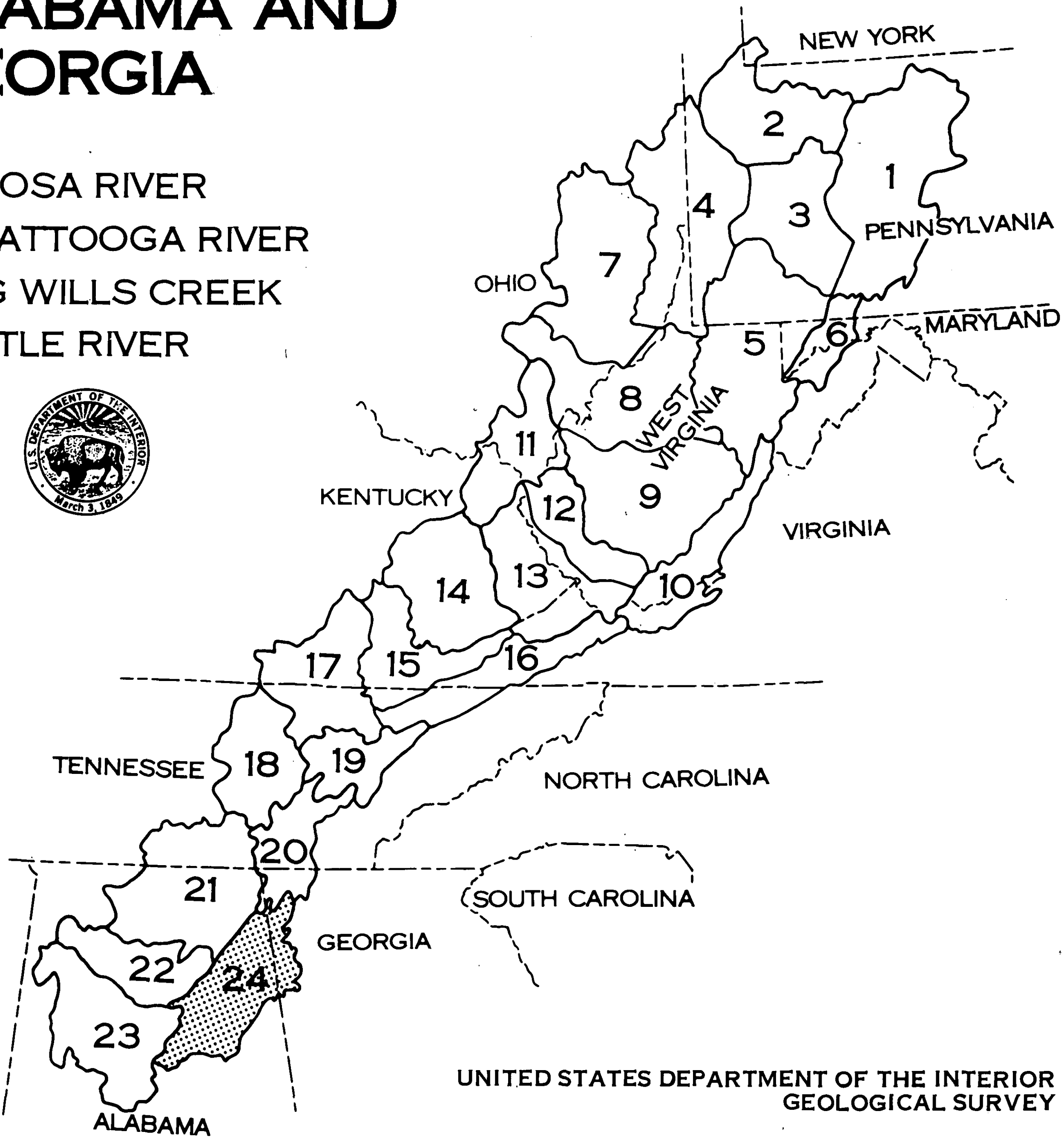
HYDROLOGY OF AREA 24, EASTERN COAL PROVINCE, ALABAMA AND GEORGIA

- COOSA RIVER
- CHATTOOGA RIVER
- BIG WILLS CREEK
- LITTLE RIVER



UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES INVESTIGATIONS
OPEN-FILE REPORT 81-1113

S. HAMILTON

HYDROLOGY OF AREA 24, EASTERN COAL PROVINCE, ALABAMA AND GEORGIA

BY
JOE R. HARKINS AND OTHERS

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TUSCALOOSA, ALABAMA
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UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, *SECRETARY*

GEOLOGICAL SURVEY

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CONTENTS

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

For the convenience of readers who may want to use International System of Units (SI), the data may be converted by using the following factors:

Multiply inch-pound units	By	To obtain SI units
inches (in)	25.4	millimeters (mm)
inches per hour (in/h)	25.4	millimeters per hour (mm/h)
	2.54	centimeters per hour (cm/h)
feet (ft)	0.3048	meters (m)
feet per mile (ft/mi)	0.1894	meters per kilometer (m/km)
miles	1.609	kilometers (km)
square miles (mi^2)	2.590	square kilometers (km^2)
acre	0.4047	square hectometers (hm^2)
acre feet	1233.	cubic meters (m^3)
gallons per minute (gal/min)	0.06309	liters per second (L/s)
million gallons per day (mgal/d)	0.04381	cubic meters per second (m^3/s)
	3785.	cubic meters per day (m^3/d)
cubic feet per second (ft^3/s)	0.02832	cubic meters per second (m^3/s)
cubic feet per second per square mile [(ft^3/s)/mi^2]	0.01093	cubic meters per second per square kilometer [(m^3/s)/km^2]
tons per square mile per year [(tons/mi^2)/yr]	0.3503	metric ton per square kilometer per year [(metric ton/km^2)/yr]

Abstract

A nationwide need for hydrologic information characterizing conditions in mined and potential mine areas has become paramount with the enactment of the Surface Mining Control and Reclamation Act of 1977. This report is designed to be useful to the mine owners, operators, and others by presenting existing hydrologic information and by identifying sources of hydrologic information. A brief text with an accompanying map, chart, graph, or other illustration presents general hydrologic information for each of a series of water-resources related topics. The summation of the topical discussions provides a description of the hydrology of the area.

The Eastern Coal Province has been divided into 24 hydrologic areas shown on the cover of this report. The divisions are based on hydrologic factors, location, and size. Each area is composed of one or more hydrologic units.

Area 24, in northeastern Alabama and northwestern Georgia, lies in three physiographic provinces: the Appalachian Plateaus, Valley and Ridge, and Piedmont. Coal is found in the Pottsville Formation of Pennsylvanian age. The coal-bearing areas have been named the Plateau and Coosa coal fields. The coal fields are located on the west side of the Coosa River. Very little surface-coal mining has taken place in the area. Most that has occurred has been in the Plateau Coal field in Georgia. Undifferentiated pre-Pennsylvanian sedimentary rocks underly about 80 percent of the area; metamorphic rocks underly about 5 percent of the area. Area 24 is entirely within the Coosa River basin and includes the drainage area of the Coosa River between Rome, Georgia and Wilsonville, Alabama, and has a surface area of 4,350 square miles.

The area has a moist temperate climate with an annual rainfall that ranges from 56 inches in its southern part to 52 inches in its northern and eastern parts. Most of the area is covered by forest and the soils have a high erosion potential when vegetative cover is removed.

Water is obtained primarily from surface-water sources. The largest uses of water are for hydroelectric power generation and for cooling water for thermoelectric power generation. Ground water from the Pottsville Formation generally is not sufficient for public supplies. Springs with very large flows are common in the limestone and dolomite of the pre-Pennsylvanian sedimentary rocks. Coldwater Spring near Anniston flows as much as 30,000 gallon per minute and other large springs flow as much as 4,800 gallon per minute. Wells drilled in the dolomite yield as much as 1,600 gallons per minute. Yields to wells from metamorphic rocks range from 2 to 25 gallons per minute.

The Pottsville Formation does not sustain the low flow of streams during dry periods and many of the small streams go dry. The pre-Pennsylvanian sedimentary rocks generally store and release enough water to maintain streamflow during dry periods. Low flow of streams in the area of metamorphic rocks is highly variable.

Hydrologic conditions relating to surface mining are (1) erosion and sedimentation, (2) decline in ground-water levels, and (3) degradation of water quality. Due to the general lack of mining in the area, these problems are seldom seen. Suspended-sediment concentrations in streams in Area 24 are low due to forest cover which lessens the effect of the steep slopes and easily erodible soils. Suspended-sediment load of streams is generally less than 150 tons/day. Sediment yields increase drastically when vegetation is removed from the highly erodible soils and from unregulated surface mining operations. Ground-water levels can decline in and near surface mining areas when excavation extends below the water level in the aquifer. This can cause nearby wells and springs to go dry. Acid-water drainage is a problem only near mined areas. The acid water is neutralized quickly by the buffering action of calcareous minerals and/or alkaline water, but it retains increased trace-constituent concentrations including mercury, copper, lead, and zinc. Dissolved-manganese concentrations range from 0 to 600 milligrams per liter in streamflow from unmined areas, and dissolved iron seldom exceeds 300 micrograms per liter. Sulfate concentrations seldom exceed 20 milligrams per liter and generally reflect baseline conditions. Sulfate is generally the major dissolved constituent in water from mined areas and tends to remain in solution; although its concentrations are reduced by dilution. Sulfate concentrations, like most others, are higher at times of low flows of streams. The chemical quality of ground water generally is good to excellent throughout the area from all three major geologic units; although iron and silica locally can pose problems.

