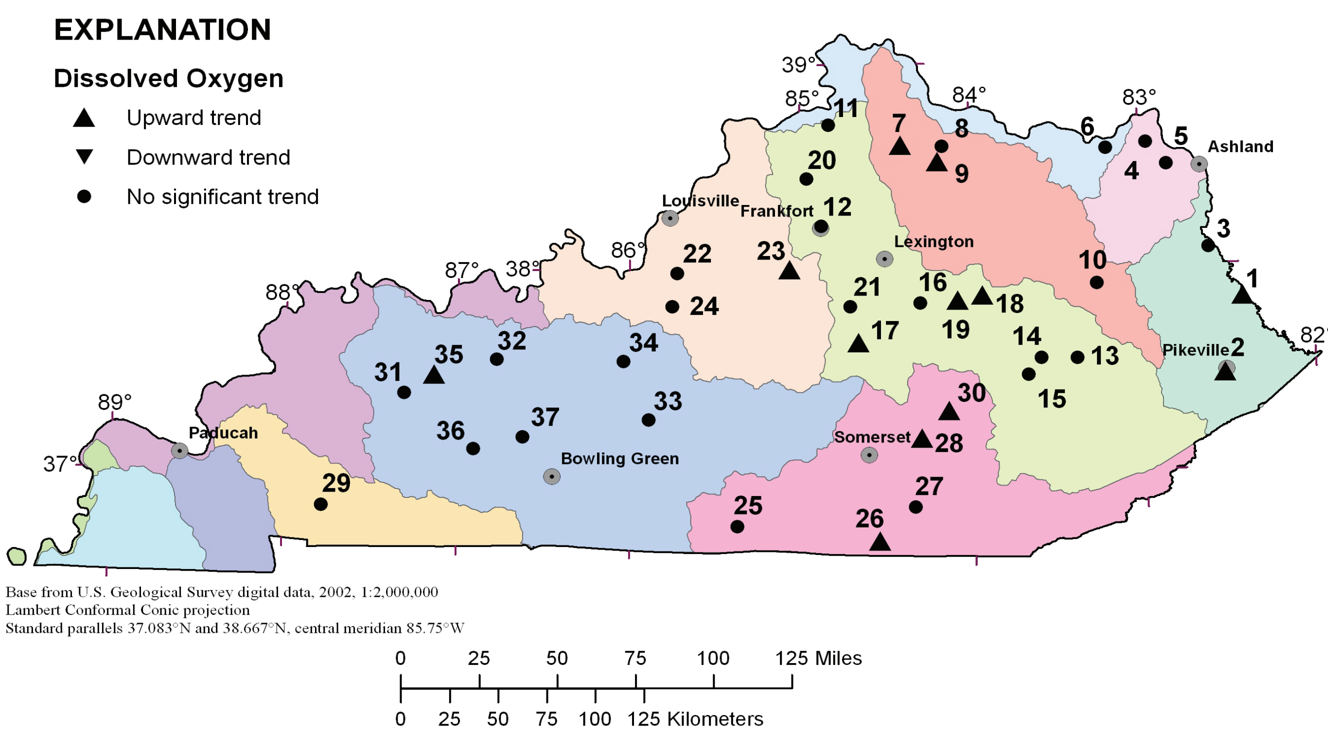


Figure 8. Trends in dissolved oxygen in water at selected water-quality stations, 1979–2004.

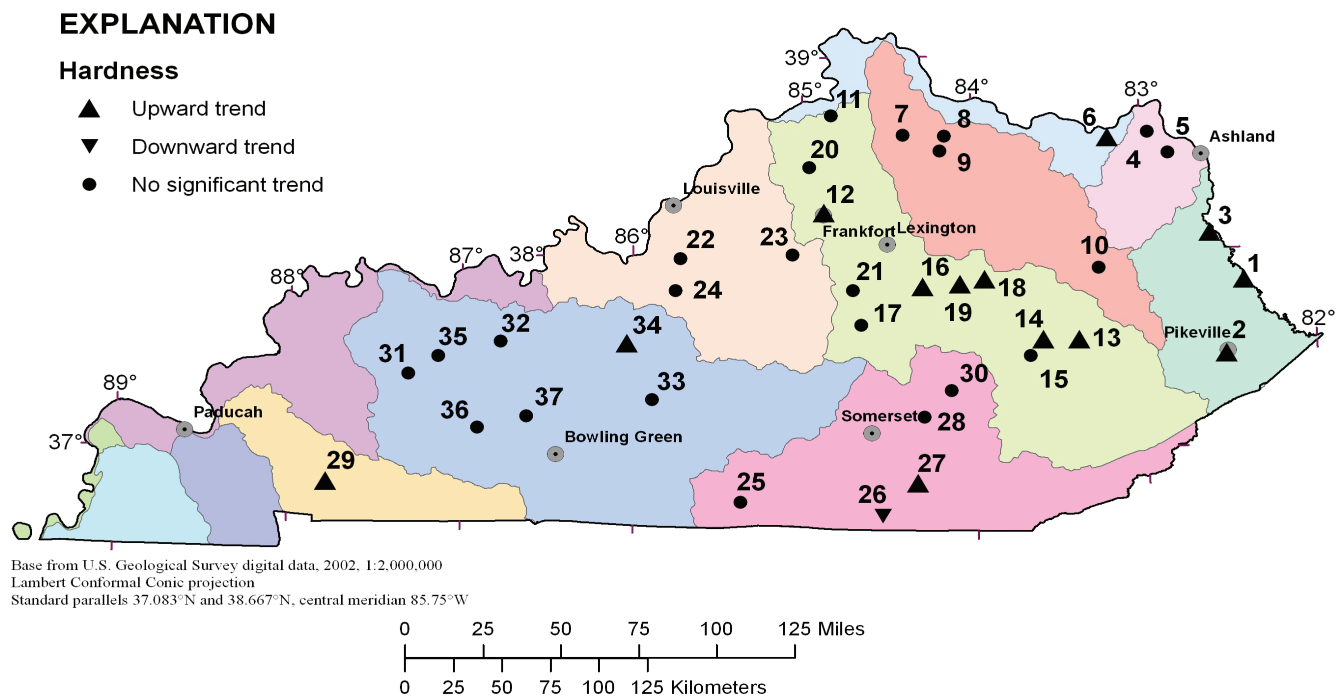


Figure 9. Trends in hardness of water samples at selected water-quality stations, 1979–2004.

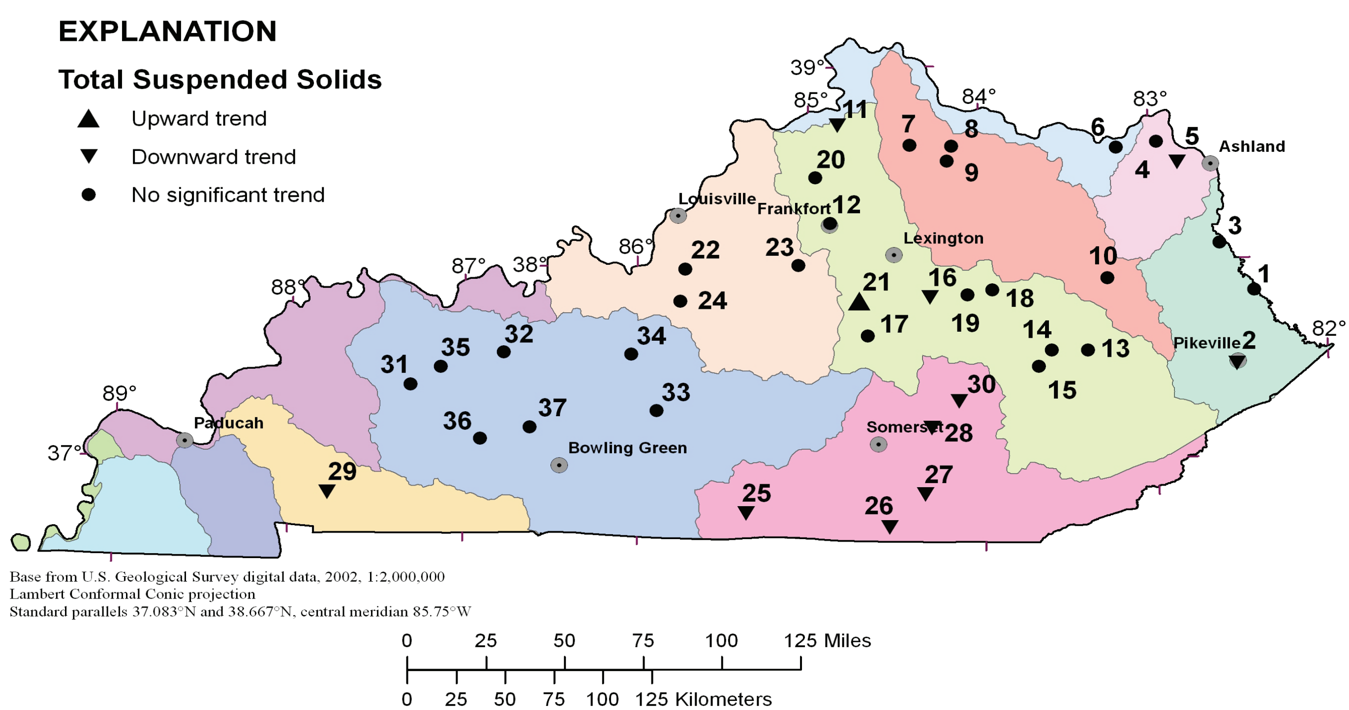


Figure 10. Trends in total suspended solids of water samples at selected water-quality stations, 1979–2004.

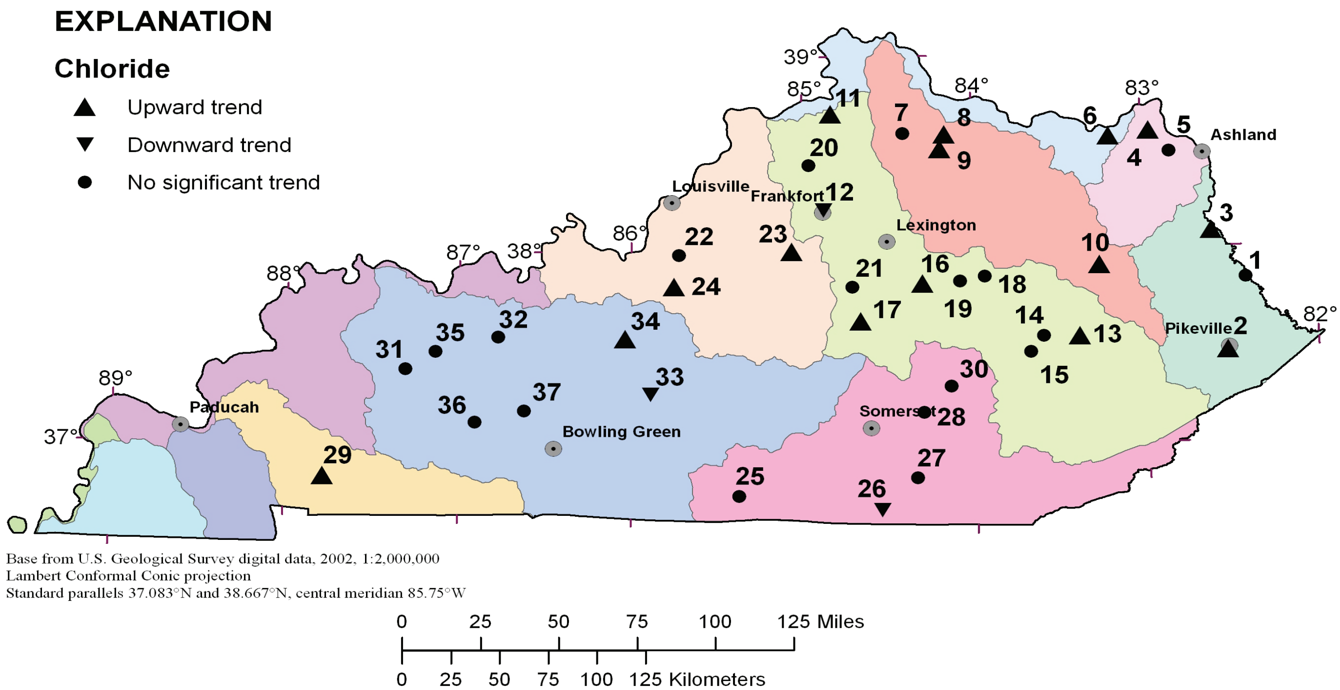


Figure 11. Trends in chloride of water samples at selected water-quality stations, 1979–2004.

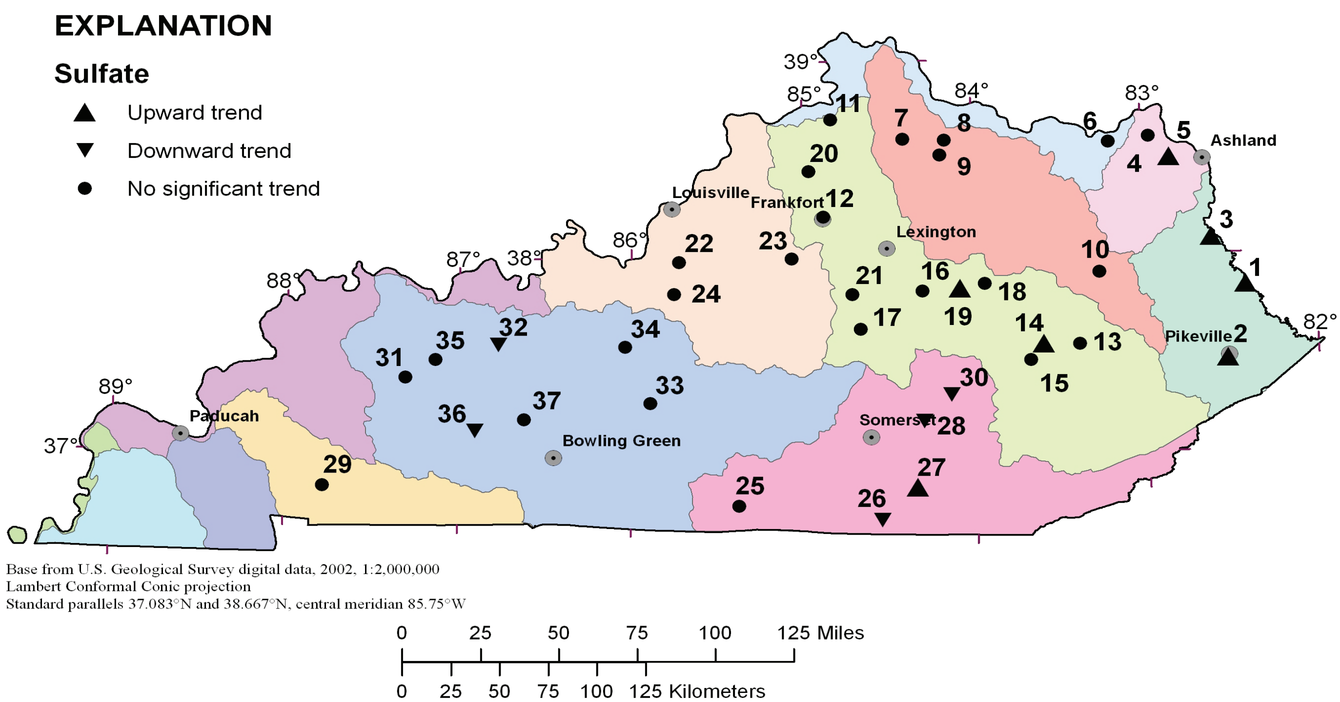


Figure 12. Trends in sulfate of water samples at selected water-quality stations, 1979–2004.

Iron and Manganese

Iron and manganese are common metallic elements found in the earth's crust and are chemically similar (Hem, 1985). Natural waters contain variable amounts of iron and manganese depending on the area geology and the pH of the stream water (Hem, 1985). Streams that receive acid drainage from coal mines usually have higher concentrations of iron and manganese. Recent studies have shown that dissolved concentrations of some trace metals exhibit substantial and persistent variation throughout the day (Nimick, 2003; Nimick and others, 2003). These diurnal and diel variations have been observed for most metals in streams that have neutral to slightly alkaline pH and also have been observed in acidic streams in concentrations of iron. The diurnal variations are likely caused by geochemical processes or by sorption of metals to bed material (Nimick and others, 2003). Iron and manganese generally are considered non-hazardous elements that are nuisances in water supply. Data for total iron and total manganese were evaluated for trend analysis at 37 stations. Concentrations of total iron increased at one station (Tygarts Creek near Lynn (map number 4)) and decreased at four stations (fig. 13). Of the five stations with median concentrations of total iron greater than 1,000 mg/L, none had a significant trend (table 6). The median concentration of total iron exceeded the USEPA's secondary drinking water standard (300 mg/L) for total iron at 34 stations. Of these 34 stations, 4 stations had decreasing trends in concentrations of total iron, 1 station had increasing trends in concentrations of total iron, and 29 stations had no trend in concentrations of total iron.

Concentrations of total manganese increased at two stations: Rolling Fork near Lebanon Junction (map number 24) and Licking River at West Liberty (map number 10) (fig. 14). Thirteen stations had decreasing concentrations of total manganese scattered statewide, and all 6 monitoring stations in the Cumberland River Basin had decreasing concentrations of total manganese. This decline in concentrations of total manganese, spanning 2 decades, indicates a regional cause, possibly a decline in coal extraction. The median concentration of total manganese exceeded the USEPA's secondary drinking-water standard (50 µg/L) for total manganese at 29 stations. Of these 29 stations, 11 stations had decreasing trends in concentrations of total manganese, 2 stations had increasing trends in concentrations of total manganese, and 16 stations had no trend in concentrations of total manganese.

Nutrients

Phosphorus is an essential plant nutrient, but in high concentrations can cause excessive growth of undesirable plants and algae in water bodies leading to reduced oxygen levels (hypoxia). Major sources of phosphorus are wastewater-treatment facilities, septic-tank leaks, fertilizer application, and the weathering of rocks and soil. Soil erosion is a major contributor of phosphorus to streams, because phosphorus tends to attach to soil particles. Total phosphorus includes dissolved and particulate (sediment bound) species. Although no established aquatic-life criterion exists for total phosphorus, the USEPA recommends a maximum concentration of total phosphorus of 0.1 mg/L to discourage excessive growth of aquatic plants and algae. Median concentrations of total phosphorus were greater than 0.1 mg/L at 7 of the 37 stations. Four of the seven stations (Beech Fork at Maud (map number 16), Salt River at Shepherdsville (map number 34), Salt River at Glensboro (map number 23), and Little River near Cadiz (map number 29)) had decreasing trends in concentrations of total phosphorus; the remaining 3 stations had no significant trend in concentration over time. Concentrations of total phosphorus increased at 4 stations, decreased at 14 stations, and exhibited no significant trend in concentration over time at 19 stations. Three of the four stations with increased concentrations of total phosphorus were in the Kentucky River Basin (fig. 15). These included the Middle Fork Kentucky River at Tallega station (map number 14), the Red River at Clay City station (map number 18), and the Kentucky River at Lockport (Lock 2) station (map number 20). The fourth station was in the Green River basin on the Green River near Woodbury (map number 37).

Nitrogen also is an essential nutrient for plants, and like phosphorus, potentially can cause hypoxia in water bodies in higher concentrations. The major sources of nitrogen include wastewater-treatment facilities, rainfall, and fertilizer application. Nitrogen can be measured as total nitrogen (TN), total Kjeldahl nitrogen (TKN), as nitrite-nitrate-nitrogen (NO_2+NO_3-N), and ammonia-nitrogen (NH_4-N). TN is the total amount of nitrogen in a sample; TKN represents the fraction of TN that is unavailable for growth or bound up in organic form and includes NH_4-N. The remaining nitrogen species, NO_2+NO_3-N, represents the bioavailable form of nitrogen.

Concentrations of TN increased at 2 stations (Little Sandy at Argillite (map number 5) and Little River near Cadiz (map number 29)) and decreased at 10 stations statewide (fig. 16). No trends were detected at 25 stations. A possible reason for increased concentrations of TN at the Little Sandy at Argillite station and Little River near Cadiz station is that both stations had greater than 50-percent increases in developed land cover. The upper portion of the Cumberland River Basin had four of five stations with decreasing concentrations of TN, indicating a regional cause.

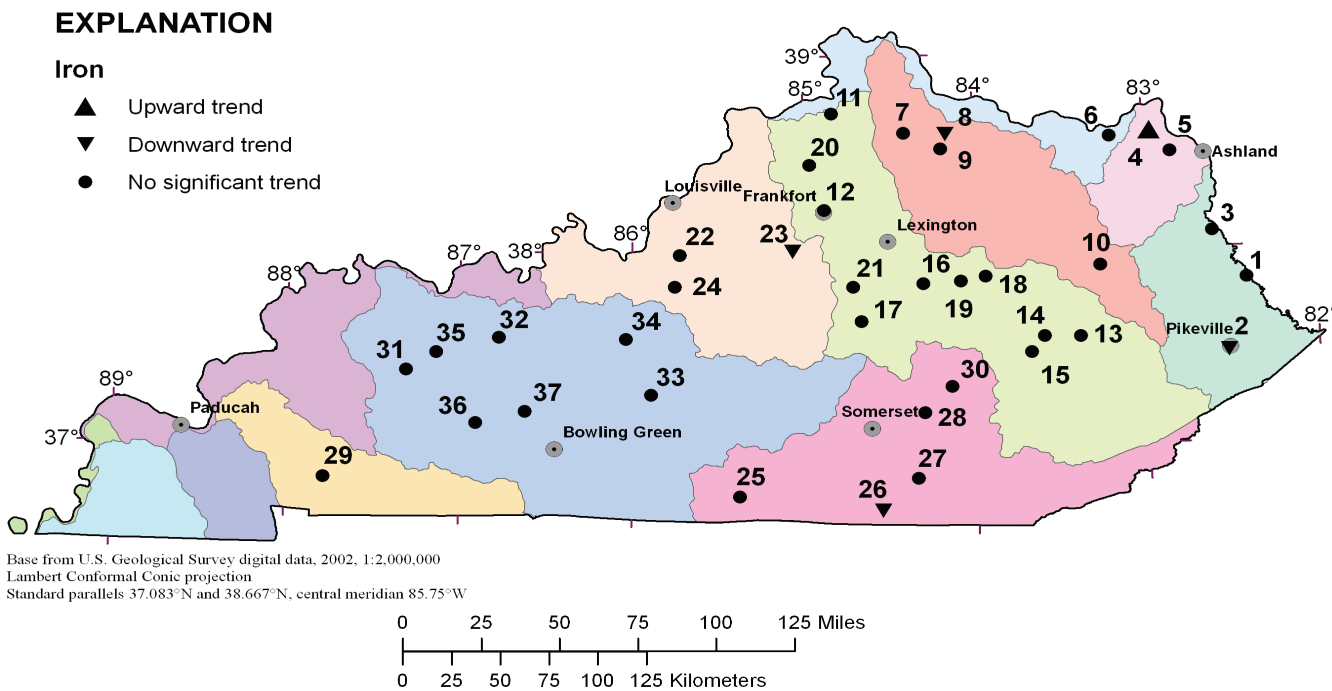


Figure 13. Trends in iron of water samples at selected water-quality stations, 1979–2004.

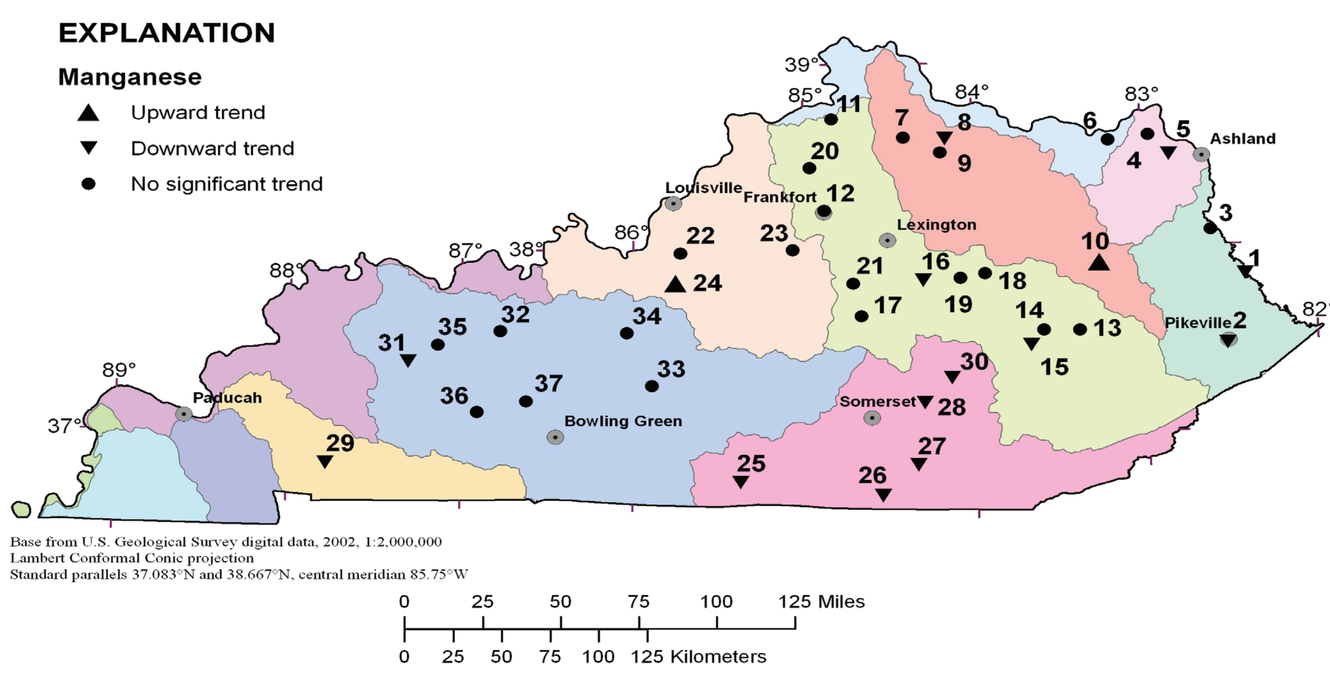


Figure 14. Trends in manganese of water samples at selected water-quality stations, 1979–2004.

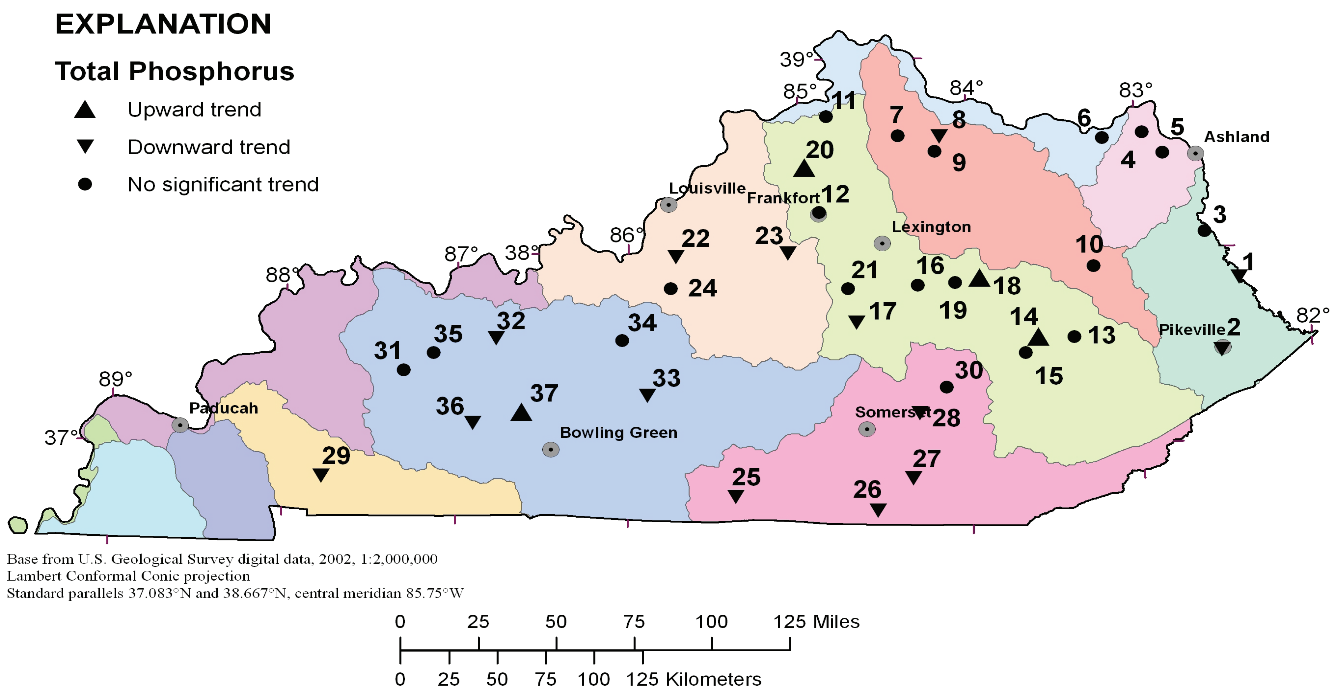


Figure 15. Trends in total phosphorus of water samples at selected water-quality stations, 1979–2004.

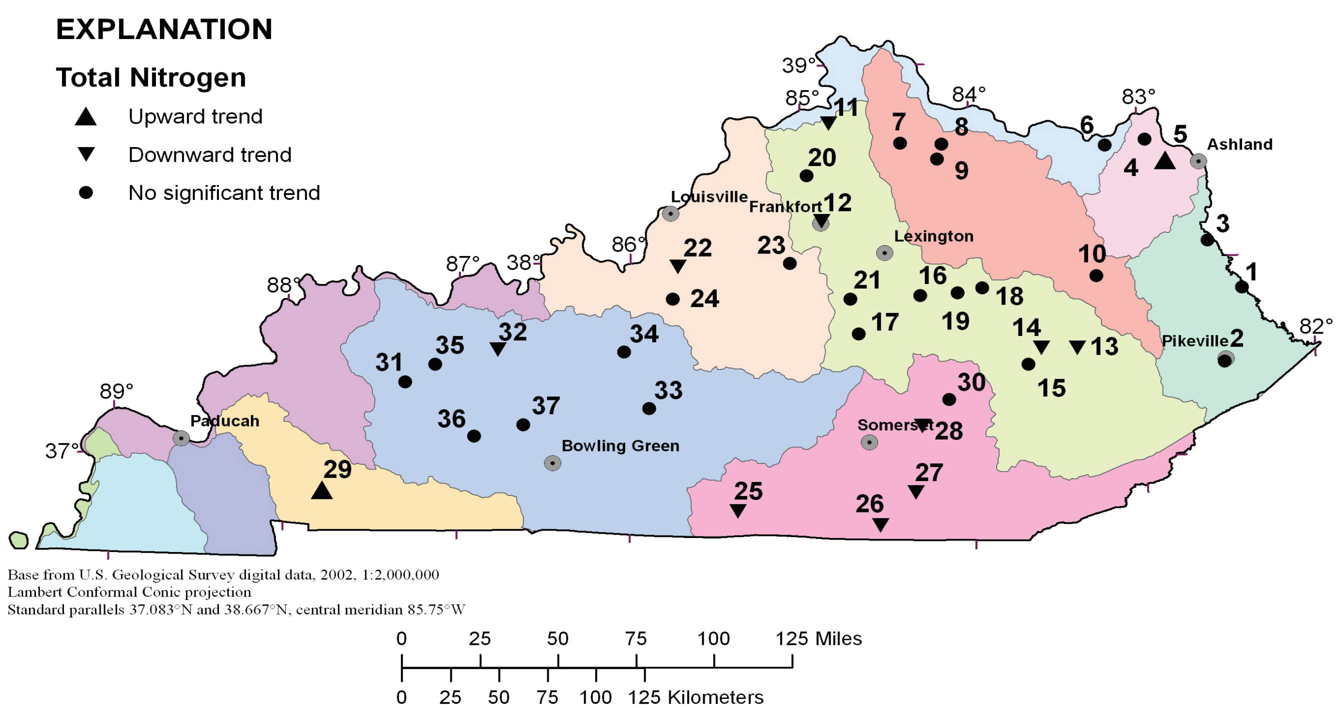


Figure 16. Trends in total nitrogen of water samples at selected water-quality stations, 1979–2004.

Nineteen stations had decreasing trends in concentrations of TKN, and 18 stations had no trends in concentrations of TKN (fig. 17). No increasing trends were shown at any station. Although TKN is immobile in soils because of adsorption on soil surfaces, it is susceptible to nitrification under aerobic conditions; thus, potentially forming NO_2+NO_3-N. The majority of stations had lower median concentrations of TKN than NO_2+NO_3-N (table 6). Only the Eagle Creek near Glencoe station (map number 11) and the Pond River near Sacramento station (map number 31) had higher median concentrations of TKN (about two times higher) than NO_2+NO_3-N (table 6).

Increasing trends of concentrations of NO_2+NO_3-N were detected at four stations (fig. 18). These stations include Little River near Cadiz (map number 29), Nolin River at White Mills (map number 34), Little Sandy River at Argillite (map number 5), and Levisa Fork near Pikeville (map number 2). The Little River near Cadiz station (map number 29) and the Nolin River at White Mills station (map number 34) have the highest median concentrations of NO_2+NO_3-N at 3.08 and 2.69 mg/L as nitrogen, respectively. The major land-use category at both the Little River near Cadiz station (map number 29) and the Nolin River at White Mills station (map number 34) is agriculture. The Little Sandy River at Argillite station (map number 5) and the Levisa Fork near Pikeville station (map number 2) had increases in developed land use between 1992 and 2001 (appendix 1 and 2). Decreasing trends in concentrations of NO_2+NO_3-N were detected at five stations throughout the Commonwealth (table 6). Trends for concentrations of ammonia were not performed because concentrations of ammonia were highly censored (more than 50 percent) for the majority of stations (table 6).

Bacteria

Numerous factors such as land use, the chemical and physical properties of stream water, seasonality, and reservoirs can affect the concentrations of fecal coliform. Data for fecal coliform were analyzed for trends at 37 stations (fig. 19); three stations had increasing trends in fecal coliform. These stations include Green River near Woodbury (map number 37), Horse Lick Creek near Lamero (map number 30), and Kentucky River near Trapp (map number 19). Sixteen stations throughout the Commonwealth had decreasing trends in concentrations of fecal coliform; 3 stations had increasing trends in concentration of fecal coliform; the remaining 17 stations had no trends in concentrations of fecal coliform. The median concentrations of fecal coliform at six stations exceeded the Kentucky primary-contact recreation water-quality standard of 400 colonies per 100 milliliters (Kentucky Energy and Environment Cabinet, 2008b). Four of these stations (Tug Fork at Kermit, West Virginia (map number 1), Levisa Fork near Pikeville (map number 2), Licking River at West Liberty (map number 3), and North Fork Kentucky River at Jackson (map number 13) had decreasing trends in concentrations of fecal coliform and two stations (Levisa Fork near Louisa (map number 3) and Salt River at Shepherdsville (map number 22)) had no trend in concentrations of fecal coliform.