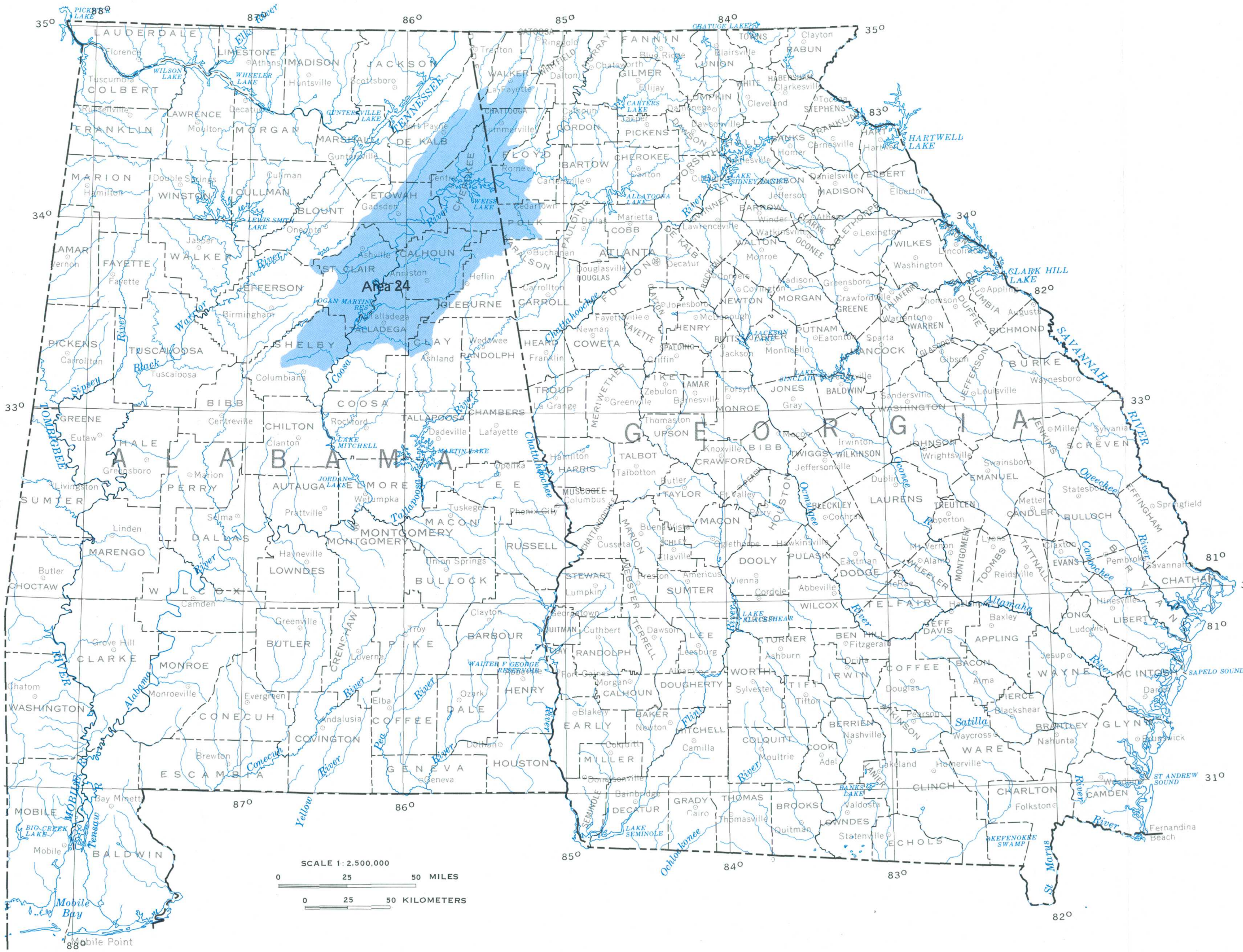
Area 24 Report to Aid in Preparing and Appraising Mine Permit Applications

Existing hydrologic conditions and identification of sources of hydrologic information are described.

A need for hydrologic information and analysis on a scale never before required nationally was initiated when the "Surface Mining Control and Reclamation Act of 1977" was signed into law as Public Law 95-87, August 3, 1977. This need is partially met by this report which broadly characterizes the hydrology of Area 24, (fig. 1.1-1) a part of the Plateau coal field of Alabama and Georgia and all of the Coosa coal field in Alabama. This report is one of a series that covers the coal provinces nationwide. The report contains a brief text with an accompanying map, chart, graph, or other illustration for each of a number of water-resources related topics. The summation of the topical discussions provides a description of the hydrology of the area.

The hydrologic information presented or available through sources identified in this report may be used in describing the hydrology of the general area of any proposed mine. Furthermore, it is expected that this hydrologic information will be supplemented by the lease applicant's specific site data as well as data from other sources to provide a more detailed description of the hydrology in the vicinity of the mine and the anticipated hydrologic consequences of the mining operation.

The information contained will be useful to surface mine owners, operators, and consulting engineers in the preparation of permits and to regulatory authorities in appraising the adequacy of permit applications.



BASE FROM U.S. GEOLOGICAL SURVEY
UNITED STATES BASE MAP, 1980

Figure 1.1-1 Location of Area 24 in Alabama and Georgia.

Area 24 is Located along the Southeastern Edge of the Eastern Coal Province

Area 24 includes 4,350 square miles of the Coosa River basin between Rome, Georgia and Wilsonville, Alabama.

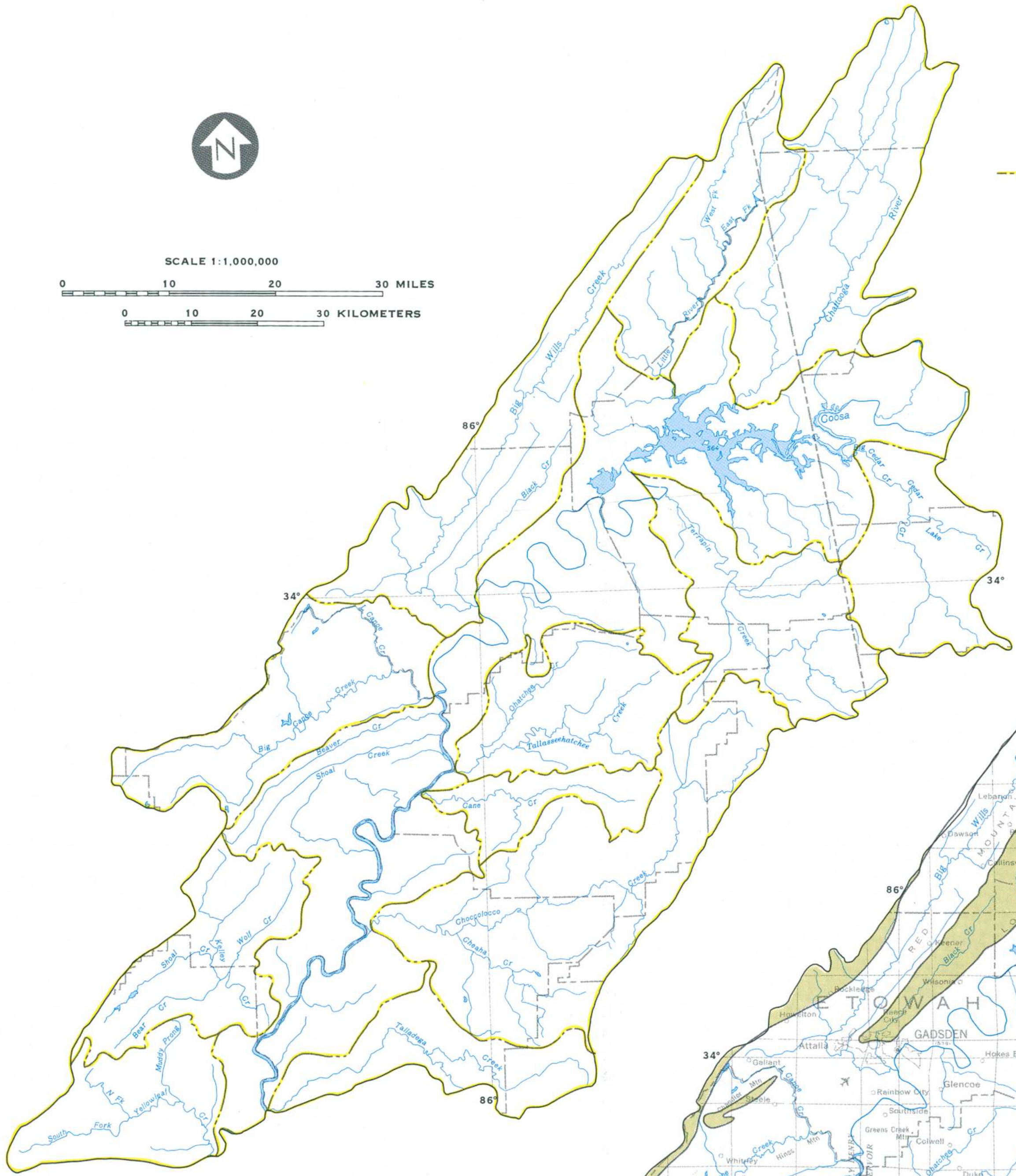
The Eastern Coal province is divided into 24 hydrologic reporting areas. The division is based on hydrologic factors, location, size, and mining activity. Drainage basins or parts of basins are combined to form each area (see front cover for areas in the Eastern Coal province). The subbasin boundaries for basins draining Area 24 are shown in figure 1.2-1.