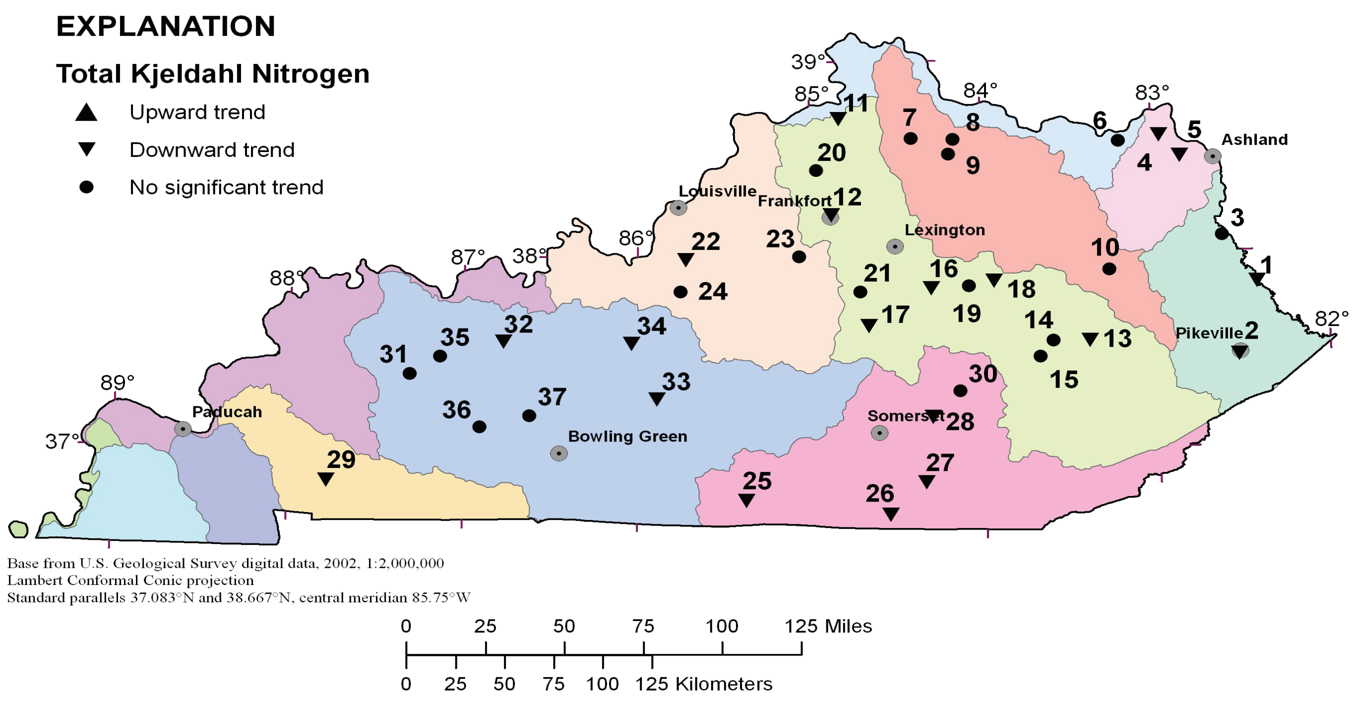


Figure 17. Trends in total Kjeldahl nitrogen of water samples at selected water-quality stations, 1979–2004.

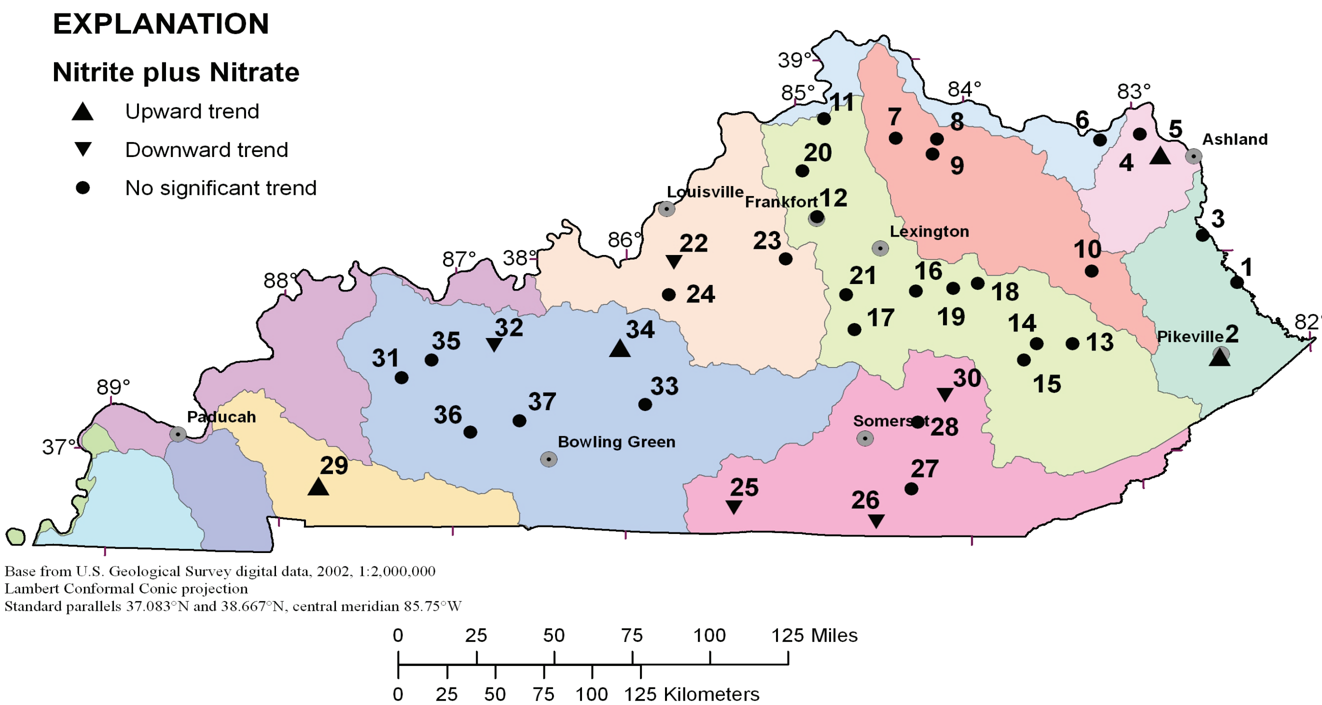


Figure 18. Trends in nitrite plus nitrate of water samples at selected water-quality stations, 1979–2004.

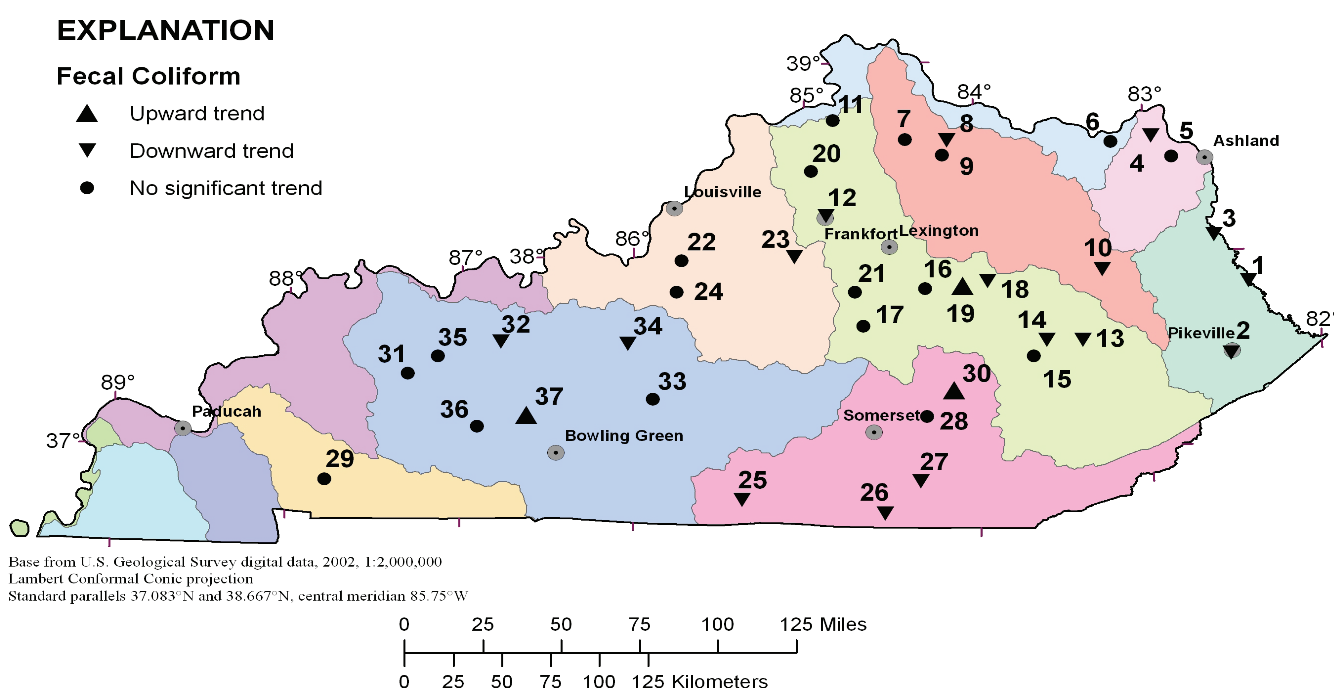


Figure 19. Trends in fecal coliform of water samples at selected water-quality stations, 1979–2004.

Summary and Conclusions

This report presents the results of a study conducted by the U.S. Geological Survey, in cooperation with the Kentucky Energy and Environment Cabinet–Kentucky Division of Water, to analyze and summarize long-term water-quality trends of selected properties and water-quality constituents in select streams in Kentucky's ambient stream water-quality monitoring network. For this study, a total of 37 Commonwealth ambient water-quality-network stations were selected and 15 properties and water-quality constituents were evaluated at each station. Water-quality records for selected physical properties (temperature, specific conductance, pH, dissolved oxygen, hardness, and suspended solids), major ions (chloride and sulfate), selected metals (iron and manganese), nutrients (total phosphorus, total Kjeldahl nitrogen, nitrite plus nitrate, and ammonia), and fecal coliform were retrieved from U.S. Environmental Protection Agency's Legacy Data Center and Modernized storage and retrieval (STORET) database, screened, and analyzed for select periods of record during water years 1979–2004. The selected water-quality stations cover all of the major river basins in Kentucky, except for the Tradewater River Basin. Physiography, general land use, and population distribution were presented to provide assistance in the interpretation of detected trends, when possible. Detailed analyses of how detected trends relate to hydrogeology, hydrologic modifications, and pollution sources are beyond the scope of this report.

Trend analyses were completed using the S-Plus statistical program S-Estimate Trend (S-ESTREND), which detects trends in water-quality data. The trend-detection techniques supplied by this program include the Seasonal Kendall nonparametric methods for use with uncensored data or data censored with only one reporting limit and the Tobit-regression parametric method for use with data censored with multiple reporting limits. One of these tests was selected for each property and water-quality constituent and applied to all station records so that the results of the trend procedure could be compared among stations. These techniques were used in conjunction with flow-adjustment procedures at all stations to remove the effects of streamflow on water-quality variability. Flow adjustments can be an integral part of understanding the effects on water quality. Flow adjustments were used for all properties, except temperature, and all water-quality constituents. Trend results presented in this report were considered statistically significant when p-values were less than 0.05.

Significant trends varied by station, constituent, and the period of record for each station. All stations and all constituents have at least one statistically significant increasing or decreasing trend. The South Fork Cumberland River near Blue Heron station has the most trends: 13 decreasing trends and 3 increasing trends (dissolved oxygen, temperature, and pH). The stations with only one statistically significant trend are the South Fork Licking River at Morgan station and the Green River near Livermore station, with one increasing trend in concentrations of dissolved oxygen; the Kentucky River at High Bridge station, with one increasing trend in concentrations of total suspended solids; and the Pond River near Sacramento station, with one decreasing trend in concentrations of manganese.

Trends for physical properties typically were not numerous nor geographically widespread; thus, indicating the improvement or degradation of water quality generally has been station specific. No trends for water temperature were detected, except for the increasing trend at the South Fork Cumberland River near Blue Heron station. This same station also had significant decreasing trends in specific conductance and concentrations of hardness. Concentrations of dissolved oxygen had no statistically significant decreasing trends at any station and had statistically significant increasing trends at 12 stations. The Mud River near Gus station had the only decreasing trend in pH. Concentrations of total suspended solids decreased at 10 stations with 5 of those stations located in the Cumberland River Basin. This decline in concentrations of total suspended solids spanned 2 decades and indicates a regional cause (possibly a decline in coal extraction).

Major ions analyzed for trends included chloride and sulfate. Concentrations of chloride at the 37 stations had increasing trends at 15 stations, decreasing trends at 3 stations, and no significant trend in concentration over time at 19 stations. Most of the increasing trends in concentrations of chloride are located in the northern part of Kentucky, possibly indicating an increase in the use of road salts for road deicing and (or) the result of resource extraction (oil, gas, and coal). Increasing trends in concentrations of sulfate were detected at seven stations, all of which were located in the Appalachian Region of eastern Kentucky, where water quality in streams is potentially affected by surface mining. Two stations with the largest median concentrations of sulfate had no trend.

Concentrations of total iron had statistically significant increasing (one station) and decreasing (four stations) trends scattered in the eastern part of Kentucky, where high concentrations of total iron are common. The Tygarts Creek near Lynn station had a significant increasing trend in total iron; although, an explanation for this increase is beyond the scope of this report. Five stations had median concentrations of total iron greater than 1,000 micrograms per liter, but none had a statistically significant trend. Concentrations of total manganese had increasing trends at 2 stations, decreasing trends at 13 stations, and no significant trend in concentration over time at 22 stations. All six monitoring stations in the Cumberland River Basin had decreasing concentrations of total manganese, possibly because of a decline in coal extraction. The median concentration of total manganese exceeded the U.S. Environmental Protection Agency's secondary drinking-water standard (50 micrograms per liter) for total manganese at 29 stations. Eleven of these stations had decreasing trends, 2 stations had increasing trends, and 16 stations had no trend in concentrations of total manganese.

Concentrations of total phosphorus (includes dissolved and particulate species) had increasing trends at 4 stations, decreasing trends at 14 stations, and no significant trend in concentration over time at 19 stations. Three of the four stations with increased concentrations of total phosphorus were in the Kentucky River Basin. These stations were Middle Fork Kentucky River at Tallega, Red River at Clay City, and Kentucky River at Lockport (Lock 2). The fourth station was Green River near Woodbury, in the Green River Basin.

Trend analysis for all nitrogen constituents analyzed indicated no trends at 25 stations. Concentrations of total nitrogen had two significant increasing trends at the Little Sandy at Argillite station and at the Little River near Cadiz station. Concentrations of total Kjeldahl nitrogen (TKN) decreased at 19 stations and had no trends at 18 stations. No stations had an increasing trend in concentrations of TKN. Although TKN is immobile in soils because of adsorption on soil surfaces, it is susceptible to nitrification under aerobic conditions; thus, potentially forming nitrite-nitrate-nitrogen (NO_2+NO_3-N). The majority of stations had lower median concentrations of TKN than NO_2+NO_3-N. Two stations (Eagle Creek at Glencoe and Pond River near Sacramento) had about two times the concentration of TKN than NO_2+NO_3-N. Increasing trends of concentrations of NO_2+NO_3-N were detected at four stations. These stations include Little River near Cadiz, Nolin River at White Mills, Little Sandy River at Argillite, and Levisa Fork near Pikeville. The Little River near Cadiz station and the Nolin River at White Mills station have the highest median concentrations of NO_2+NO_3-N at 3.08 and 2.69 milligrams per liter, respectively. The major land-use category at both the Little River near Cadiz station and the Nolin River at White Mills station is agriculture. The Little Sandy River at Argillite station and the Levisa Fork near Pikeville station had increases in developed land use between 1992 and 2001. Decreasing trends of concentrations of NO_2+NO_3-N were detected at five stations throughout the Commonwealth. Trends for concentrations of ammonia were not performed because concentrations of ammonia were highly censored (>50 percent) for the majority of stations.

Trend analysis for concentrations of fecal coliform had 16 decreasing trends and 3 increasing trends, statewide. Every major drainage basin had at least one station with a significant decreasing trend in concentration of fecal coliform, except the Middle Ohio-Little Miami River Basin. This basin only contains one ambient water-quality monitoring station (Kinniconick Creek near Tannery), which had no significant trend in fecal coliform.

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Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004.

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Temperature (degrees Celsius)								
1	03214500	PRI002	239	0	1979-2003	0.0	5.0	8.0	14.5	23.0	25.0	30.0	None	0.068	0.420
2	03209500	PRI006	244	0	1979-2003	.0	5.3	8.0	15.4	22.7	25.0	29.0	None	.561	.000
3	03215000	PRI064	99	0	1991-2003	2.0	5.8	8.0	15.0	23.0	25.0	30.0	None	.050	1.78
4	03217000	PRI048	178	0	1985-2004	.0	4.0	6.0	12.8	21.0	23.3	28.0	None	.768	.000
5	03216500	PRI049	174	0	1985-2003	.3	4.0	7.0	13.2	20.6	23.0	26.0	None	.701	.000
6	03237250	PRI063	102	0	1991-2003	1.0	4.0	6.0	12.5	20.8	24.0	30.0	None	.662	.000
7	03252500	PRI059	105	0	1991-2003	.1	3.5	7.4	14.1	22.9	26.0	33.6	None	.119	-1.17
8	03251400	PRI060	106	0	1991-2003	.3	3.5	6.8	13.9	20.6	23.0	27.8	None	.550	-.377
9	03249500	PRI061	106	0	1991-2003	.4	4.5	8.0	13.1	21.5	24.3	28.6	None	.194	-.755
10	03248640	PRI062	83	0	1992-2003	.2	4.0	7.0	12.3	20.0	23.0	26.0	None	.292	-1.058
11	03291500	PRI022	258	0	1979-2003	-1.0	1.6	6.8	13.5	23.0	25.0	31.0	None	.514	-.048
12	03287500	PRI024	274	0	1979-2003	1.3	5.5	7.9	15.2	24.0	27.1	30.3	None	.709	-.049
13	03280000	PRI031	199	0	1984-2003	-.1	4.2	7.2	14.6	22.8	25.0	27.8	None	.914	.000
14	03281000	PRI032	199	0	1984-2003	.5	4.4	7.8	14.4	21.7	23.8	27.8	None	.555	.190
15	03281500	PRI033	197	0	1984-2003	-.1	4.4	7.4	14.6	23.0	25.6	28.2	None	.808	-.077
16	03300400	PRI041	200	0	1984-2003	.1	3.6	6.8	14.9	22.1	25.9	29.3	None	.318	.578
17	03285000	PRI045	180	0	1985-2003	.0	4.4	7.3	14.4	22.2	24.9	29.8	None	.702	-.181
18	03283500	PRI046	169	0	1985-2003	-.2	3.4	6.0	12.5	21.5	23.9	26.8	None	.219	-.482
19	03282300	PRI058	126	0	1991-2003	-.8	4.8	7.1	15.4	22.7	26.1	29.6	None	.886	-.285
20	03290500	PRI066	68	0	1996-2003	2.8	6.1	9.0	16.4	24.1	26.3	30.4	None	.838	.204
21	03286500	PRI067	43	0	1997-2003	2.7	5.8	8.8	14.9	22.8	25.9	30.4	None	.318	-2.27
22	03298500	PRI029	245	0	1979-2003	.1	4.1	7.0	14.6	22.7	25.7	29.1	None	.396	.202
23	03295400	PRI052	159	0	1989-2003	-.1	4.3	6.9	14.5	21.4	24.8	31.1	None	.402	.909
24	03301500	PRI057	121	0	1991-2003	-.1	4.8	6.9	15.1	22.0	25.2	27.6	None	.704	.333
25	03414110	PRI007	253	0	1979-2003	4.0	7.0	9.0	12.0	14.0	15.4	19.0	None	.200	.000
26	03410500	PRI008	259	0	1979-2003	.1	5.0	8.6	15.0	23.0	26.8	31.0	Increasing	.041	.551
27	03404500	PRI009	258	0	1979-2003	.0	5.0	8.5	15.0	23.0	26.0	32.0	None	.090	.429
28	03406500	PRI010	252	0	1979-2003	-.1	5.0	8.0	14.5	21.5	25.0	32.0	None	.466	-.044

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Temperature (degrees Celsius)—continued															
29	03438000	PRI043	171	0	1985-2003	2.0	6.6	9.5	14.8	19.5	21.5	26.0	None	0.604	0.174
30	03405842	PRI051	178	0	1985-2003	.1	5.3	7.6	12.5	18.9	22.0	26.3	None	.137	.637
31	03321060	PRI012	254	0	1979-2003	-1.0	3.4	7.2	15.5	23.4	27.0	31.0	None	.260	.364
32	03319000	PRI014	255	0	1979-2003	1.0	5.0	8.1	14.6	19.9	23.5	27.5	None	.134	.342
33	03308500	PRI018	279	0	1979-2003	1.0	6.2	9.0	14.8	21.0	24.0	27.0	None	.161	.167
34	03310300	PRI021	261	0	1979-2003	.5	7.0	9.5	14.0	19.6	22.0	28.0	None	1.000	.000
35	03316500	PRI055	115	0	1991-2003	4.6	8.4	10.3	18.9	26.4	29.7	33.0	None	.390	.670
36	03316275	PRI056	117	0	1991-2003	1.0	4.8	8.0	17.0	23.1	25.0	28.4	None	.673	.358
37	03315500	PRI103	43	0	1998-2004	2.8	6.9	9.3	16.3	21.8	25.7	27.9	None	.295	-2.64
Specific conductance (µS/cm)															
1	03214500	PRI002	241	0	1979-2004	27	280	351	487	700	873	1,230	Increasing	.000	1.28
2	03209500	PRI006	245	0	1979-2004	36	284	346	452	561	659	795	Increasing	.000	2.17
3	03215000	PRI064	104	0	1991-2004	237	282	360	451	568	628	784	Increasing	.003	2.51
4	03217000	PRI048	179	0	1985-2004	110	172	192	230	258	286	386	None	.101	.663
5	03216500	PRI049	177	0	1985-2003	118	150	175	224	282	334	999	None	.061	1.24
6	03237250	PRI063	105	0	1991-2003	13	78	91	111	130	153	312	None	.160	.541
7	03252500	PRI059	106	0	1991-2003	210	321	351	397	449	508	601	None	.378	.472
8	03251400	PRI060	106	0	1991-2003	184	309	376	425	456	491	534	None	.600	-.141
9	03249500	PRI061	105	0	1991-2003	167	186	198	224	252	281	343	Increasing	.035	1.45
10	03248640	PRI062	92	0	1992-2003	115	159	209	261	329	367	628	None	.786	.553
11	03291500	PRI022	324	0	1979-2003	162	278	322	365	442	495	855	None	.229	.281
12	03287500	PRI024	316	0	1979-2003	140	214	260	308	360	421	656	Increasing	.034	.945
13	03280000	PRI031	201	0	1984-2004	252	358	427	545	753	897	1,770	Increasing	.001	2.79
14	03281000	PRI032	65	0	1995-2004	142	171	232	307	372	418	569	Increasing	.032	4.37
15	03281500	PRI033	205	0	1984-2004	96	146	181	227	303	381	1,900	None	.568	.175
16	03300400	PRI041	199	0	1984-2003	7	280	318	377	452	485	563	None	.310	-.222
17	03285000	PRI045	179	0	1985-2003	130	260	291	321	359	392	483	Increasing	.026	.611
18	03283500	PRI046	54	0	1995-2003	53	160	172	203	242	273	363	None	.957	-.044

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Specific conductance (µS/cm)—continued								
19	03282300	PRI058	117	0	1991-2003	189	227	278	337	445	581	838	None	0.198	0.675
20	03290500	PRI066	67	0	1996-2003	200	279	310	345	407	455	557	Increasing	.338	1.72
21	03286500	PRI067	43	0	1997-2003	185	255	310	375	462	572	662	None	.561	1.01
22	03298500	PRI029	255	0	1979-2004	159	299	353	397	441	484	1,040	Increasing	.013	.482
23	03295400	PRI052	153	0	1989-2003	12	334	399	462	527	585	1,030	None	.745	.108
24	03301500	PRI057	122	0	1991-2003	228	293	347	392	427	462	652	None	.705	.149
25	03414110	PRI007	257	0	1979-2003	12	140	153	170	184	209	313	Increasing	.004	.690
26	03410500	PRI008	256	0	1979-2003	39	82	100	124	167	221	340	Decreasing	.000	-1.65
27	03404500	PRI009	213	0	1979-2003	27	177	230	286	388	485	735	Increasing	.001	1.68
28	03406500	PRI010	254	0	1979-2003	18	117	140	175	223	261	547	None	1.00	-.005
29	03438000	PRI043	170	0	1985-2003	146	290	338	383	430	460	555	None	.263	-.428
30	03405842	PRI051	170	0	1985-2003	45	84	106	141	188	235	464	None	.976	-.023
31	03321060	PRI012	125	0	1991-2004	215	361	562	845	1,410	2,024	3,310	None	.762	-.767
32	03319000	PRI014	259	0	1979-2004	47	131	168	207	238	262	893	None	.252	.360
33	03308500	PRI018	264	0	1979-2003	25	174	199	243	310	354	529	None	.754	-.138
34	03310300	PRI021	125	0	1979-2004	108	243	304	354	413	518	785	Increasing	.004	1.35
35	03316500	PRI055	117	0	1991-2003	155	188	240	287	347	444	710	None	.357	.856
36	03316275	PRI056	135	0	1991-2004	4	183	229	300	355	389	434	None	.534	-.234
37	03315500	PRI103	40	0	1979-2004	160	203	222	261	299	324	368	None	.220	-2.77
							pH (standard units)								
1	03214500	PRI002	225	0	1979-2003	5.5	6.9	7.3	7.7	8.0	8.2	9.2	Increasing	.017	.302
2	03209500	PRI006	226	0	1979-2003	6.0	6.8	7.2	7.6	7.9	8.3	9.3	Increasing	.005	.529
3	03215000	PRI064	99	0	1991-2003	6.7	7.3	7.6	7.8	7.9	8.1	9.3	None	.059	-.278
4	03217000	PRI048	176	0	1985-2004	6.3	7.0	7.2	7.4	7.6	7.7	9.2	Increasing	.002	.373
5	03216500	PRI049	166	0	1985-2003	6.2	6.9	7.1	7.2	7.3	7.5	9.2	Increasing	.002	.280
6	03237250	PRI063	98	0	1991-2003	6.3	6.8	6.9	7.0	7.2	7.4	8.4	Increasing	.025	.479
7	03252500	PRI059	103	0	1991-2003	4.6	7.4	7.6	7.8	8.1	8.3	9.0	None	.657	.068
8	03251400	PRI060	105	0	1991-2003	6.9	7.2	7.4	7.6	7.8	7.9	8.8	None	.439	.092

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							pH (standard units)—continued								
9	03249500	PRI061	104	0	1991-2003	6.4	7.2	7.4	7.6	7.8	8.1	8.5	Increasing	0.047	0.228
10	03248640	PRI062	81	0	1992-2003	6.8	7.0	7.2	7.4	7.5	7.7	8.6	Increasing	.005	.503
11	03291500	PRI022	279	0	1979-2003	6.6	7.2	7.5	7.8	8.0	8.2	8.9	None	.615	-.093
12	03287500	PRI024	265	0	1979-2003	6.3	7.2	7.4	7.6	7.9	8.1	9.1	None	.551	.028
13	03280000	PRI031	192	0	1984-2003	6.8	7.1	7.4	7.5	7.8	8.0	8.7	None	.303	.130
14	03281000	PRI032	193	0	1984-2003	6.4	6.9	7.1	7.3	7.5	7.9	8.8	Increasing	.030	.391
15	03281500	PRI033	192	0	1984-2003	6.4	6.8	7.1	7.3	7.5	8.0	8.4	Increasing	.014	.301
16	03300400	PRI041	197	0	1984-2003	6.4	7.2	7.4	7.7	7.8	8.1	8.8	None	.061	.131
17	03285000	PRI045	177	0	1985-2003	6.9	7.4	7.6	7.8	8.0	8.4	9.2	Increasing	.038	.276
18	03283500	PRI046	164	0	1985-2003	6.4	6.9	7.1	7.3	7.5	7.8	8.4	None	.238	-.116
19	03282300	PRI058	124	0	1991-2003	5.8	6.9	7.2	7.4	7.6	7.8	8.4	None	1.000	.004
20	03290500	PRI066	64	0	1996-2003	7.0	7.4	7.5	7.6	7.7	7.9	8.5	None	.631	.132
21	03286500	PRI067	41	0	1997-2003	6.9	7.3	7.5	7.6	7.8	8.6	9.8	None	.577	-.293
22	03298500	PRI029	241	0	1980-2004	6.4	7.2	7.5	7.7	7.9	8.2	9.0	None	.870	-.014
23	03295400	PRI052	155	0	1989-2003	6.8	7.4	7.6	7.8	8.1	8.3	9.2	None	.139	.196
24	03301500	PRI057	119	0	1991-2003	6.5	7.3	7.4	7.5	7.7	7.9	11.7	None	.520	.070
25	03414110	PRI007	253	0	1979-2003	6.1	6.8	7.0	7.2	7.5	7.8	9.3	None	.316	.124
26	03410500	PRI008	256	0	1979-2003	6.0	6.6	6.8	7.1	7.4	7.8	9.4	Increasing	.003	.411
27	03404500	PRI009	254	0	1979-2003	6.4	6.9	7.2	7.5	7.9	8.2	8.8	Increasing	.000	.423
28	03406500	PRI010	247	0	1979-2003	6.0	6.8	7.0	7.3	7.5	7.9	8.9	Increasing	.031	.193
29	03438000	PRI043	171	0	1985-2003	6.9	7.3	7.5	7.6	7.8	7.9	8.2	None	.805	-.013
30	03405842	PRI051	178	0	1985-2003	5.8	6.7	7.0	7.3	7.6	8.0	8.7	None	.525	.085
31	03321060	PRI012	254	0	1979-2003	4.3	6.5	6.8	7.0	7.4	7.7	8.0	None	.492	.087
32	03319000	PRI014	256	0	1979-2004	6.5	7.0	7.1	7.3	7.6	7.8	8.7	Increasing	.028	.177
33	03308500	PRI018	277	0	1979-2003	6.6	7.0	7.2	7.4	7.6	7.8	8.7	None	.196	.130
34	03310300	PRI021	258	0	1979-2004	6.6	7.0	7.2	7.4	7.6	7.7	8.6	None	.389	.120
35	03316500	PRI055	115	0	1991-2003	6.8	7.2	7.4	7.7	7.9	8.3	8.8	None	.476	.090
36	03316275	PRI056	118	0	1991-2003	5.9	7.1	7.2	7.5	7.7	7.9	8.5	Decreasing	.035	-.375
37	03315500	PRI103	42	0	1998-2004	7.2	7.3	7.4	7.6	7.8	7.9	8.2	None	.399	-.400

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Dissolved oxygen (mg/L)								
1	03214500	PRI002	219	0	1979-2002	3.4	6.2	7.3	8.8	10.4	12.0	16.0	Increasing	0.019	0.924
2	03209500	PRI006	219	0	1979-2003	3.9	6.4	7.5	9.0	10.6	12.2	20.0	Increasing	.015	.789
3	03215000	PRI064	92	0	1991-2003	3.0	7.0	7.7	9.4	11.5	12.6	16.0	None	.972	-.122
4	03217000	PRI048	176	0	1985-2004	4.3	6.3	7.2	9.4	12.1	13.4	22.0	None	.286	.373
5	03216500	PRI049	169	0	1985-2003	4.1	7.2	8.1	9.9	11.8	12.9	15.7	None	.078	.566
6	03237250	PRI063	96	0	1991-2003	4.5	6.2	7.4	9.7	12.2	13.2	17.2	None	.052	-.782
7	03252500	PRI059	101	0	1991-2003	4.7	6.8	8.3	9.7	11.7	13.1	16.5	Increasing	.012	1.98
8	03251400	PRI060	103	0	1991-2003	2.1	5.4	7.0	8.5	10.8	12.3	14.4	None	.064	1.79
9	03249500	PRI061	103	0	1991-2003	6.5	7.3	8.0	9.6	11.4	12.7	14.0	Increasing	.017	1.47
10	03248640	PRI062	82	0	1992-2003	4.0	6.5	8.0	10.0	12.0	13.0	14.9	None	.189	-.997
11	03291500	PRI022	279	0	1979-2003	3.4	6.5	7.7	9.4	12.0	13.6	19.2	None	.386	1.43
12	03287500	PRI024	273	0	1979-2003	4.2	7.2	8.1	10.0	11.7	12.9	15.8	None	.101	1.03
13	03280000	PRI031	186	0	1984-2003	3.4	7.0	7.7	9.4	11.2	12.2	16.0	None	.589	.196
14	03281000	PRI032	183	0	1984-2003	3.7	6.6	7.3	8.9	11.2	12.0	15.6	None	.496	.239
15	03281500	PRI033	182	0	1984-2003	2.9	6.3	7.0	8.7	11.0	12.0	14.7	None	.212	-.471
16	03300400	PRI041	192	0	1984-2003	2.7	5.4	6.9	8.5	11.0	12.7	20.0	None	.390	.394
17	03285000	PRI045	176	0	1985-2003	5.7	7.0	8.1	10.2	11.9	13.6	16.8	Increasing	.015	1.26
18	03283500	PRI046	167	0	1985-2003	4.8	6.5	7.3	9.3	11.5	12.8	20.0	Increasing	.037	.607
19	03282300	PRI058	125	0	1991-2003	6.0	7.3	8.0	9.6	12.1	13.3	20.0	Increasing	.012	1.24
20	03290500	PRI066	66	0	1996-2003	5.5	7.3	7.7	9.6	12.0	13.1	14.7	None	1.000	.000
21	03286500	PRI067	43	0	1997-2003	6.6	7.6	8.5	10.0	12.4	12.9	16.0	None	.584	.491
22	03298500	PRI029	233	0	1980-2003	4.3	5.8	7.2	9.6	11.4	12.8	18.2	None	.069	-.676
23	03295400	PRI052	143	0	1989-2003	4.2	6.6	7.5	9.4	11.5	13.2	18.4	Increasing	.027	1.19
24	03301500	PRI057	116	0	1991-2003	3.7	5.7	6.3	7.8	10.4	11.8	20.0	None	.895	.118
25	03414110	PRI007	252	0	1979-2003	5.2	7.3	8.6	9.9	11.1	11.8	13.9	None	.342	-.222
26	03410500	PRI008	259	0	1979-2003	4.8	7.0	8.0	9.8	11.4	13.6	20.0	Increasing	.000	1.25
27	03404500	PRI009	257	0	1979-2003	3.5	7.2	8.0	9.3	11.2	12.7	19.0	None	.082	.606
28	03406500	PRI010	251	0	1979-2003	4.6	6.8	7.8	9.2	11.0	12.8	17.0	Increasing	.028	.916