Area 24 is near the southern end of the Eastern Coal province in Northeastern Alabama and northwestern Georgia. The area, which includes all of Cherokee and Calhoun Counties and part of eight counties in Alabama and part of six counties in Georgia (Fig. 1.2-1), drains to the Coosa River.

The 4,350 mi^2 area encompasses the drainage area of the Coosa River from Rome, Georgia to Wilsonville, Alabama. It includes the basins of Chattooga and Little Rivers, and Big Wills, Big Canoe, Kelly, and Yellowleaf Creeks which drain the coal-bearing rocks on the western side of Coosa River. Basins of streams draining the non coal-bearing rocks on the eastern side of Coosa River include Big Cedar, Terrapin, Ohatchee, Cane, Choccolocco, and Talladega Creeks.

Area 24 covers all the Coosa Coal Field and a small part of the eastern edge of the Plateau Coal Field (Fig. 1.2-2). Surface mining of coal has been primarily in the Plateau Coal field of Georgia. The area also includes the drainage area east of the Coosa River which is not a part of the coal fields.

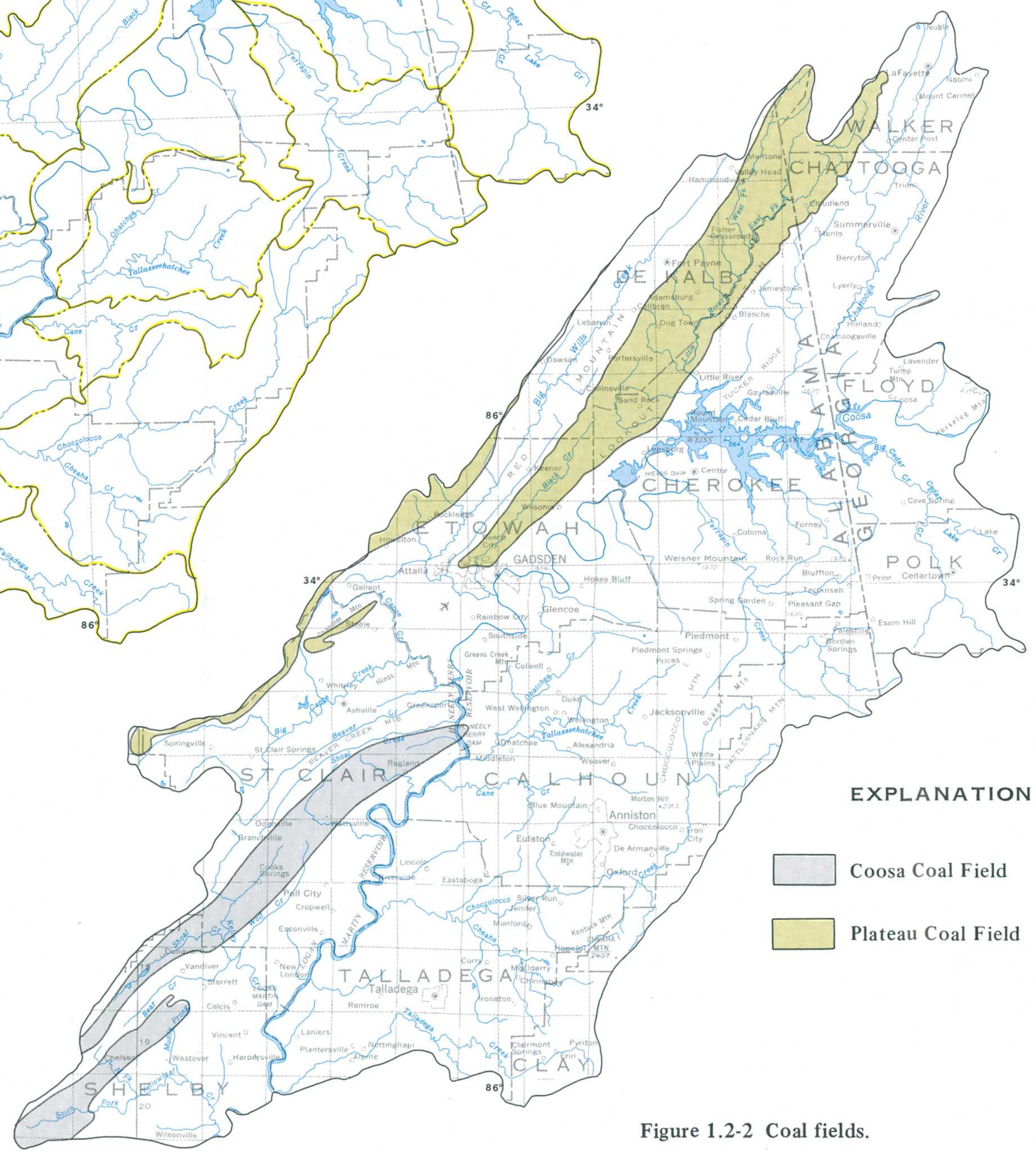
The area is in three physiographic provinces. The northwestern part is in Cumberland Plateau section of the Appalachian Plateaus province. The central part is in the Southern Valley and Ridge section of the Valley and Ridge province and the southeastern edge is in the Piedmont Uplands section of the Piedmont province (Fig. 1.2-3).



EXPLANATION

Drainage basin boundary

Figure 1.2-1 Drainage basins.