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Dissolved oxygen (mg/L)—continued								
29	03438000	PRI043	171	0	1985-2003	5.7	6.8	7.5	8.7	10.6	11.4	14.0	None	0.961	-0.045
30	03405842	PRI051	178	0	1985-2003	4.2	6.9	8.2	10.0	11.8	13.0	18.0	Increasing	.046	1.04
31	03321060	PRI012	251	0	1979-2003	3.8	5.3	6.2	7.6	9.6	11.2	13.2	None	.360	.979
32	03319000	PRI014	254	0	1979-2003	3.3	5.6	6.5	8.3	10.1	11.9	16.6	None	.304	-.309
33	03308500	PRI018	274	0	1979-2003	5.5	7.4	8.1	9.4	11.1	11.9	14.0	None	.372	.180
34	03310300	PRI021	258	0	1979-2003	5.8	7.0	8.0	9.2	10.7	11.6	16.0	None	.419	.138
35	03316500	PRI055	114	0	1991-2003	3.7	5.6	6.5	8.3	9.6	11.7	16.2	Increasing	.027	1.92
36	03316275	PRI056	117	0	1991-2003	3.8	4.8	5.4	7.0	10.0	11.3	14.0	None	.294	-.598
37	03315500	PRI103	40	0	1998-2004	6.6	7.6	8.1	9.9	11.2	13.2	18.4	None	.854	-1.79
							Hardness (mg/L as $CaCO_3$)								
1	03214500	PRI002	109	0	1979-2004	56	89	120	170	200	240	290	Increasing	.000	1.83
2	03209500	PRI006	235	0	1979-2004	67	120	150	170	200	240	310	Increasing	.000	1.66
3	03215000	PRI064	110	0	1991-2004	88	110	140	170	200	220	280	Increasing	.000	2.73
4	03217000	PRI048	187	0	1985-2004	44	83	93	100	120	130	170	None	.077	.607
5	03216500	PRI049	183	0	1985-2004	29	57	68	78	88	100	200	None	.515	.208
6	03237250	PRI063	110	0	1991-2004	24	28	31	38	48	56	180	Increasing	.001	1.54
7	03252500	PRI059	128	0	1991-2004	63	147	160	180	210	230	280	None	.457	.379
8	03251400	PRI060	125	0	1991-2004	76	134	170	200	230	240	350	None	.883	-.087
9	03249500	PRI061	129	0	1991-2004	56	72	82	94	110	120	240	None	.636	.332
10	03248640	PRI062	112	0	1992-2004	48	67	80	100	140	160	200	None	.062	1.46
11	03291500	PRI022	286	0	1979-2004	72	130	150	180	210	250	450	None	.275	.453
12	03287500	PRI024	281	0	1979-2004	77	100	120	130	160	180	340	Increasing	.002	.930
13	03280000	PRI031	210	0	1984-2004	110	150	180	230	350	441	980	Increasing	.000	3.36
14	03281000	PRI032	208	0	1984-2004	42	62	74	98	120	130	220	Increasing	.027	.766
15	03281500	PRI033	207	0	1984-2004	32	51	64	82	100	140	330	None	.895	.072
16	03300400	PRI041	211	0	1984-2004	57	120	150	180	220	250	500	Increasing	.050	1.15
17	03285000	PRI045	187	0	1985-2004	59	110	130	150	160	180	210	None	.123	.505
18	03283500	PRI046	180	0	1985-2004	26	55	62	74	93	100	220	Increasing	.020	.913

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Hardness (mg/L as $CaCO_3$)—continued								
19	03282300	PRI058	130	0	1991-2004	74	91	110	140	188	250	410	Increasing	0.024	1.77
20	03290500	PRI066	73	0	1996-2004	78	120	130	150	170	198	250	None	.082	3.41
21	03286500	PRI067	50	0	1997-2004	68	110	120	150	188	220	300	None	.772	.545
22	03298500	PRI029	268	0	1979-2004	11	130	160	180	200	223	530	None	.388	.211
23	03295400	PRI052	154	0	1989-2004	66	150	180	200	238	260	340	None	.061	.976
24	03301500	PRI057	132	0	1991-2004	2	140	160	190	200	220	300	None	.237	.720
25	03414110	PRI007	115	0	1992-2004	57	66	71	77	83	87	120	None	.231	.416
26	03410500	PRI008	248	0	1979-2004	18	34	39	48	61	78	180	Decreasing	.000	-1.73
27	03404500	PRI009	266	0	1979-2004	38	73	90	110	140	160	280	Increasing	.001	1.45
28	03406500	PRI010	251	0	1979-2004	42	58	65	83	110	120	440	None	.780	.060
29	03438000	PRI043	192	0	1985-2004	54	130	150	180	210	229	250	Increasing	.018	1.25
30	03405842	PRI051	185	0	1985-2004	11	39	50	70	98	110	150	None	.926	-.019
31	03321060	PRI012	193	0	1979-2004	60	130	200	310	530	760	1,800	None	.579	3.19
32	03319000	PRI014	111	0	1992-2004	48	76	93	110	120	130	150	None	.332	-.643
33	03308500	PRI018	280	0	1980-2004	44	80	94	115	140	150	280	None	.102	.419
34	03310300	PRI021	254	0	1980-2004	54	120	143	170	200	210	400	Increasing	.016	.867
35	03316500	PRI055	125	0	1991-2004	87	120	130	150	170	210	360	None	.797	.110
36	03316275	PRI056	133	0	1991-2004	65	92	120	140	170	180	210	None	.902	-.135
37	03315500	PRI103	46	0	1998-2004	89	97	110	125	140	160	160	None	.132	-.886
							Total suspended solids (mg/L)								
1	03214500	PRI002	190	3	1985-2004	<1	3	7	16	42	104	1,270	None	.139	-1.79
2	03209500	PRI006	250	5	1979-2004	<1	4	7	16	35	77	705	Decreasing	.002	-5.58
3	03215000	PRI064	110	2	1991-2004	2	8	13	20	40	90	188	None	.301	-1.95
4	03217000	PRI048	186	8	1985-2004	<1	2	4	7	14	37	372	None	.242	-1.55
5	03216500	PRI049	183	3	1985-2004	<1	2	6	15	34	101	564	Decreasing	.041	-4.09
6	03237250	PRI063	115	11	1991-2004	<1	<1	2	3	6	15	223	None	.968	-0.32
7	03252500	PRI059	85	5	1994-2004	<1	2	3	9	26	78	296	None	.159	-5.35
8	03251400	PRI060	127	6	1991-2004	<1	2	5	12	29	105	848	None	.069	-7.28

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Total suspended solids (mg/L)—continued															
9	03249500	PRI061	130	1	1991-2004	<1	4	9	19	43	112	388	None	0.249	-3.75
10	03248640	PRI062	108	4	1992-2004	<1	4	7	15	38	107	310	None	.805	.639
11	03291500	PRI022	229	3	1983-2004	<1	4	8	14	29	131	1,180	Decreasing	.001	-7.14
12	03287500	PRI024	227	7	1983-2004	<1	4	7	13	37	91	410	None	.611	.999
13	03280000	PRI031	206	3	1984-2004	<1	4	8	18	58	147	1,890	None	.066	-4.48
14	03281000	PRI032	70	3	1995-2004	<1	2	3	6	22	61	1,260	None	.853	.790
15	03281500	PRI033	203	12	1984-2004	<1	2	4	8	18	50	344	None	.243	1.79
16	03300400	PRI041	210	1	1984-2004	<1	4	8	15	29	91	870	Decreasing	.010	-3.59
17	03285000	PRI045	185	8	1985-2004	<1	<1	4	7	14	29	681	None	.177	-1.83
18	03283500	PRI046	64	0	1995-2004	<1	3	6	10	26	46	514	None	.169	-8.80
19	03282300	PRI058	131	2	1991-2004	<1	3	6	11	29	51	282	None	.217	2.14
20	03290500	PRI066	73	2	1996-2004	<1	2	6	11	21	72	386	None	.117	8.93
21	03286500	PRI067	50	0	1997-2004	<1	2	6	10	27	47	320	Increasing	.013	15.14
22	03298500	PRI029	258	2	1979-2004	<1	7	12	22	46	96	698	None	.899	-.142
23	03295400	PRI052	173	4	1989-2004	<1	2	4	10	32	91	610	None	.214	-2.50
24	03301500	PRI057	131	2	1991-2004	<1	13	26	48	89	236	3,800	None	.728	-.543
25	03414110	PRI007	268	11	1979-2004	<1	<1	2	4	8	18	141	Decreasing	.000	-4.61
26	03410500	PRI008	256	31	1979-2004	<1	<1	2	4	9	34	317	Decreasing	.001	-6.41
27	03404500	PRI009	256	10	1979-2004	<1	2	4	13	38	109	694	Decreasing	.002	-6.05
28	03406500	PRI010	262	15	1979-2004	<1	<1	2	5	11	36	291	Decreasing	.022	-2.39
29	03438000	PRI043	192	3	1985-2004	<1	4	9	18	33	68	1,730	Decreasing	.003	-4.50
30	03405842	PRI051	179	23	1985-2004	<1	<1	2	3	6	14	58	Decreasing	.034	-3.99
31	03321060	PRI012	128	1	1991-2004	<1	8	15	36	56	83	250	None	.762	-.636
32	03319000	PRI014	258	0	1979-2004	4	13	24	36	55	97	1,200	None	.129	-1.14
33	03308500	PRI018	226	0	1983-2004	<1	7	10	21	34	84	258	None	.064	-2.09
34	03310300	PRI021	127	0	1979-2004	<1	5	8	17	38	89	360.0	None	.080	1.39
35	03316500	PRI055	125	0	1991-2004	3	10	14	19	40	86	834	None	.243	1.79
36	03316275	PRI056	133	1	1991-2004	<1	6	14	26	40	50	173	None	.212	-2.58
37	03315500	PRI103	43	0	1998-2004	4	11	19	26	41	67	570	None	.149	11.8

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of observations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Chloride, total (mg/L)															
1	03214500	PRI002	199	2	1985-2004	<1	6.0	8.4	13.3	23.8	31.3	61.8	None	0.838	0.078
2	03209500	PRI006	261	3	1979-2004	<1	5.8	8.4	12.2	19.0	27.3	44.9	Increasing	.000	2.38
3	03215000	PRI064	117	1	1991-2004	<1	6.3	10.0	14.6	21.5	27.3	37.2	Increasing	.016	2.76
4	03217000	PRI048	186	5	1985-2004	<1	3.1	4.9	6.9	9.4	12.3	47.7	Increasing	.033	2.398
5	03216500	PRI049	191	2	1985-2004	<1	5.0	7.5	13.9	24.5	39.3	64.9	None	.609	-.432
6	03237250	PRI063	126	12	1991-2004	<1	1.0	2.7	3.7	4.7	6.3	14.9	Increasing	.021	4.81
7	03252500	PRI059	85	2	1994-2004	<1	5.4	7.5	10.9	16.6	33.4	55.3	None	.303	5.12
8	03251400	PRI060	127	5	1991-2004	<1	3.5	5.7	7.3	9.1	11.8	61.9	Increasing	.009	3.41
9	03249500	PRI061	129	11	1991-2004	<1	1.8	4.0	5.1	6.7	9.9	31.0	Increasing	.012	6.59
10	03248640	PRI062	110	2	1992-2004	<1	3.7	5.8	9.4	13.2	18.6	36.8	Increasing	.025	4.082
11	03291500	PRI022	228	9	1983-2004	<1	3.4	4.9	6.9	9.9	14.0	27.0	Increasing	.013	3.56
12	03287500	PRI024	226	7	1983-2004	<1	3.7	5.4	8.0	11.9	21.9	71.5	Decreasing	.003	-20.6
13	03280000	PRI031	209	7	1984-2004	<1	3.2	4.8	7.3	10.8	14.5	105	Increasing	.012	6.59
14	03281000	PRI032	71	4	1995-2004	<1	1.7	3.4	5.8	7.6	9.2	17.7	None	.128	4.24
15	03281500	PRI033	205	10	1984-2004	<1	2.5	4.0	7.7	14.1	28.0	123	None	.770	.357
16	03300400	PRI041	212	11	1984-2004	<1	2.6	4.2	5.3	6.7	8.8	38.5	Increasing	.037	2.64
17	03285000	PRI045	188	3	1995-2004	<1	3.4	5.1	6.5	9.3	13.0	52.5	Increasing	.007	7.46
18	03283500	PRI046	64	1	1995-2004	<1	3.9	5.0	7.5	11.0	15.4	46.6	None	.057	14.1
19	03282300	PRI058	130	7	1991-2004	<1	2.0	4.1	6.3	9.5	12.4	25.8	None	1.000	-.021
20	03290500	PRI066	73	1	1996-2004	<1	4.4	6.1	8.7	11.8	17.7	26.1	None	.253	4.65
21	03286500	PRI067	50	2	1997-2004	<1	3.8	5.9	8.1	11.4	15.1	21.3	None	.911	.578
22	03298500	PRI029	260	5	1979-2004	<1	5.8	7.9	10.9	16.3	22.8	48.2	None	.076	1.30
23	03295400	PRI052	156	2	1989-2004	<1	5.4	7.8	12.4	21.8	35.0	94.8	Increasing	.001	5.25
24	03301500	PRI057	131	5	1991-2004	<1	3.5	5.0	7.2	10.2	17.0	40.7	Increasing	.015	4.33
25	03414110	PRI007	269	15	1979-2004	<1	2.2	3.0	3.7	4.6	5.6	76.8	None	.933	-.040
26	03410500	PRI008	261	23	1979-2004	<1	1.0	2.2	3.3	5.3	8.1	146	Decreasing	.000	-4.92
27	03404500	PRI009	262	17	1979-2004	<1	1.3	3.3	4.7	6.8	12.0	52.1	None	.074	-1.64
28	03406500	PRI010	260	15	1979-2004	<1	1.4	3.0	4.0	5.5	7.7	42.8	None	.403	.677

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Chloride, total (mg/L)—continued								
29	03438000	PRI043	193	4	1985-2004	<1	5.3	7.0	8.7	12.0	15.3	35.6	Increasing	0.001	2.61
30	03405842	PRI051	184	14	1985-2004	<1	1.0	1.6	2.6	4.2	6.8	141	None	.366	-1.65
31	03321060	PRI012	128	6	1991-2004	<1	4.1	6.0	9.1	12.6	17.7	29.8	None	.145	-2.30
32	03319000	PRI014	257	11	1979-2004	<1	2.2	3.8	4.9	5.9	7.8	68.6	None	.784	.216
33	03308500	PRI018	230	6	1983-2004	<1	3.9	5.8	8.8	13.8	28.0	74.5	Decreasing	.005	-4.13
34	03310300	PRI021	126	1	1979-2004	<1	5.2	8.4	11.8	17.3	33.4	97.7	Increasing	.004	3.92
35	03316500	PRI055	125	5	1991-2004	<1	3.7	5.6	7.2	9.2	12.0	18.9	None	.358	.813
36	03316275	PRI056	134	8	1991-2004	<1	2.9	5.3	7.8	13.3	20.2	33.4	None	.489	2.14
37	03315500	PRI103	43	2	1998-2004	<1	5.2	6.1	7.3	9.1	11.4	34.7	None	.056	-7.98
							Sulfate, total (mg/L)								
1	03214500	PRI002	188	0	1984-2004	11.0	81.8	104	138	189	233	396	Increasing	.02	1.36
2	03209500	PRI006	248	0	1979-2004	13.0	79.6	109	133	167	197	447	Increasing	.000	2.59
3	03215000	PRI064	110	0	1991-2004	19.5	76.7	105	137	170	195	261	Increasing	.004	2.57
4	03217000	PRI048	186	0	1985-2004	5.0	15.9	19.4	23.2	27.6	31.5	137	None	.433	.332
5	03216500	PRI049	182	0	1985-2004	9.8	31.9	35.5	40.8	47.4	56.4	1,720	Increasing	.044	1.22
6	03237250	PRI063	116	1	1991-2004	5.0	14.9	18.5	20.6	24.6	30.7	129	None	.128	-1.01
7	03252500	PRI059	85	1	1994-2004	5.0	15.6	19.9	26.2	35.5	43.3	63.3	None	.607	1.51
8	03251400	PRI060	125	1	1991-2004	5.0	15.3	23.8	31.2	41.1	52.7	128	None	.180	-1.48
9	03249500	PRI061	128	1	1991-2004	5.0	18.2	23.3	28.8	33.9	38.5	65.7	None	.116	1.63
10	03248640	PRI062	110	0	1992-2004	13.6	36.1	46.0	61.6	78.2	88.9	136	None	.779	.370
11	03291500	PRI022	227	0	1983-2004	10.1	22.0	28.5	37.7	52.9	70.1	174	None	.481	-.518
12	03287500	PRI024	228	0	1983-2004	12.1	33.6	40.0	51.0	65.7	86.3	248	None	.283	1.89
13	03280000	PRI031	207	0	1984-2004	46.4	99.8	130	166	236	354	856	None	.116	-1.63
14	03281000	PRI032	71	0	1995-2004	30.5	41.8	50.5	76.6	97.8	112.0	145	Increasing	.023	8.14
15	03281500	PRI033	205	0	1984-2004	16.2	33.4	41.6	53.7	71.2	88.3	163	None	.545	-.263
16	03300400	PRI041	210	0	1984-2004	5.6	14.6	20.1	30.0	39.1	51.1	288	None	.559	-.291
17	03285000	PRI045	184	1	1985-2004	5.0	14.7	18.2	22.3	28.2	35.2	69.5	None	.700	-.309
18	03283500	PRI046	64	1	1995-2004	8.3	11.2	14.5	17.6	23.8	33.9	53.9	None	.842	1.26

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of observations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Sulfate, total (mg/L)—continued								
19	03282300	PRI058	129	0	1991-2004	11.6	44.9	60.1	91.3	125	188	334	Increasing	0.026	2.56
20	03290500	PRI066	73	0	1996-2004	12.7	33.2	41.5	53.5	71.2	90.6	361	None	.900	.876
21	03286500	PRI067	50	0	1997-2004	11.2	41.8	49.4	69.6	90.1	145	215	None	.640	1.14
22	03298500	PRI029	256	2	1979-2004	3.5	19.2	25.1	31.3	39.3	53.1	96.0	None	.148	-.565
23	03295400	PRI052	154	0	1989-2004	5.7	20.4	30.8	40.4	54.1	66.0	188	None	.085	2.10
24	03301500	PRI057	128	0	1991-2004	6.0	18.1	23.6	30.3	36.6	48.1	105	None	.189	-2.03
25	03414110	PRI007	270	0	1979-2004	11.0	24.8	28.7	31.9	36.0	39.2	97.3	None	.656	.136
26	03410500	PRI008	259	0	1979-2004	6.7	20.1	25.9	33.4	43.8	63.8	137	Decreasing	.000	-1.90
27	03404500	PRI009	261	0	1979-2004	10.2	48.0	62.2	80.5	108	135	185	Increasing	.000	1.96
28	03406500	PRI010	262	0	1979-2004	7.6	16.8	21.0	27.8	35.0	45.7	134	Decreasing	.046	-.787
29	03438000	PRI043	189	10	1985-2004	3.4	6.5	8.9	11.1	15.2	21.7	209	None	.220	-1.34
30	03405842	PRI051	183	2	1985-2004	4.9	10.0	12.1	14.5	19.7	28.9	101	Decreasing	.020	-1.45
31	03321060	PRI012	123	0	1991-2004	45.6	106	176	296	564	1,016	1,900	None	.524	.855
32	03319000	PRI014	254	5	1979-2004	3.5	8.0	11.2	16.0	22.2	31.0	858	Decreasing	.006	-1.49
33	03308500	PRI018	229	4	1983-2004	5.0	9.4	12.0	14.4	17.9	21.7	107	None	.220	-.717
34	03310300	PRI021	127	8	1979-2004	3.6	5.0	6.9	9.3	13.1	17.4	70.5	None	.946	-.029
35	03316500	PRI055	123	0	1991-2004	5.0	20.2	30.1	41.3	60.4	87.8	967	None	.696	-.687
36	03316275	PRI056	130	4	1991-2004	5.0	8.6	12.7	17.6	25.3	35.1	78.3	Decreasing	.037	-3.74
37	03315500	PRI103	43	0	1998-2004	5.9	7.2	9.6	12.6	16.3	23.7	27.6	None	.323	-4.78
							Iron, total (µg/L)								
1	03214500	PRI002	230	1	1980-2003	<10	260	440	720	1,708	3,402	13,000	None	.525	-.639
2	03209500	PRI006	232	2	1981-2003	<10	240	320	550	1,070	2,165	7,720	Decreasing	.028	-2.45
3	03215000	PRI064	106	0	1991-2002	230	420	590	935	1,835	4,370	8,280	None	.860	-.481
4	03217000	PRI048	186	0	1985-2004	150	480	560	685	1,010	1,555	50,900	Increasing	.002	2.07
5	03216500	PRI049	178	0	1985-2002	270	480	633	950	1,673	3,802	17,700	None	.683	-.460
6	03237250	PRI063	113	0	1991-2002	170	234	330	490	690	1,170	9,000	None	.112	-3.15
7	03252500	PRI059	117	0	1991-2002	10	120	210	520	1,540	4,204	19,000	None	.097	-4.90
8	03251400	PRI060	115	0	1991-2002	50	140	285	580	1,740	4,612	31,400	Decreasing	.008	-8.35

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Iron, total (µg/L)—continued								
9	03249500	PRI061	117	0	1991-2002	40	220	500	840	1,720	4,796	17,000	None	0.164	-4.56
10	03248640	PRI062	102	0	1992-2002	330	551	730	1,000	2,133	5,621	16,400	None	.248	1.88
11	03291500	PRI022	257	0	1980-2003	10	220	370	760	1,660	3,888	29,700	None	.381	-.984
12	03287500	PRI024	255	0	1980-2003	10	124	205	510	1,670	3,868	13,000	None	.794	.636
13	03280000	PRI031	202	1	1984-2004	<10	282	390	715	1,728	5,226	85,300	None	.069	-1.45
14	03281000	PRI032	200	1	1984-2003	<10	240	378	675	1,383	2,802	58,100	None	.964	.031
15	03281500	PRI033	186	1	1984-2003	<10	210	303	420	855	1,600	48,600	None	.574	.651
16	03300400	PRI041	198	0	1984-2003	10	257	363	690	1,260	3,917	25,100	None	.433	-1.06
17	03285000	PRI045	172	1	1985-2002	<10	80	158	305	600	1,118	15,400	None	.154	-3.20
18	03283500	PRI046	175	0	1985-2003	20	490	605	850	1,555	3,024	36,500	None	.431	1.12
19	03282300	PRI058	116	0	1991-2003	10	225	350	635	1,483	2,520	12,100	None	.463	-1.59
20	03290500	PRI066	58	0	1996-2002	110	150	243	455	1,035	3,067	15,700	None	.188	8.21
21	03286500	PRI067	53	0	1997-2004	100	160	240	460	1,620	3,006	9,790	None	.204	10.3
22	03298500	PRI029	235	0	1980-2003	80	220	375	760	1,480	2,826	24,900	None	.063	2.59
23	03295400	PRI052	143	0	1989-2002	20	142	230	450	1,175	3,432	23,700	Decreasing	.019	-7.05
24	03301500	PRI057	118	0	1991-2002	370	754	1,203	1,890	3,183	8,380	77,500	None	.298	-1.04
25	03414110	PRI007	246	2	1980-2003	<10	50	80	140	240	500	4,370	None	.960	.095
26	03410500	PRI008	234	0	1980-2003	20	170	240	350	580	1,044	10,900	Decreasing	.000	-5.14
27	03404500	PRI009	236	0	1980-2003	10	100	215	525	1,400	2,825	28,000	None	.063	-2.97
28	03406500	PRI010	236	1	1980-2003	<10	80	120	200	370	915	6,830	None	.071	2.49
29	03438000	PRI043	182	0	1985-2003	90	181	283	500	915	1,905	37,400	None	.323	-1.72
30	03405842	PRI051	170	2	1985-2002	<10	120	180	260	378	731	1,980	None	.299	1.96
31	03321060	PRI012	233	0	1980-2003	30	554	960	1,570	2,310	3,728	14,000	None	.898	-.271
32	03319000	PRI014	240	1	1980-2003	<10	480	790	1,170	1,880	3,276	10,300	None	.198	1.49
33	03308500	PRI018	263	0	1980-2003	40	170	240	460	925	1,836	8,210	None	.163	1.66
34	03310300	PRI021	285	0	1980-2003	10	160	240	410	800	1,450	10,700	None	.124	2.08
35	03316500	PRI055	116	0	1991-2002	80	365	488	740	1,160	2,505	49,000	None	.786	-.590
36	03316275	PRI056	112	0	1991-2002	240	571	758	1,140	1,515	2,038	8,820	None	.786	-1.20
37	03315500	PRI103	46	0	1998-2004	220	405	520	848	1,208	2,655	15,400	None	.394	9.43

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
							Manganese, total (µg/L)								
1	03214500	PRI002	227	0	1980-2004	<10	46	60	80	110	200	1,450	Decreasing	0.001	-2.35
2	03209500	PRI006	225	0	1981-2004	20	50	70	90	130	170	990	Decreasing	.001	-3.00
3	03215000	PRI064	106	0	1991-2004	11	50	60	75	110	200	630	None	1.000	.001
4	03217000	PRI048	187	0	1985-2004	14	40	60	90	155	274	590	None	.496	-.453
5	03216500	PRI049	178	0	1985-2004	20	107	150	235	380	540	1,070	Decreasing	.013	-3.07
6	03237250	PRI063	107	1	1991-2004	<10	<10	20	30	70	154	770	None	.687	-.510
7	03252500	PRI059	116	1	1991-2004	<10	20	30	50	100	205	690	None	.906	.315
8	03251400	PRI060	123	0	1991-2004	20	30	40	60	115	258	850	Decreasing	.045	-4.24
9	03249500	PRI061	126	0	1991-2004	20	40	50	80	120	230	580	None	.858	-.226
10	03248640	PRI062	111	0	1992-2004	40	70	100	140	225	320	940	Increasing	.031	3.24
11	03291500	PRI022	269	1	1980-2004	<10	20	40	60	100	190	1,330	None	.104	-1.82
12	03287500	PRI024	266	0	1980-2004	<10	30	40	60	90	180	790	None	.866	-.156
13	03280000	PRI031	205	0	1984-2004	<10	50	70	100	170	290	1,870	None	.284	-1.20
14	03281000	PRI032	204	0	1984-2004	<10	50	60	90	130	177	1,350	None	.107	-1.72
15	03281500	PRI033	195	0	1984-2004	<10	40	60	80	120	170	900	Decreasing	.005	-3.77
16	03300400	PRI041	204	0	1984-2004	20	30	40	70	110	170	1,880	Decreasing	.001	-2.39
17	03285000	PRI045	168	2	1985-2004	<10	<10	20	30	50	80	2,000	None	.269	-1.52
18	03283500	PRI046	178	0	1985-2004	30	50	60	80	110	150	300	None	.316	-.961
19	03282300	PRI058	125	0	1991-2004	20	50	70	90	130	226	1,110	None	.651	1.18
20	03290500	PRI066	67	0	1996-2004	20	30	40	60	70	134	530	None	.063	3.47
21	03286500	PRI067	45	0	1997-2004	30	40	50	70	100	140	400	None	.556	2.02
22	03298500	PRI029	246	0	1980-2004	20	50	70	110	160	255	2,810	None	.817	.162
23	03295400	PRI052	143	0	1989-2004	<10	20	20	40	70	148	700	None	.476	-1.04
24	03301500	PRI057	125	0	1991-2004	40	50	80	120	180	312	2,440	Increasing	.037	4.20
25	03414110	PRI007	236	21	1980-2004	<10	10	10	20	40	75	180	Decreasing	.070	-2.06
26	03410500	PRI008	240	1	1980-2004	<10	30	40	80	110	160	410	Decreasing	.000	-7.34
27	03404500	PRI009	243	1	1980-2004	<10	30	50	90	165	240	890	Decreasing	.000	-4.41
28	03406500	PRI010	243	1	1980-2004	<10	30	40	60	80	130	510	Decreasing	.009	-1.68

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
									Manganese, total (µg/L)—continued						
29	03438000	PRI043	189	0	1985-2004	20	38	50	60	80	142	2,540	Decreasing	0.006	-2.48
30	03405842	PRI051	173	2	1985-2004	<10	<10	20	30	50	90	460	Decreasing	.035	-2.90
31	03321060	PRI012	239	0	1980-2004	50	228	430	770	1,335	2,034	7,280	Decreasing	.036	-6.75
32	03319000	PRI014	247	0	1980-2004	50	120	160	230	360	588	1,720	None	.073	-1.46
33	03308500	PRI018	268	1	1980-2004	<10	20	30	50	80	130	310	None	.255	-.770
34	03310300	PRI021	292	0	1980-2004	<10	20	38	50	80	130	520.0	None	.066	-1.88
35	03316500	PRI055	122	0	1991-2004	20	70	80	110	160	248	4,130	None	.809	.621
36	03316275	PRI056	116	0	1991-2004	<10	40	70	135	190	295	520	None	.098	5.96
37	03315500	PRI103	46	0	1998-2004	40	60	70	90	118	178	810	None	.708	-2.25
									Total phosphorus (mg/L)						
1	03214500	PRI002	190	29	1985-2004	<.01	<.01	.01	.02	.03	.07	.47	Decreasing	.000	-4.86
2	03209500	PRI006	246	52	1979-2004	<.01	<.01	.01	.02	.04	.07	.66	Decreasing	.000	-8.33
3	03215000	PRI064	111	20	1991-2004	<.01	.01	.01	.02	.04	.06	.17	None	.297	-2.29
4	03217000	PRI048	187	47	1985-2004	<.01	<.01	.01	.01	.02	.04	.64	None	.127	-1.59
5	03216500	PRI049	184	6	1985-2004	<.01	<.01	.01	.02	.04	.09	.82	None	.142	-2.14
6	03237250	PRI063	117	51	1991-2004	<.01	.01	.01	.01	.01	.02	.09	None	.858	.434
7	03252500	PRI059	85	1	1994-2004	<.01	.05	.09	.12	.19	.31	.96	None	.849	.392
8	03251400	PRI060	126	4	1991-2004	<.01	.03	.05	.09	.14	.29	1.04	Decreasing	.017	-5.22
9	03249500	PRI061	129	6	1991-2004	<.01	.01	.02	.04	.07	.13	.63	None	.014	.996
10	03248640	PRI062	112	16	1992-2004	<.01	<.01	.01	.02	.04	.08	.46	None	.299	2.79
11	03291500	PRI022	215	4	1983-2004	<.01	.03	.04	.07	.14	.26	1.78	None	.160	-3.45
12	03287500	PRI024	229	4	1983-2004	<.01	.03	.05	.07	.11	.18	1.03	None	.066	-2.64
13	03280000	PRI031	208	31	1984-2004	<.01	<.01	.01	.02	.04	.07	.50	None	.056	-2.81
14	03281000	PRI032	208	43	1984-2004	<.01	<.01	.01	.01	.02	.05	.43	Increasing	.000	23.4
15	03281500	PRI033	206	49	1984-2004	<.01	<.01	.01	.01	.02	.04	.22	None	.008	.995
16	03300400	PRI041	211	0	1984-2004	<.01	.07	.10	.14	.22	.39	1.62	None	.088	-1.50
17	03285000	PRI045	185	4	1985-2004	<.01	.02	.03	.06	.10	.15	.96	Decreasing	.040	-3.14
18	03283500	PRI046	181	21	1985-2004	<.01	<.01	.01	.01	.02	.04	.19	Increasing	.001	15.8

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Total phosphorus (mg/L)—continued															
19	03282300	PRI058	129	27	1991-2004	<0.01	0.01	0.01	0.01	0.03	0.06	0.14	None	0.137	2.78
20	03290500	PRI066	255	3	1996-2004	<.01	.04	.05	.07	.10	.14	1.12	Increasing	.013	5.72
21	03286500	PRI067	50	3	1997-2004	<.01	.03	.04	.05	.08	.13	.32	None	.544	-2.62
22	03298500	PRI029	257	0	1980-2004	<.01	.11	.15	.21	.30	.47	1.82	Decreasing	.000	-2.39
23	03295400	PRI052	173	0	1989-2004	<.01	.14	.20	.28	.41	.84	1.78	Decreasing	.001	-3.10
24	03301500	PRI057	129	1	1991-2004	<.01	.06	.08	.13	.23	.35	1.89	None	.076	-3.12
25	03414110	PRI007	259	68	1980-2004	<.01	<.01	.01	.01	.01	.02	2.50	Decreasing	.006	-2.54
26	03410500	PRI008	257	73	1979-2004	<.01	<.01	<.01	.01	.02	.05	.23	Decreasing	.000	-7.56
27	03404500	PRI009	262	39	1979-2004	<.01	.01	.01	.02	.04	.08	.28	Decreasing	.000	-9.47
28	03406500	PRI010	261	54	1979-2004	<.01	<.01	.01	.01	.03	.05	.26	Decreasing	.000	-4.50
29	03438000	PRI043	190	6	1985-2004	<.01	.03	.06	.10	.17	.29	1.30	Decreasing	.000	-9.19
30	03405842	PRI051	183	72	1985-2004	<.01	.01	.01	.01	.01	.02	.06	None	.051	-2.24
31	03321060	PRI012	128	10	1991-2004	<.01	.01	.03	.05	.07	.10	.35	None	.795	-.587
32	03319000	PRI014	252	8	1980-2004	<.01	.02	.03	.04	.07	.10	.53	Decreasing	.003	-2.11
33	03308500	PRI018	226	8	1983-2004	<.01	.01	.03	.04	.06	.10	1.27	Decreasing	.006	-2.71
34	03310300	PRI021	256	5	1980-2004	<.01	.05	.07	.11	.19	.30	1.2	None	.230	0.87
35	03316500	PRI055	124	4	1991-2004	<.01	.02	.03	.04	.06	.10	1.44	None	.562	-1.02
36	03316275	PRI056	132	7	1991-2004	<.01	.02	.03	.06	.07	.09	.23	Decreasing	.046	-3.45
37	03315500	PRI103	43	5	1998-2004	<.01	.01	.02	.04	.06	.10	.21	Increasing	.047	17.71
Total nitrogen (mg/L as nitrogen)															
1	03214500	PRI002	164	0	1985-2004	.19	.43	.60	.80	1.10	1.40	2.40	None	.529	-.733
2	03209500	PRI006	243	0	1979-2004	.13	.34	.46	.62	.79	.99	2.94	None	.855	-.121
3	03215000	PRI064	93	0	1991-2004	.27	.43	.54	.68	.83	1.00	1.90	None	-.435	.637
4	03217000	PRI048	176	0	1985-2004	.12	.35	.46	.63	.85	1.14	2.74	None	.470	-.505
5	03216500	PRI049	161	0	1985-2004	.27	.48	.60	.78	1.00	1.30	2.00	Increasing	.002	2.87
6	03237250	PRI063	109	0	1991-2004	.10	.15	.29	.52	.81	1.12	2.24	None	.099	-3.12
7	03252500	PRI059	128	0	1991-2004	.22	.45	.75	1.57	2.36	3.23	4.83	None	.746	-.575
8	03251400	PRI060	112	0	1991-2004	.23	.55	.71	1.40	2.20	2.70	5.10	None	.361	-1.63