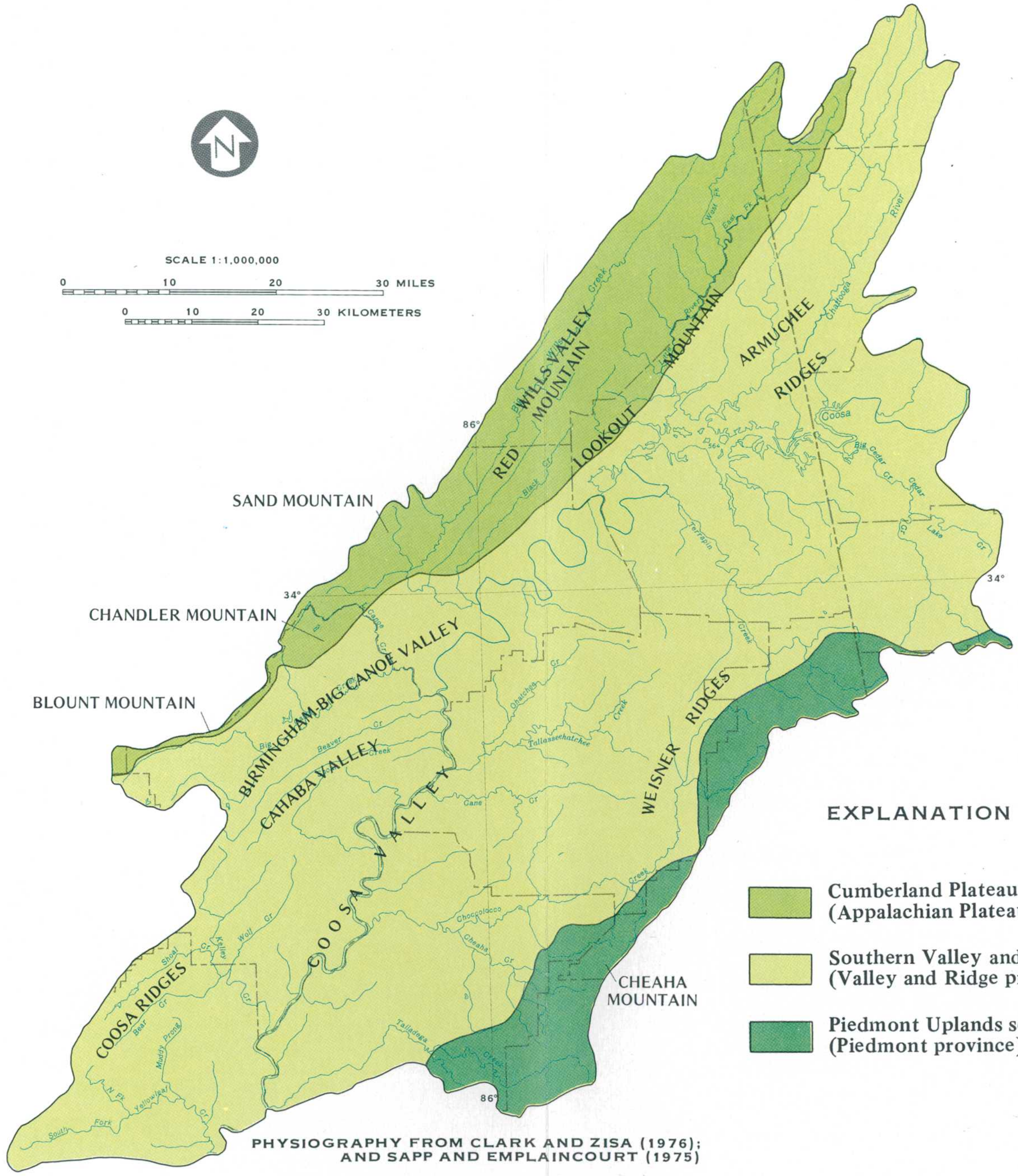
EXPLANATION

Coosa Coal Field

Plateau Coal Field

Figure 1.2-2 Coal fields.

BASE FROM U. S. GEOLOGICAL SURVEY
STATE BASE MAPS, 1966



EXPLANATION

Cumberland Plateau section (Appalachian Plateaus province)

Southern Valley and Ridge (Valley and Ridge province)

Piedmont Uplands section (Piedmont province)

PHYSIOGRAPHY FROM CLARK AND ZISA (1976); AND SAPP AND EMPLAINCOURT (1975)

Figure 1.2-3 Physiographic divisions.

Hydrologic Environment can be Adversely Altered by Surface Coal Mining

Erosion, sedimentation, decline in water levels, and degradation of water quality are typical problems associated with surface coal mining.

Surface mining drastically alters the environment of undisturbed areas and may cause detrimental changes to the environment. Mining activities such as the removal of vegetation, excavation, diversion of drainage (fig. 1.3-1), and dumping of large volumes of unconsolidated spoil materials may create unstable areas of loose earth and rock. These generally erode easily and if not controlled may contribute additional sediment to surface streams, channels, and flood plains. If the mined area is reclaimed shortly some of the detrimental environmental effects can be decreased or prevented.

Adverse effects associated with erosion and increased sedimentation include excessive sediment deposition in streams and reservoirs which in turn increases the cost of maintaining navigation channels and treating water for industrial and domestic uses. Other adverse effects include destruction of wildlife habitat, increased flooding due to filling of the stream channels and flood plains by sediment, and reduction of aesthetic value and recreation use.

Along with increased sedimentation, another common and troublesome water-quality problem is acid-mine drainage. After mining, accelerated weathering of iron-bearing minerals (pyrite and marcasite, for example) in spoil materials and coal beds produces sulfuric acid and accelerates the dissolution of minerals (fig. 1.3-2). Water draining such a mined area generally has low pH values (2.5-5.0 units) and increased sulfate and dissolved-solids concentrations. The acidic water reacts with other minerals increasing concentrations of metals such as copper, lead, iron, manganese, and zinc. Adverse effects associated with acidic and highly mineralized mine drainage may include reduction of the number of aquatic organisms, increased corrosiveness of water, limitations on the use of water for domestic and industrial purposes, and reduction of aesthetic value and recreational use.

The adverse effects are most apparent on and near the mine site. The receiving stream for surface and seepage drainage at the mine site usually is most affected. Problems caused by suspended sediment, increased metals content, and low pH values will usually diminish in severity downstream from the mine. This is due to settling out of the sediment, and the buffering and dilution capacity of the stream.

Decline of ground-water levels can occur in and near surface-mining areas when excavation extends below the water table causing some wells and springs to go dry (fig. 1.3-3). The quality of ground water can also be affected even though the effect may take much longer to detect at points remote from mining activities.

The magnitude of the effect of surface mining on the surrounding hydrologic environment depends on several physical and chemical factors. The more influential factors include mining and reclamation methods, topography, geology, climate, and rate and volume of water movement, the distance to the mine site, and the time elapsed since mining began.

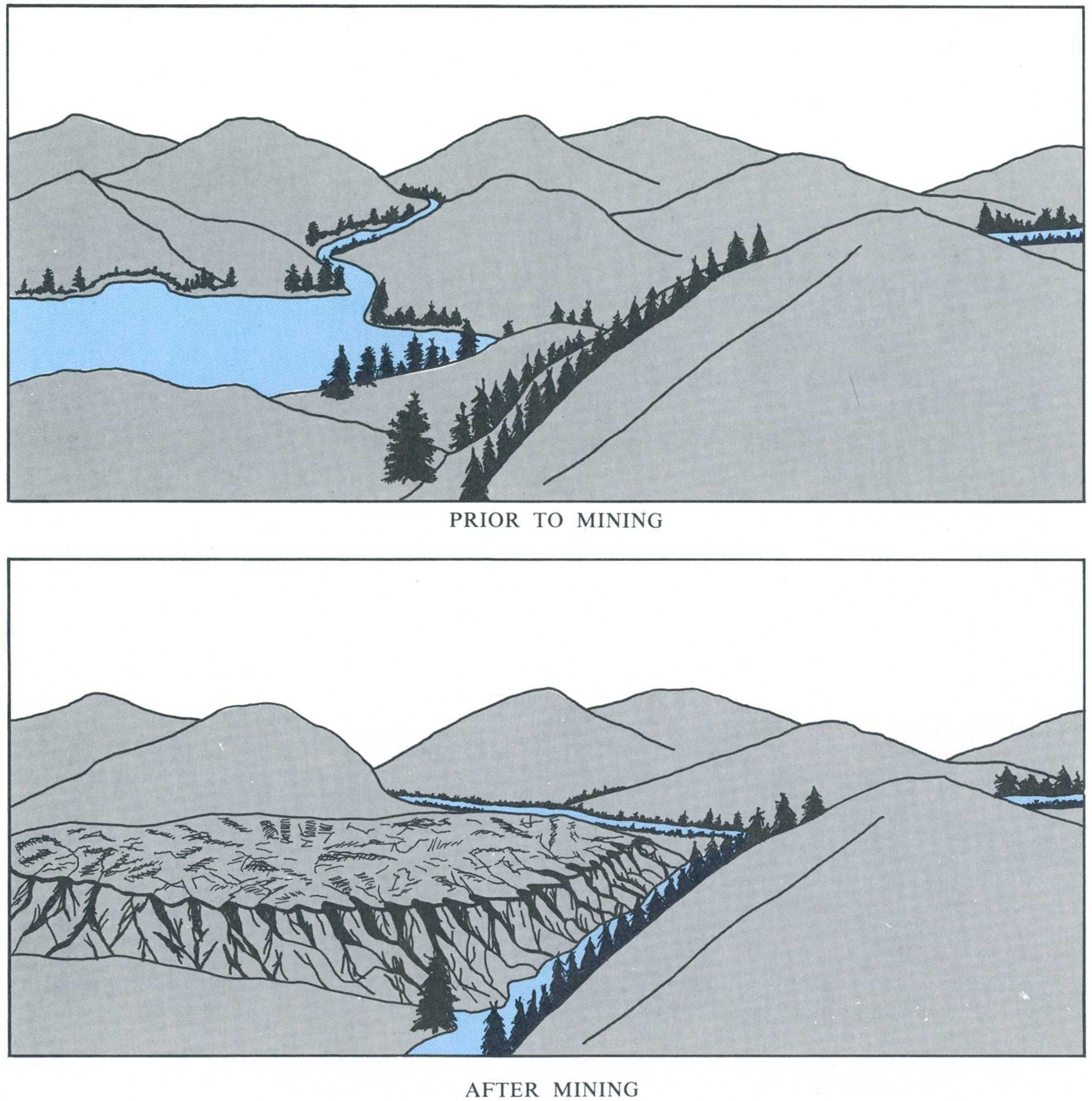


Figure 1.3-1 Possible disruption of drainage patterns resulting from mining operations.