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Total nitrogen (mg/L as nitrogen)—continued															
9	03249500	PRI061	119	0	1991-2004	0.19	0.38	0.53	0.75	1.10	1.40	1.90	None	0.274	-1.07
10	03248640	PRI062	107	0	1992-2004	.09	.24	.38	.53	.73	.97	3.94	None	.947	.097
11	03291500	PRI022	216	0	1983-2004	.12	.46	.64	.96	1.40	1.75	6.40	Decreasing	.005	-1.80
12	03287500	PRI024	215	0	1983-2004	.26	.59	.81	1.00	1.30	1.70	3.90	Decreasing	.018	-1.39
13	03280000	PRI031	185	0	1984-2004	.14	.38	.51	.68	.86	1.00	3.00	Decreasing	.027	-1.918
14	03281000	PRI032	176	0	1984-2004	.11	.24	.32	.41	.50	.67	1.80	Decreasing	.008	-2.83
15	03281500	PRI033	200	0	1984-2004	.07	.21	.32	.42	.60	.76	1.72	None	.327	-.791
16	03300400	PRI041	199	0	1984-2004	.15	.47	.74	1.10	1.60	2.40	9.50	None	-.923	.320
17	03285000	PRI045	169	0	1985-2004	.23	.60	.96	1.40	1.90	2.50	4.10	None	.808	.339
18	03283500	PRI046	153	0	1985-2004	.14	.30	.42	.52	.75	1.00	2.10	None	-.524	.415
19	03282300	PRI058	126	0	1991-2004	.16	.30	.41	.52	.63	.82	1.27	None	.842	.479
20	03290500	PRI066	73	0	1996-2004	.36	.82	1.01	1.16	1.39	1.70	2.45	None	.072	-2.25
21	03286500	PRI067	49	0	1997-2004	.47	.58	.72	.92	1.15	1.23	1.38	None	.848	-1.09
22	03298500	PRI029	251	0	1980-2004	.27	.94	1.20	1.70	2.30	3.00	8.30	Decreasing	.000	-2.71
23	03295400	PRI052	157	0	1989-2004	.14	.69	1.10	2.20	2.90	3.94	5.70	None	.560	-.577
24	03301500	PRI057	123	0	1991-2004	.38	.68	.91	1.30	1.80	2.28	5.90	None	.429	-.845
25	03414110	PRI007	211	0	1980-2004	.27	.41	.49	.56	.67	.84	4.90	Decreasing	.000	-1.66
26	03410500	PRI008	254	0	1979-2004	.06	.12	.19	.31	.44	.64	1.85	Decreasing	.001	-3.13
27	03404500	PRI009	246	0	1979-2004	.14	.29	.40	.52	.74	1.00	2.65	Decreasing	.000	-2.67
28	03406500	PRI010	258	0	1979-2004	.10	.29	.42	.58	.75	.96	1.51	Decreasing	.007	-1.22
29	03438000	PRI043	156	0	1985-2004	.33	2.40	2.88	3.40	4.00	4.30	6.50	Increasing	.009	.842
30	03405842	PRI051	183	0	1985-2004	.06	.16	.22	.31	.42	.57	1.81	None	.944	.144
31	03321060	PRI012	106	0	1991-2004	.25	.41	.59	.80	1.10	1.40	13	None	.330	1.26
32	03319000	PRI014	250	0	1980-2004	.40	.71	.89	1.10	1.40	1.80	3.30	Decreasing	.005	-1.43
33	03308500	PRI018	213	0	1983-2004	.36	.68	.85	1.10	1.40	1.78	3.50	None	.345	.397
34	03310300	PRI021	272	0	1980-2004	.43	2.11	2.50	3.00	3.40	3.70	15	None	.291	.268
35	03316500	PRI055	125	0	1991-2004	.38	.82	1.12	1.44	1.77	1.93	10	None	.717	.247
36	03316275	PRI056	126	0	1991-2004	.16	.65	.83	1.10	1.37	1.80	2.70	None	.672	-.668
37	03315500	PRI103	38	0	1998-2004	.53	.67	.99	1.32	1.91	2.27	2.94	None	.474	4.11

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Total Kjeldahl nitrogen (mg/L as nitrogen)															
1	03214500	PRI002	254	25	1979-2004	<0.05	<0.05	0.13	0.25	0.41	0.63	1.70	Decreasing	0.000	-4.05
2	03209500	PRI006	244	28	1979-2004	<.05	<.05	.13	.23	.38	.50	1.80	Decreasing	.000	-3.10
3	03215000	PRI064	117	18	1991-2004	<.05	<.05	.10	.21	.33	.48	1.50	None	.182	-2.91
4	03217000	PRI048	185	23	1985-2004	<.05	<.05	.14	.24	.32	.43	1.10	Decreasing	.005	-2.89
5	03216500	PRI049	189	19	1985-2004	<.05	<.05	.15	.26	.39	.52	1.20	Decreasing	.014	-2.78
6	03237250	PRI063	110	20	1991-2004	<.05	<.05	.09	.17	.28	.43	1.10	None	.116	-3.96
7	03252500	PRI059	127	1	1991-2004	<.05	.26	.37	.52	.72	1.00	1.90	None	.586	-.773
8	03251400	PRI060	126	9	1991-2004	<.05	.14	.28	.46	.65	.97	1.60	None	.437	-1.82
9	03249500	PRI061	129	6	1991-2004	<.05	.14	.21	.33	.44	.71	1.10	None	.976	-.059
10	03248640	PRI062	110	16	1992-2004	<.05	<.05	.11	.20	.39	.54	1.60	None	.149	3.88
11	03291500	PRI022	290	4	1979-2004	<.05	.26	.41	.57	.72	1.10	4.50	Decreasing	.002	-2.91
12	03287500	PRI024	284	7	1979-2004	<.05	.16	.24	.40	.58	.80	1.80	Decreasing	.000	-4.15
13	03280000	PRI031	210	20	1984-2004	<.05	.06	.13	.22	.35	.56	2.40	Decreasing	.000	-4.14
14	03281000	PRI032	207	28	1984-2004	<.05	<.05	.11	.17	.26	.36	1.60	None	.054	-1.86
15	03281500	PRI033	204	32	1984-2004	<.05	<.05	.08	.16	.28	.41	1.10	None	.620	-.559
16	03300400	PRI041	210	4	1984-2004	<.05	.19	.34	.48	.72	.99	9.40	Decreasing	.013	-2.20
17	03285000	PRI045	184	11	1985-2004	<.05	.12	.22	.36	.52	.67	2.50	Decreasing	.001	-3.33
18	03283500	PRI046	180	23	1985-2004	<.05	<.05	.10	.23	.35	.55	1.80	Decreasing	.000	-4.64
19	03282300	PRI058	129	15	1991-2004	<.05	<.05	.12	.21	.31	.51	0.83	None	.925	.185
20	03290500	PRI066	73	10	1996-2004	<.05	<.05	.22	.30	.41	.61	1.50	None	.214	-4.16
21	03286500	PRI067	50	5	1997-2004	<.05	.07	.10	.22	.31	.58	.85	None	.087	-7.45
22	03298500	PRI029	256	2	1980-2004	<.05	.34	.47	.65	.83	1.15	7.00	Decreasing	.001	-1.61
23	03295400	PRI052	172	4	1989-2004	<.05	.28	.40	.57	.81	1.39	2.70	None	.086	-2.38
24	03301500	PRI057	128	2	1991-2004	<.05	.21	.33	.48	.74	1.10	5.50	None	.492	-1.16
25	03414110	PRI007	261	49	1980-2004	<.05	<.05	.07	.14	.23	.39	4.50	Decreasing	.000	-5.07
26	03410500	PRI008	258	63	1979-2004	<.05	<.05	.05	.15	.26	.39	1.60	Decreasing	.000	-6.53
27	03404500	PRI009	247	22	1979-2004	<.05	.07	.15	.24	.37	.57	2.10	Decreasing	.000	-5.37
28	03406500	PRI010	263	37	1979-2004	<.05	<.05	.11	.20	.31	.44	1.50	Decreasing	.000	-3.91

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Total Kjeldahl nitrogen (mg/L as nitrogen)—continued															
29	03438000	PRI043	190	33	1985-2004	<0.05	<0.05	0.12	0.27	0.43	0.70	2.90	Decreasing	0.000	-6.12
30	03405842	PRI051	185	52	1985-2004	<.05	<.05	.05	.13	.22	.33	1.50	None	.362	1.71
31	03321060	PRI012	115	3	1991-2004	<.05	.21	.36	.53	.69	.86	3.70	None	.735	-.594
32	03319000	PRI014	252	1	1980-2004	<.05	.29	.40	.53	.68	.96	2.20	Decreasing	.003	-1.37
33	03308500	PRI018	277	10	1980-2004	<.05	.14	.21	.30	.42	.61	1.80	Decreasing	.000	-2.65
34	03310300	PRI021	304	28	1980-2004	<.05	<.05	.19	.34	.51	.81	2.0	Decreasing	.000	-4.71
35	03316500	PRI055	125	6	1991-2004	<.05	.14	.22	.35	.49	.80	8.60	None	.349	-1.78
36	03316275	PRI056	132	3	1991-2004	<.05	.15	.30	.49	.67	.82	2.10	None	.865	-.250
37	03315500	PRI103	43	5	1998-2004	<.05	.06	.23	.37	.54	.86	1.40	None	.352	8.96
Nitrite plus nitrate-nitrogen, total (mg/L as nitrogen)															
1	03214500	PRI002	188	1	1985-2004	<.01	.25	.40	.54	.68	.84	1.22	None	.836	-.230
2	03209500	PRI006	247	0	1979-2004	.03	.16	.24	.35	.46	.58	2.87	Increasing	.007	1.51
3	03215000	PRI064	110	0	1991-2004	.09	.27	.32	.42	.51	.58	.77	None	.609	.528
4	03217000	PRI048	186	1	1985-2004	<.01	.11	.22	.42	.58	.79	2.37	None	.464	.583
5	03216500	PRI049	183	0	1985-2004	.12	.23	.34	.45	.70	.98	1.63	Increasing	.001	2.03
6	03237250	PRI063	117	0	1991-2004	.01	.05	.17	.35	.53	.76	1.98	None	.074	-4.12
7	03252500	PRI059	127	2	1991-2004	<.01	.07	.18	.99	1.86	2.49	4.14	None	.891	-.251
8	03251400	PRI060	124	2	1991-2004	<.01	.05	.16	.78	1.53	2.13	4.69	None	.981	.162
9	03249500	PRI061	128	1	1991-2004	<.01	.10	.24	.42	.64	.83	1.23	None	.922	-.117
10	03248640	PRI062	112	0	1992-2004	.01	.12	.24	.32	.42	.51	2.34	None	.178	-1.57
11	03291500	PRI022	228	6	1983-2004	<.01	.02	.04	.34	.63	.97	6.30	None	.263	-2.15
12	03287500	PRI024	226	2	1983-2004	<.01	.27	.49	.67	.85	1.11	3.10	None	.141	-2.88
13	03280000	PRI031	207	0	1984-2004	.04	.19	.30	.40	.53	.60	2.25	None	.291	-.299
14	03281000	PRI032	72	0	1995-2004	.01	.08	.16	.20	.26	.32	1.22	None	.865	.381
15	03281500	PRI033	203	2	1984-2004	<.01	.06	.14	.24	.37	.49	1.00	None	.905	-.146
16	03300400	PRI041	209	3	1984-2004	<.01	.05	.12	.52	1.00	1.47	2.35	None	.144	-1.51
17	03285000	PRI045	184	1	1985-2004	<.01	.07	.59	1.04	1.59	2.00	3.20	None	.779	.277
18	03283500	PRI046	64	0	1995-2004	.04	.13	.22	.28	.41	.55	1.36	None	.671	.907

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Nitrite plus nitrate-nitrogen, total (mg/L as nitrogen)—continued															
19	03282300	PRI058	128	0	1991-2004	0.01	0.15	0.22	0.28	0.36	0.42	0.79	None	0.785	0.390
20	03290500	PRI066	73	0	1996-2004	.05	.42	.67	.85	1.06	1.37	1.93	None	.916	.574
21	03286500	PRI067	49	0	1997-2004	.26	.43	.48	.65	.74	1.02	1.16	None	.659	.751
22	03298500	PRI029	256	0	1980-2004	.01	.34	.55	.97	1.46	2.37	5.40	Decreasing	.006	-2.84
23	03295400	PRI052	170	1	1989-2004	<.01	.13	.66	1.32	2.14	2.91	5.33	None	.783	-.511
24	03301500	PRI057	127	0	1991-2004	.05	.23	.46	.71	1.13	1.49	2.43	None	1.000	.019
25	03414110	PRI007	263	0	1980-2004	.15	.26	.33	.39	.43	.48	.60	Decreasing	.034	-.756
26	03410500	PRI008	256	3	1979-2004	<.01	.03	.07	.13	.20	.26	.69	Decreasing	.007	-1.79
27	03404500	PRI009	261	2	1979-2004	<.01	.08	.19	.30	.39	.49	1.30	None	.132	-.992
28	03406500	PRI010	259	1	1979-2004	<.01	.10	.20	.35	.49	.62	.95	None	.190	-.784
29	03438000	PRI043	191	0	1985-2004	.02	1.99	2.47	3.08	3.65	4.10	6.00	Increasing	.010	.375
30	03405842	PRI051	184	2	1985-2004	<.01	.04	.10	.16	.23	.34	1.56	Decreasing	.042	-2.02
31	03321060	PRI012	123	2	1991-2004	<.01	.05	.12	.27	.43	.78	10.4	None	.692	.924
32	03319000	PRI014	252	0	1980-2004	.09	.25	.42	.58	.78	1.05	2.30	Decreasing	.032	-1.37
33	03308500	PRI018	226	0	1983-2004	.18	.40	.59	.81	1.09	1.31	2.15	None	.802	.128
34	03310300	PRI021	121	0	1980-2004	.52	1.59	2.14	2.69	3.10	3.46	14.7	Increasing	.016	1.20
35	03316500	PRI055	125	0	1991-2004	.29	.52	.72	1.04	1.29	1.52	2.00	None	.119	1.75
36	03316275	PRI056	132	2	1991-2004	<.01	.06	.26	.62	.92	1.10	2.25	None	.163	-2.18
37	03315500	PRI103	43	0	1998-2004	.12	.48	.70	.99	1.35	1.66	2.55	None	.543	1.31
Ammonia-nitrogen, total (mg/L as nitrogen)															
1	03214500	PRI002	245	178	1979-2004	<.05	.05	.05	.05	.05	.09	.50	na	na	na
2	03209500	PRI006	246	176	1979-2004	<.05	.05	.05	.05	.05	.10	1.2	na	na	na
3	03215000	PRI064	108	102	1991-2004	<.05	.05	.05	.05	.05	.05	.08	na	na	na
4	03217000	PRI048	42	38	1999-2004	<.05	.05	.05	.05	.05	.05	.14	na	na	na
5	03216500	PRI049	183	145	1985-2004	<.05	.05	.05	.05	.05	.07	.35	na	na	na
6	03237250	PRI063	108	101	1991-2004	<.05	.05	.05	.05	.05	.05	.16	na	na	na
7	03252500	PRI059	127	112	1991-2004	<.05	.05	.05	.05	.05	.05	.30	na	na	na
8	03251400	PRI060	125	110	1991-2004	<.05	.05	.05	.05	.05	.05	.85	na	na	na

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Ammonia-nitrogen, total (mg/L as nitrogen)—continued															
9	03249500	PRI061	127	116	1991-2004	<0.05	0.05	0.05	0.05	0.05	0.05	0.50	na	na	na
10	03248640	PRI062	111	102	1992-2004	<.05	.05	.05	.05	.05	.05	.11	na	na	na
11	03291500	PRI022	287	202	1979-2004	<.05	.05	.05	.05	.06	.12	.67	na	na	na
12	03287500	PRI024	285	178	1979-2004	<.05	.05	.05	.05	.07	.15	1.8	na	na	na
13	03280000	PRI031	209	189	1984-2004	<.05	.05	.05	.05	.05	.05	.18	na	na	na
14	03281000	PRI032	207	187	1984-2004	<.05	.05	.05	.05	.05	.05	.30	na	na	na
15	03281500	PRI033	205	192	1984-2004	<.05	.05	.05	.05	.05	.05	.09	na	na	na
16	03300400	PRI041	212	176	1984-2004	<.05	.05	.05	.05	.05	.06	.28	na	na	na
17	03285000	PRI045	186	159	1985-2004	<.05	.05	.05	.05	.05	.06	.64	na	na	na
18	03283500	PRI046	180	155	1985-2004	<.05	.05	.05	.05	.05	.05	.25	na	na	na
19	03282300	PRI058	128	115	1991-2004	<.05	.05	.05	.05	.05	.05	.23	na	na	na
20	03290500	PRI066	73	57	1996-2004	<.05	.05	.05	.05	.05	.08	.15	na	na	na
21	03286500	PRI067	50	43	1997-2004	<.05	.05	.05	.05	.05	.05	.27	na	na	na
22	03298500	PRI029	258	133	1980-2004	<.05	.05	.05	.05	.10	.21	1.1	na	na	na
23	03295400	PRI052	173	133	1989-2004	<.05	.05	.05	.05	.05	.08	.42	na	na	na
24	03301500	PRI057	129	89	1991-2004	<.05	.05	.05	.05	.05	.09	.30	na	na	na
25	03414110	PRI007	262	222	1980-2004	<.05	.05	.05	.05	.05	.06	1.35	na	na	na
26	03410500	PRI008	257	213	1979-2004	<.05	.05	.05	.05	.05	.07	.50	na	na	na
27	03404500	PRI009	263	205	1979-2004	<.05	.05	.05	.05	.05	.09	.29	na	na	na
28	03406500	PRI010	262	209	1979-2004	<.05	.05	.05	.05	.05	.09	5.0	na	na	na
29	03438000	PRI043	191	162	1985-2004	<.05	.05	.05	.05	.05	.07	1.4	na	na	na
30	03405842	PRI051	182	177	1985-2004	<.05	.05	.05	.05	.05	.05	16.0	na	na	na
31	03321060	PRI012	255	89	1979-2004	<.05	.05	.05	.08	.24	.50	12.2	na	na	na
32	03319000	PRI014	251	54	1980-2004	<.05	.05	.05	.09	.16	.29	1.6	na	na	na
33	03308500	PRI018	280	218	1980-2004	<.05	.05	.05	.05	.05	.11	.30	na	na	na
34	03310300	PRI021	306	170	1980-2004	<.05	.05	.05	.05	.07	.14	.44	na	na	na
35	03316500	PRI055	124	104	1991-2004	<.05	.05	.05	.05	.05	.07	.34	na	na	na
36	03316275	PRI056	120	102	1991-2004	<.05	.05	.05	.05	.05	.07	.25	na	na	na
37	03315500	PRI103	43	35	1998-2004	<.05	.05	.05	.05	.05	.07	.50	na	na	na