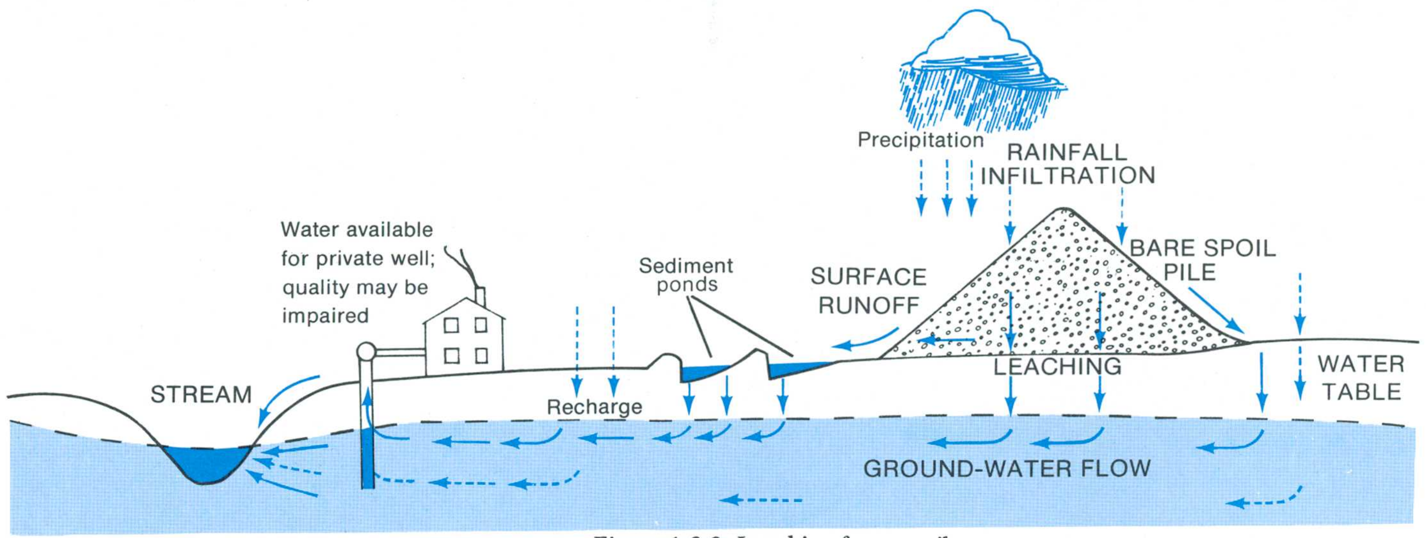


Figure 1.3-2 Leaching from spoils.

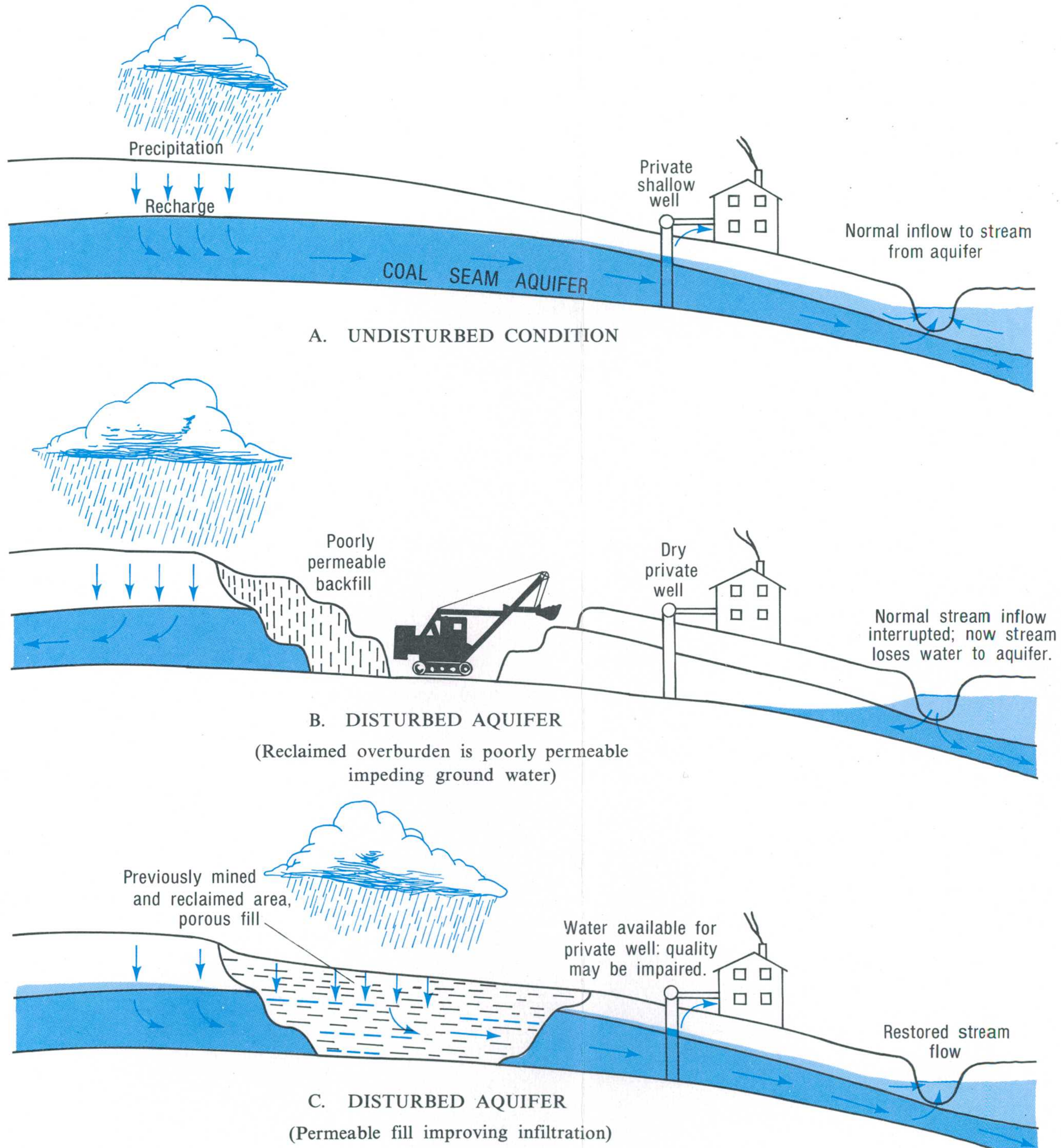


Figure 1.3-3 Possible impacts of mining aquifers.

DIAGRAMS FROM RICKERT AND OTHERS (1979)

Three Geologic Units Underlie the Area

Area 24 is underlain by three principal geologic units: the Pottsville Formation, which contains the coal beds; the undifferentiated pre-Pennsylvanian sedimentary rocks, and metamorphic rocks.

The Pottsville Formation of Pennsylvanian age underlies about 15 percent of Area 24, including parts of two coal fields, the Plateau and the Coosa. Undifferentiated pre-Pennsylvanian sedimentary rocks occupy about 80 percent of the area. The remaining 5 percent of Area 24 is underlain by metamorphic rocks (fig. 2.1-1).

Geologic structure in Area 24 is complex, involving folding and faulting of the strata to form anticlines and synclines trending generally southwest-northeast. The anticlines have been eroded to form the topographic lows of Wills, Birmingham-Big Canoe, and Cahaba Valleys. The synclinal troughs form Lookout, Sand, Blount, and Chandler Mountains and the Coosa Ridges, all capped by the erosion-resistant sandstones of the Pottsville Formation (fig. 2.2-1). Southeast of the Coosa River, the simple folding of strata changes to complex faulting. In many places the local trend of the faults departs from the general southwest-northeast trend. In the southeast part of Area 24, metamorphic rocks override the pre-Pennsylvanian sedimentary rocks along a large thrust fault, the Cartersville Fault.

The Pottsville Formation consists chiefly of alternating beds of sandstone, conglomerate, siltstone, and shale with beds of coal and underclay. The formation generally becomes thicker to the south because (1) the regional dip to the southwest is greater than the southward slope of the land surface preserving younger beds to the southwest, and (2) the beds of the formation thicken and increase in number to the south and southeast. Thickness of the Pottsville Formation in Area 24 reaches 1,740 feet in the Yellowleaf Creek basin in the southwest part of the Coosa coal field (Butts, 1927). The changes in thickness and lithology make correlation of coal beds difficult. The thickest and most productive coal beds are found in the upper part of the Pottsville. Vertical sections of coal fields are shown in figure 2.1-2.

The undifferentiated pre-Pennsylvanian sedimentary rocks consist primarily of limestone, dolomite, chert, sandstone, shale, and some beds of hematite. These strata crop out in the valleys in Area 24.

The metamorphic rocks in Area 24 include slate, phyllite, schist, marble, and quartzite. Foliations in the metamorphic rocks generally dip to the southeast from 30 to 65 degrees (Chandler and others, 1972).

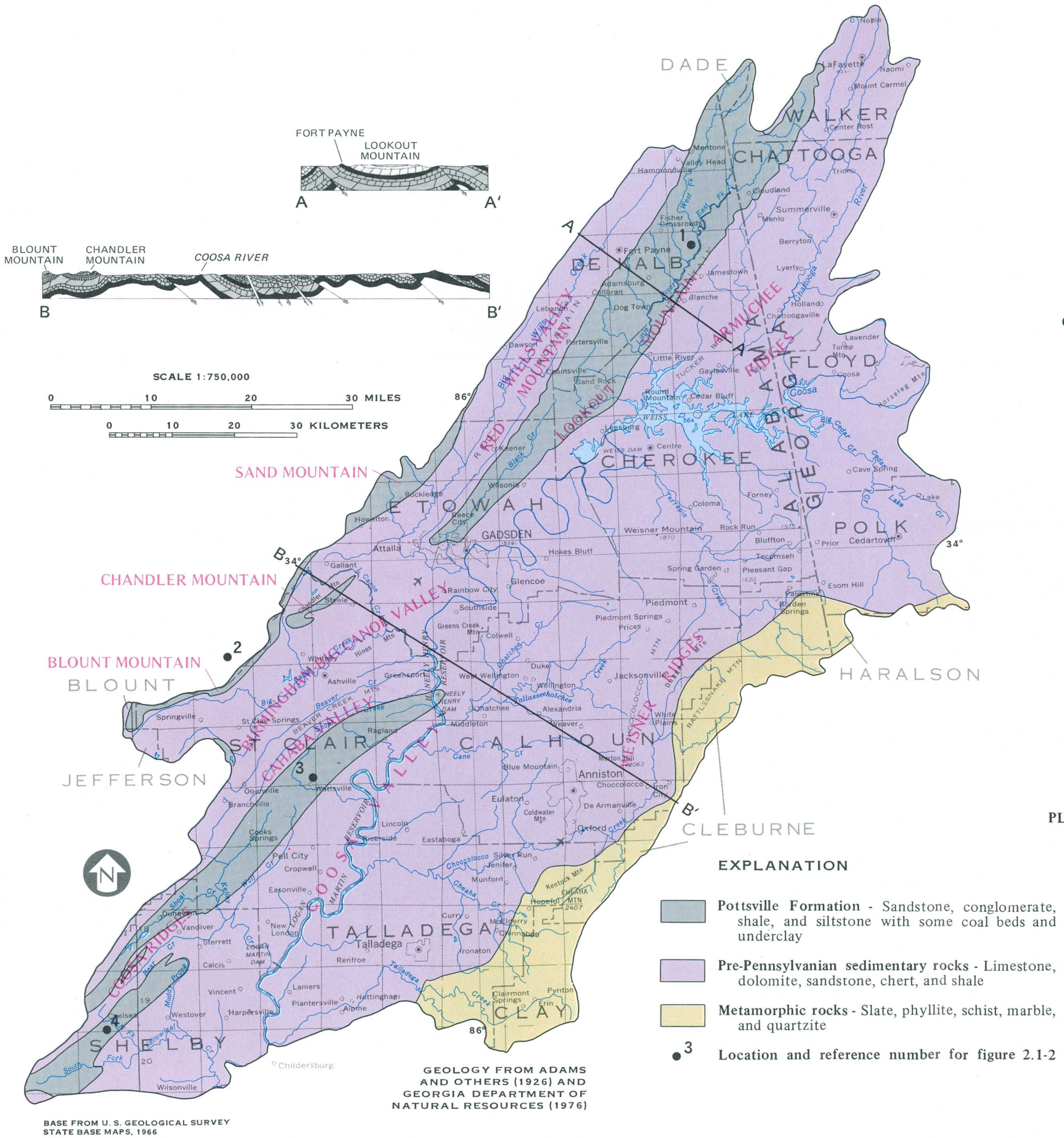


Figure 2.1-1 Geology and structure sections.

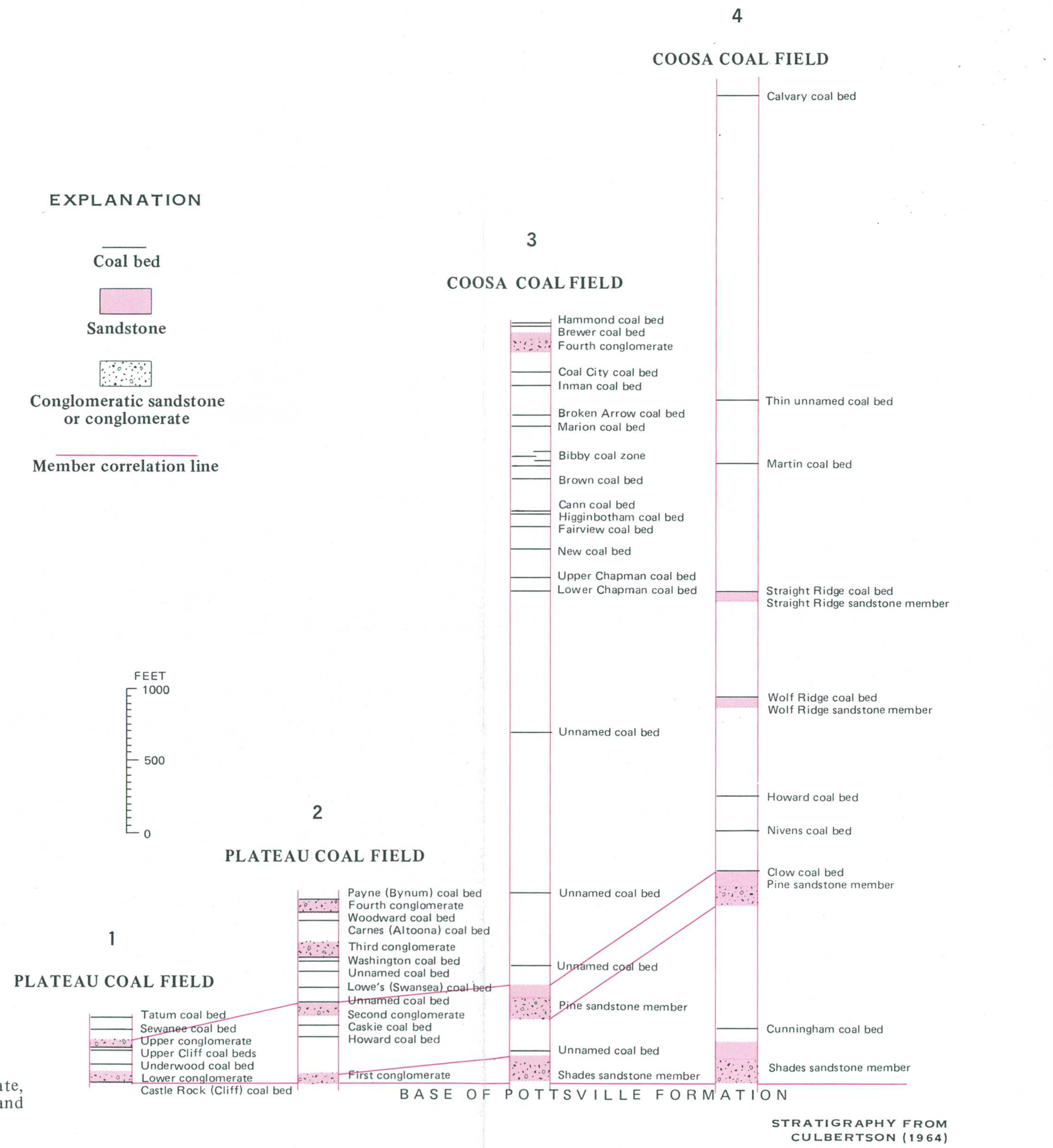


Figure 2.1-2 Generalized columnar sections showing position of coal beds.

Area 24 Within Three Physiographic Provinces

Area 24 is within three physiographic provinces: Appalachian Plateaus, Valley and Ridge, and Piedmont.

The northwestern part of Area 24 is within the Cumberland Plateau section of the Appalachian Plateaus physiographic province (Fenneman, 1938). To the southeast the area includes the Southern Valley and Ridge section (Clarke and Zisa, 1976) of the Valley and Ridge province (Johnston, 1932) and the Piedmont Uplands section of the Piedmont province (Sapp and Emplaincourt,1975)(fig. 2.2-1).

The surface of the Cumberland Plateau section is generally higher than that of adjacent provinces. Most of the Plateau is underlain by the Pottsville Formation which contains massive sandstone beds. These beds resist erosion and form escarpments along the edges of the Plateau. The Cumberland Plateau section is represented by Lookout Mountain and adjacent Wills Valley, the eastern edges of Sand Mountain and Blount Mountain, and by Chandler Mountain.

Lookout Mountain is a narrow, synclinal remnant of the Cumberland Plateau, trending southwest-northeast. At its south end near Gadsden, Alabama, it is about 3 miles wide and has an altitude of 1,200 feet. It is 7 miles wide at the Alabama-Georgia border and reaches an altitude of over 2,000 feet in Georgia. The surface of the Plateau on Lookout Mountain is relatively undissected in the northern part, but becomes more uneven to the south where the edges of the plateau stand higher than the middle, a reflection of the synclinal structure of the underlying rocks. Little River and Black Creek drain Lookout Mountain.

Wills Valley is parallel with Lookout Mountain and is underlain by pre-Pennsylvanian sedimentary rocks. Within the valley, ridges formed by resistant sandstone beds separate three narrow valleys underlain by limestone and dolomite. Red Mountain is the most pronounced of these ridges. Wills Valley is drained by southward-flowing Big Wills Creek and Little Wills Creek.