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Fecal coliform (colonies per 100 milliliters)															
1	03214500	PRI002	196	2	1980-2003	<1	110	250	690	1,600	3,100	600,000	Decreasing	0.019	-4.07
2	03209500	PRI006	191	1	1980-2003	<5	70	200	400	760	2,000	30,000	Decreasing	.000	-12.0
3	03215000	PRI064	64	1	1991-2003	<1	13	40	290	863	1,640	7,000	Decreasing	.000	-24.0
4	03217000	PRI048	134	1	1985-2004	<1	30	68	120	378	1,140	20,900	Decreasing	.025	5.20
5	03216500	PRI049	127	0	1985-2003	3	34	76	180	480	980	5,800	None	.517	-2.18
6	03237250	PRI063	50	0	1991-2003	2	15	47	85	224	342	960	None	.687	-3.68
7	03252500	PRI059	105	6	1991-2003	<10	10	20	60	250	3,320	16,000	None	.468	3.29
8	03251400	PRI060	100	3	1991-2003	<10	19	58	180	700	4,560	16,000	Decreasing	.032	-8.52
9	03249500	PRI061	100	4	1991-2003	<10	10	38	80	443	3,020	60,000	None	.184	20.2
10	03248640	PRI062	54	0	1992-2003	3	52	129	365	1,000	1,890	4,800	Decreasing	.035	-8.77
11	03291500	PRI022	248	14	1980-2003	<1	9	28	78	385	1,360	33,000	None	.762	1.13
12	03287500	PRI024	256	15	1980-2003	<10	10	13	50	160	600	4,000	Decreasing	.002	-4.22
13	03280000	PRI031	177	0	1984-2003	8	64	200	540	1,200	2,640	12,000	Decreasing	.000	-14.62
14	03281000	PRI032	175	1	1984-2003	<10	19	30	90	215	420	3,000	Decreasing	.000	-7.50
15	03281500	PRI033	173	2	1984-2003	<10	10	30	80	200	680	6,000	None	.730	-.823
16	03300400	PRI041	183	2	1984-2003	<10	20	70	150	500	2,000	16,000	None	.137	4.23
17	03285000	PRI045	159	7	1985-2003	<10	14	30	110	300	1,520	18,300	None	.121	-6.38
18	03283500	PRI046	161	1	1985-2003	<10	38	60	160	410	1,100	10,000	Decreasing	.028	-4.83
19	03282300	PRI058	101	13	1991-2003	<10	10	10	30	180	440	8,000	Increasing	.028	10.1
20	03290500	PRI066	53	4	1996-2003	<10	10	10	10	80	572	6,400	None	.052	25.7
21	03286500	PRI067	37	3	1998-2003	<10	10	10	16	34	268	2,700	None	.812	-6.25
22	03298500	PRI029	208	3	1980-2003	<10	27	60	200	703	3,060	19,000	None	.182	-2.64
23	03295400	PRI052	132	1	1989-2003	<10	40	63	150	523	1,960	13,000	Decreasing	.163	-8.19
24	03301500	PRI057	91	1	1991-2003	<10	50	80	180	1,250	2,400	20,000	None	.890	-.555
25	03414110	PRI007	188	4	1980-2003	<1	7	13	34	110	593	6,600	Decreasing	.001	-9.86
26	03410500	PRI008	198	45	1980-1998	<1	4	10	15	49	149	7,700	Decreasing	.000	-8.85
27	03404500	PRI009	205	23	1980-2002	<1	8	12	50	200	604	2,300	Decreasing	.012	-5.14
28	03406500	PRI010	205	17	1980-2002	<1	5	10	25	72	206	3,200	None	.111	2.95

Table 6. Summary statistics and trend test results of water-quality data for selected ambient water-quality monitoring network stations in Kentucky, 1979–2004. —Continued

[mg/L, milligrams per liter; µg/L, micrograms per liter; µS/cm, microsiemens per centimeter at 25 degrees Celcius; USGS, U.S. Geological Survey; KDOW, Kentucky Division of Water; No., number; Min, minimum; Max, maximum]

Map reference number (figure 1)	USGS station number	KDOW station number	No. of obser-vations	No. of censored values	Period of record	Min.	Percentile values					Max.	Trend direction	p-value	Trend slope, percent
							10th	25th	Median	75th	90th				
Fecal coliform (colonies per 100 milliliters)—continued															
29	03438000	PRI043	165	21	1985-2003	<1	33	55	86	150	276	12,600	None	0.957	0.096
30	03405842	PRI051	140	18	1985-2000	<4	7	10	31	96	201	1,750	Increasing	.043	6.09
31	03321060	PRI012	206	44	1980-2003	<1	25	34	70	130	400	7,800	None	.155	8.74
32	03319000	PRI014	204	36	1980-2003	<1	33	42	100	185	400	60,000	Decreasing	.008	-4.36
33	03308500	PRI018	215	2	1980-2003	<1	24	42	110	300	1,480	16,000	None	.121	-3.08
34	03310300	PRI021	242	4	1980-2003	<1	46	76	173	460	1,970	14,400	Decreasing	.000	-6.11
35	03316500	PRI055	83	28	1991-2003	<1	3	25	33	55	320	800	None	.879	1.10
36	03316275	PRI056	74	14	1991-2003	<1	33	44	82	163	400	5,800	None	.135	5.16
37	03315500	PRI103	26	0	1999-2004	5	8	14	29	106	1,200	6,000	Increasing	.000	93.7

Appendix 1. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 1992

Appendix 1. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 1992.

[KDOW, Kentucky Division of Water; no., number; mi^2, square miles;WV, West Virginia; S.F., South Fork; U, undeveloped; M, mixed; A, agriculture; <, less than; >, greater than]

Map reference number (figure 1)	KDOW station name	KDOW station no.	Drainage area (mi^2)	Mean annual precipitation (inches)	Land-use classification[1]	Percent land cover in 1992					
						Developed	Agricultural		Forested (undeveloped)	Water	Wetland
							Row crop	Pasture			
1	Tug Fork at Kermit, WV	PRI002	1,280	45.96	U	0.9	0.5	0.8	95.5	0.3	0.0
2	Levisa Fork near Pikeville	PRI006	1,238	45.58	U	.4	.5	1.2	94.8	.5	.0
3	Levisa Fork near Louisa	PRI064	2,326	45.10	U	.6	.3	1.0	95.9	.5	.0
4	Tygarts Creek at Load	PRI048	242	42.51	U	.7	1.7	5.0	91.7	.1	.0
5	Little Sandy at Argillite	PRI049	400	42.86	U	.5	2.2	3.4	93.0	.4	.1
6	Kinniconick Creek near Tannery	PRI063	175	43.56	U	.0	.9	2.0	96.5	.0	.0
7	South Fork Licking River at Morgan	PRI059	839	44.47	A	2.0	13.5	54.8	29.2	.2	.3
8	North Fork Licking River at Milford	PRI060	290	44.17	M	.7	12.9	32.2	54.1	.1	.0
9	Licking River at Claysville	PRI061	278	45.69	U	.4	5.9	15.3	77.0	.7	.3
10	Licking River at West Liberty	PRI062	327	45.41	U	.4	.9	2.0	96.1	.0	.0
11	Eagle Creek at Glencoe	PRI022	437	43.86	U	1.3	11.3	20.0	66.2	.3	.6
12	Kentucky River at Frankfort (Lock 4)	PRI024	5,412	47.38	U	1.1	3.3	15.3	78.5	.4	.1
13	North Fork Kentucky River at Jackson	PRI031	1,101	45.87	U	.5	.0	.4	95.9	.2	.0
14	Middle Fork Kentucky River at Tallega	PRI032	537	48.47	U	.2	.1	.4	98.3	.4	.0
15	South Fork Kentucky River at Booneville	PRI033	722	48.84	U	.3	.5	1.6	97.2	.2	.0
16	Beech Fork near Maud	PRI041	436	47.83	U	.5	6.2	39.6	53.2	.2	.1
17	Dix River near Danville	PRI045	318	49.67	M	1.0	9.7	38.2	49.5	.1	.4
18	Red River at Clay City	PRI046	362	48.17	U	.7	1.7	5.1	91.8	.1	.1
19	Kentucky River near Trapp	PRI058	3,246	47.38	U	.4	.6	2.0	95.4	.3	.0
20	Kentucky River near Lockport (Lock 2)	PRI066	6,180	46.92	U	2.7	4.8	18.3	60.2	.4	.2
21	Kentucky River at High Bridge (Lock 7)	PRI067	5,036	47.48	U	2.2	2.7	13.5	66.6	.4	.1

Appendix 1. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 1992. —Continued

[KDOW, Kentucky Division of Water; no., number; mi², square miles;WV, West Virginia; S.F., South Fork; U, undeveloped; M, mixed; A, agriculture; <, less than; >, greater than]

Map reference number (figure 1)	KDOW station name	KDOW station no.	Drainage area (mi²)	Mean annual precipitation (inches)	Land-use classification[1]	Percent land cover in 1992					
						Developed	Agricultural		Forested (undeveloped)	Water	Wetland
							Row crop	Pasture			
22	Salt River at Shepherdsville	PRI029	1,197	46.27	A	4.5	21.4	30.1	42.6	0.7	0.3
23	Salt River near Glensboro	PRI052	172	46.41	A	2.0	14.2	52.7	29.3	.2	.3
24	Rolling Fork near Lebanon Junction	PRI057	1,375	49.30	U	1.4	9.0	29.3	59.4	.3	.5
25	Cumberland River near Burkesville	PRI007	6,053	51.01	U	1.5	2.4	9.5	84.6	1.5	.3
26	South Fork Cumberland River at Blue Heron	PRI008	954	55.53	U	.8	.6	4.0	94.1	.2	.0
27	Cumberland River at Cumberland Falls	PRI009	562	51.41	U	1.3	.1	2.7	94.3	.3	.4
28	Rockcastle River at Billows	PRI010	604	49.60	U	.9	1.9	10.7	85.9	.4	.0
29	Little River near Cadiz	PRI043	244	50.45	A	4.0	36.0	31.5	22.6	.5	2.9
30	Horse Lick Creek near Lamero	PRI051	62	49.84	U	.2	.6	3.7	95.3	.0	.0
31	Pond River near Sacramento	PRI012	523	49.51	M	2.0	19.9	10.6	55.2	2.7	7.0
32	Rough River near Dundee	PRI014	757	50.33	U	1.0	25.6	18.2	52.7	1.4	.0
33	Green River at Munfordville	PRI018	1,673	52.13	U	.8	11.0	28.1	57.5	1.0	1.1
34	Nolin River at White Mills	PRI021	357	50.23	A	4.9	25.4	41.6	26.4	.6	1.0
35	Green River near Island	PRI055	6,431	51.43	U	2.0	15.7	29.0	50.3	1.1	1.5
36	Mud River near Gus	PRI056	268	50.93	U	1.8	17.8	19.9	57.1	.5	2.8
37	Green River near Woodbury	PRI103	5,404	51.78	U	2.1	15.1	32.0	48.7	1.0	1.0

[1]Land-use Classifications

Agricultural — > 50-percent agricultural land and < or equal to 5-percent urban.

Urban — > 25-percent urban and < or equal to 25-percent agricultural land.

Undeveloped — < or equal to 5-percent urban land and < or equal to 25-percent agricultural land.

Mixed — all other combinations of urban, agricultural, and forested land.

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Appendix 2. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 2001

Appendix 2. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 2001.

[KDOW, Kentucky Division of Water; no., number; mi², square miles;WV, West Virginia; S.F., South Fork; U, undeveloped; M, mixed; A, agriculture; <, less than; >, greater than]

Map reference number (figure 1)	KDOW station name	KDOW station no.	Drainage area (mi^2)	Mean annual precipitation (inches)	Land-use classification[1]	Percent land cover in 2001					
						Developed	Agricultural		Forested (undeveloped)	Water	Wetland
							Row crop	Pasture			
1	Tug Fork at Kermit, WV	PRI002	1,280	45.96	U	2.5	0.3	1.6	82.6	0.3	0.0
2	Levisa Fork near Pikeville	PRI006	1,238	45.58	U	2.4	.1	4.2	79.0	.4	.0
3	Levisa Fork near Louisa	PRI064	2,326	45.10	U	2.6	.2	4.0	79.1	.4	.0
4	Tygarts Creek at Load	PRI048	242	42.51	U	2.4	.2	14.6	68.6	.1	.0
5	Little Sandy at Argillite	PRI049	400	42.86	M	6.5	.5	11.9	74.5	.5	.0
6	Kinniconick Creek near Tannery	PRI063	175	43.56	U	.8	.0	6.1	85.6	.0	.0
7	South Fork Licking River at Morgan	PRI059	839	44.47	A	1.8	3.8	68.5	18.7	.3	.3
8	North Fork Licking River at Milford	PRI060	290	44.17	M	.5	4.3	45.5	42.1	.1	.0
9	Licking River at Claysville	PRI061	278	45.69	U	2.2	1.7	24.8	62.7	.8	.0
10	Licking River at West Liberty	PRI062	327	45.41	U	1.0	.9	4.1	83.8	.0	.0
11	Eagle Creek at Glencoe	PRI022	437	43.86	U	6.0	.4	35.4	52.4	.3	.0
12	Kentucky River at Frankfort (Lock 4)	PRI024	5,412	47.38	M	7.4	1.2	19.8	64.3	.5	.0
13	North Fork Kentucky River at Jackson	PRI031	1,101	45.87	M	6.8	.0	.8	76.7	.2	.0
14	Middle Fork Kentucky River at Tallega	PRI032	537	48.47	U	.8	.1	1.2	87.0	.4	.0
15	South Fork Kentucky River at Booneville	PRI033	722	48.84	U	1.4	.1	4.6	83.9	.3	.0
16	Beech Fork near Maud	PRI041	436	47.83	U	4.1	3.6	35.4	50.3	.2	.0
17	Dix River near Danville	PRI045	318	49.67	M	5.7	4.8	45.1	42.1	.1	.0
18	Red River at Clay City	PRI046	362	48.17	U	2.5	.4	11.0	76.9	.1	.0
19	Kentucky River near Trapp	PRI058	3,246	47.38	U	1.6	.1	4.9	79.2	.3	.0
20	Kentucky River near Lockport (Lock 2)	PRI066	6,180	46.92	U	2.7	1.4	23.9	60.2	.5	.0
21	Kentucky River at High Bridge (Lock 7)	PRI067	5,036	47.48	U	2.2	1.0	17.8	66.6	.4	.0

Appendix 2. Percent land cover of watersheds represented by selected Kentucky Energy and Environment Cabinet–Kentucky Division of Water ambient water-quality network stations, 2001. —Continued

[KDOW, Kentucky Division of Water; no., number; mi², square miles;WV, West Virginia; S.F., South Fork; U, undeveloped; M, mixed; A, agriculture; <, less than; >, greater than]

Map reference number (figure 1)	KDOW station name	KDOW station no.	Drainage area (mi²)	Mean annual precipitation (inches)	Land-use classification[1]	Percent land cover in 2001					
						Developed	Agricultural		Forested (undeveloped)	Water	Wetland
							Row crop	Pasture			
22	Salt River at Shepherdsville	PRI029	1,197	46.27	A	3.5	8.1	41.2	37.5	0.8	0.3
23	Salt River near Glensboro	PRI052	172	46.41	M	8.8	6.3	58.0	24.6	.2	1.0
24	Rolling Fork near Lebanon Junction	PRI057	1,375	49.30	U	.8	7.4	28.4	55.2	.3	.4
25	Cumberland River near Burkesville	PRI007	6,053	51.01	U	2.2	1.1	12.6	71.0	1.6	.0
26	South Fork Cumberland River at Blue Heron	PRI008	954	55.53	U	1.3	.0	5.0	80.2	.3	.2
27	Cumberland River at Cumberland Falls	PRI009	562	51.41	U	2.0	.1	4.2	80.7	.3	.0
28	Rockcastle River at Billows	PRI010	604	49.60	U	2.6	.1	17.1	65.6	.3	.0
29	Little River near Cadiz	PRI043	244	50.45	M	8.5	35.5	21.6	32.5	.4	.1
30	Horse Lick Creek near Lamero	PRI051	62	49.84	U	.9	.0	6.8	83.1	.0	.0
31	Pond River near Sacramento	PRI012	523	49.51	M	.7	13.6	12.5	60.2	.9	3.9
32	Rough River near Dundee	PRI014	757	50.33	U	.2	7.8	26.7	55.9	1.2	.2
33	Green River at Munfordville	PRI018	1,673	52.13	U	5.0	5.4	32.3	52.7	1.1	.0
34	Nolin River at White Mills	PRI021	357	50.23	A	2.5	25.3	40.0	24.7	.4	.0
35	Green River near Island	PRI055	6,431	51.43	U	.9	9.4	33.2	46.5	1.1	.5
36	Mud River near Gus	PRI056	268	50.93	U	.9	9.3	30.7	49.7	.4	.7
37	Green River near Woodbury	PRI103	5,404	51.78	U	1.0	8.9	35.7	45.2	.9	.1

[1]Land-use Classifications

Agricultural — > 50-percent agricultural land and < or equal to 5-percent urban.

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