The steep eastern edges of Sand Mountain and Blount Mountain are drained to the east. Chandler Mountain is an outlier of the plateau capped by the Pottsville Formation.

Most of Area 24 is within the Valley and Ridge province. In Alabama and Georgia the province is characterized by southwest-northeast trending valleys and ridges underlain by limestone, dolomite, shale, and sandstone. The Pottsville Formation has been completely eroded in most of the area; the Coosa Ridges in the southwest part represent the only remnants of the Pottsville Formation and plateau-type topography. Other features in the province in Area 24 are the Cahaba Valley, Coosa Valley (Chickamauga Valley and Great Valley in Georgia), part of the Birmingham-Big Canoe Valley, the Weisner Ridges and Armuchee Ridges. The Valley and Ridge province is drained by the Chattooga and Coosa Rivers and their tributaries.

The southeastern part of Area 24 lies within the Piedmont province. The resistant metamorphic rocks of this province form an upland area with high ridges, including Cheaha Mountain in Cleburne County, the highest point in Alabama (2,407 feet). Tributaries of Choccolocco and Terrapin Creeks drain the Piedmont province.

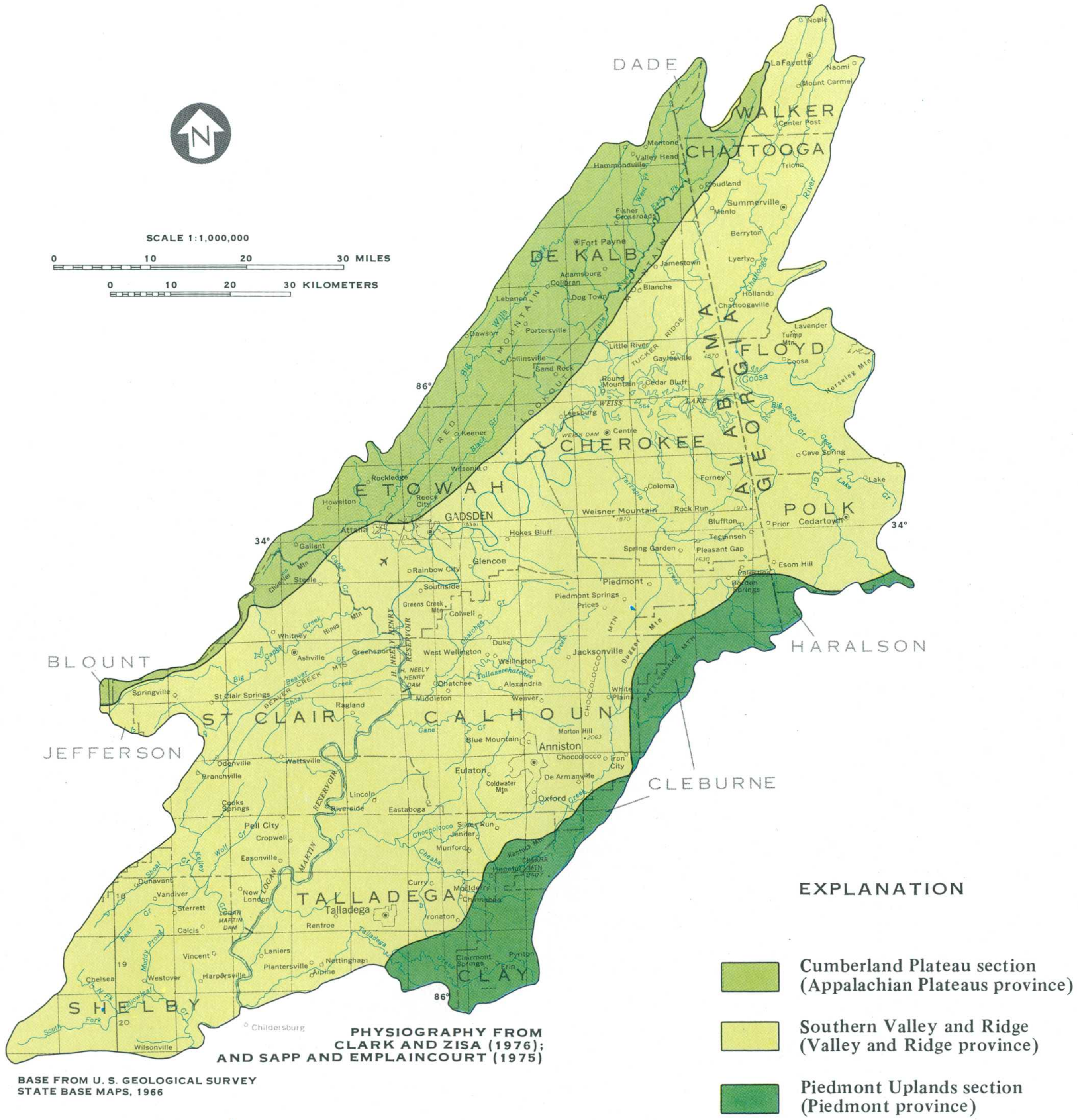


Figure 2.2-1 Physiographic divisions.

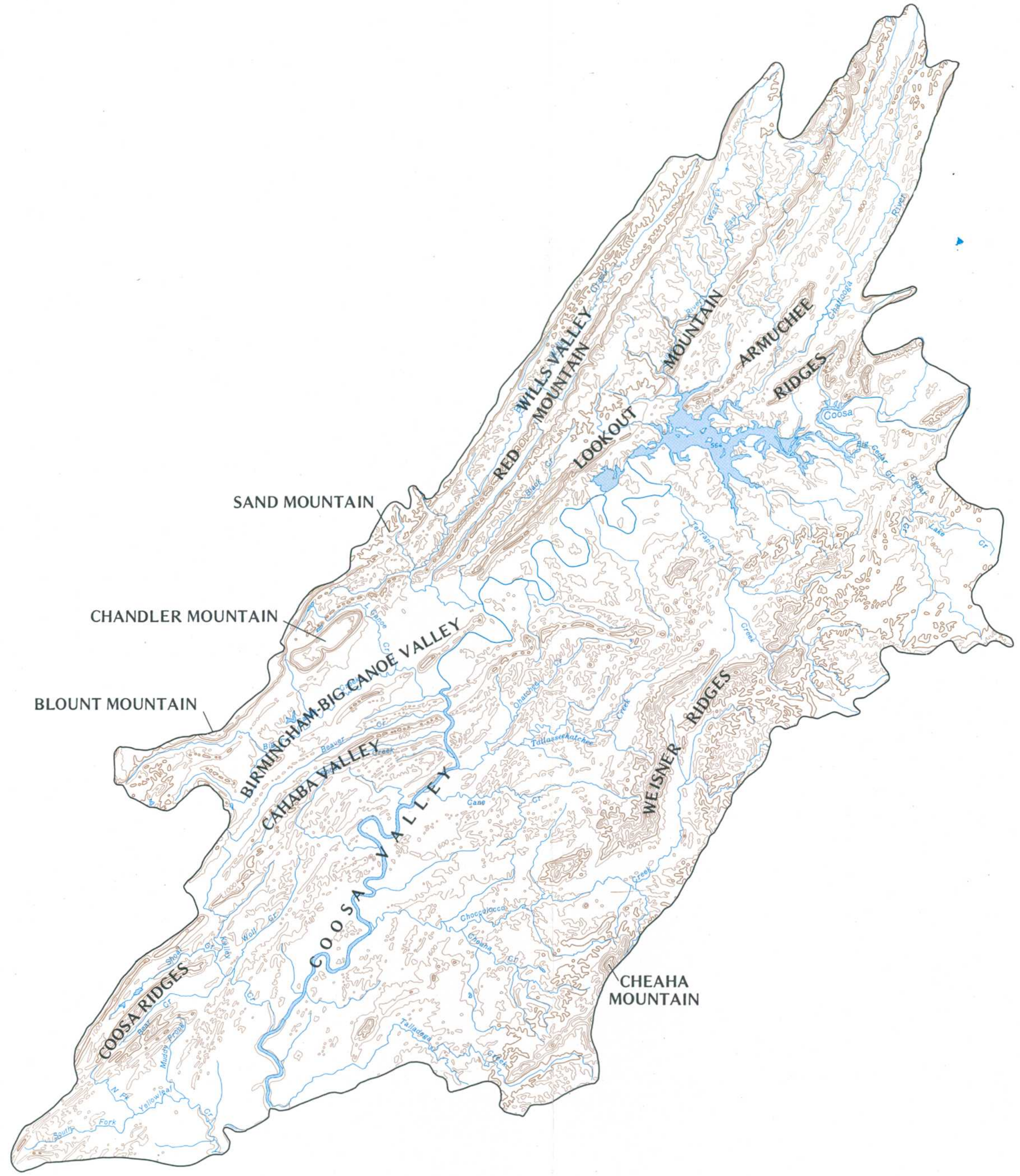


Figure 2.2-2 Topography.

Area 24 Lies Entirely Within the Coosa River Basin

Most of the coal-bearing rocks are drained by Chattooga River, Little River, and Big Wills, Big Canoe, Kelly, and Yellowleaf Creeks.

The Coosa River is impounded its entire length through Area 24 by backwater from Weiss, H. Neely Henry, Logan Martin, and Lay dams. The flow is regulated for hydro-power generation. The drainage eventually reaches the Mobile River and flows to the Gulf of Mexico.

Areas drained by tributaries to the Coosa River are shown in figure 2.3-1. Tributaries on the western side of Coosa River drain the coal-bearing rocks and the tributaries on the eastern side drain pre-Pennsylvanian sedimentary rocks and a small area of metamorphic rocks.

Chattooga River, Little River, Big Wills, and Big Canoe Creeks drain the eastern fringe of the Plateau Coal Field to the Coosa River. Chattooga River drains only a small area of coal-bearing rocks in the northwestern part of its basin. The Little River basin is underlain by coal-bearing rocks except for its lower part. Big Wills Creek drains a long, narrow, southwest-trending valley incised in pre-Pennsylvanian sedimentary rocks with coal-bearing rocks along the divide on both sides. Black Creek, a tributary to Big Wills Creek, drains an area which is entirely underlain by coal-bearing rocks. Big Wills Creek drainage also includes part of the industrial, municipal, and urban area of Attalla and Gadsden. Big Canoe Creek drains a small area of coal-bearing rocks along its northwestern divide.

Kelly and Yellowleaf Creeks and other smaller tributaries drain the entire Coosa Coal Field to the Coosa River. The northern part of the field is drained by many small tributaries to the Coosa River. The central part is drained by Kelly Creek and the southern part by Yellowleaf Creek.

Area 24 has a surface area of 4,350 mi^2. The Coosa River drains an additional 4,040 mi^2 upstream from Area 24. Area 24 includes the drainage basins of all tributaries to the Coosa River from Rome, Georgia, downstream to Wilsonville, Alabama. Some of these streams and their drainage areas are as follows:

Western side of Coosa River (coal-bearing rocks)

Plateau Coal Field

Basin	Area (square miles)
Chattooga River	380
Little River	200
Big Wills Creek	366
Big Canoe Creek	277

Coosa Coal Field

Basin	Area (square miles)
Kelly Creek	208
Yellow Leaf Creek	184

Eastern Side of Coosa River (non coal-bearing rocks)

Basin	Area (square miles)
Big Cedar Creek	208
Terrapin Creek	284
Ohatchee Creek	233
Cane Creek	96
Choccolocco Creek	403
Talladega Creek	175

Drainage area for selected locations on streams in Area 24 may be found in U.S. Geological Survey report "Drainage Areas in Coosa River Basin in Alabama", (Bodiford, 1980), U.S. Army Engineers District, Mobile Corps of Engineers report "Stream Mileage Tables with Drainage Areas" 1972, and "Drainage Area Data for Georgia Streams", (Carter, 1959).

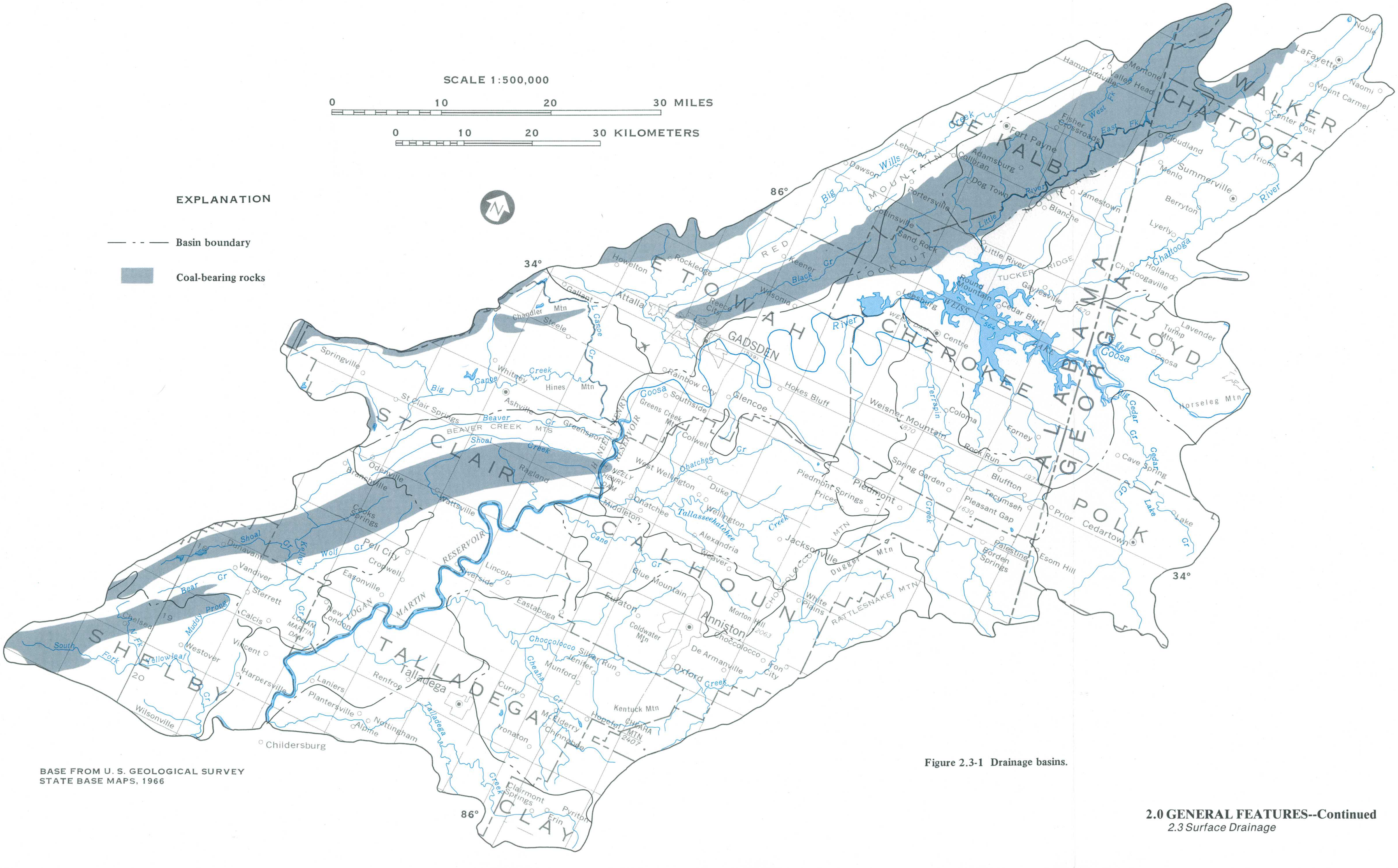


Figure 2.3-1 Drainage basins.

Forest Land Covers Majority of Area 24

Forest land covers approximately 70 percent of Area 24; agricultural land covers approximately 20 percent; with the remainder evenly divided between urban land, barren land, water, and wetlands.

The predominant land use in the Plateau and Coosa Coal Fields of Area 24 is forest land; followed by agricultural land. In general, the percentage of forest and agricultural land in these coal fields is the same as that for all of Area 24. Less than one percent of the area has been strip mined.

The land-use and land-cover categories for Area 24 are shown on figure 2.4-1. Aerial photos and other remotely sensed data were the primary sources in compiling this map at the original scale of 1:250,000 (1 inch on the map equals approximately 4 miles on the ground). A minimum mapping unit of 10 acres is used for all urban areas, surface-water bodies, mines, quarries, and selected agricultural areas; a minimum mapping unit of 40 acres is used for all other land-use and land-cover categories. A more detailed explanation of the classification system is available in U.S. Geological Survey Professional Paper 964 (Anderson and others, 1976).

Infiltration and runoff rates are affected by the use of the land surface. Where coal is surface mined, the slope and shape of the land surface is changed; great depths of overburden are broken, mixed, and rearranged; and the rate of infiltration is altered. Generally, the infiltration rate is increased immediately after mining. However, as water decomposes the material through which it percolates the rate decreases. Urban and industrial development reduces infiltration rates due to paving, roof tops, and storm sewers. Changes in cultivated land from row crops to pasture or timber also have an effect on infiltration and runoff rates. The land surface is the source of sediment and there can be a great increase of sediment yield when the land surface is changed from forest to bare surface-mined land.

Land-use and land-cover information and maps at a larger scale may be found in U.S. Geological Survey open-file reports titled "Land-use and Land-cover Series". Information concerning these maps may be obtained from:

National Cartographic Information Center
U.S. Geological Survey
National Center
Reston, Virginia 22092

or

Alabama Geological Survey
National Cartographic Information Center Affiliate
P. O. Box O
University, Alabama 35486

or

Department of Community Affairs
40 Marietta St. NW, 8th Floor
Atlanta, Georgia 30303

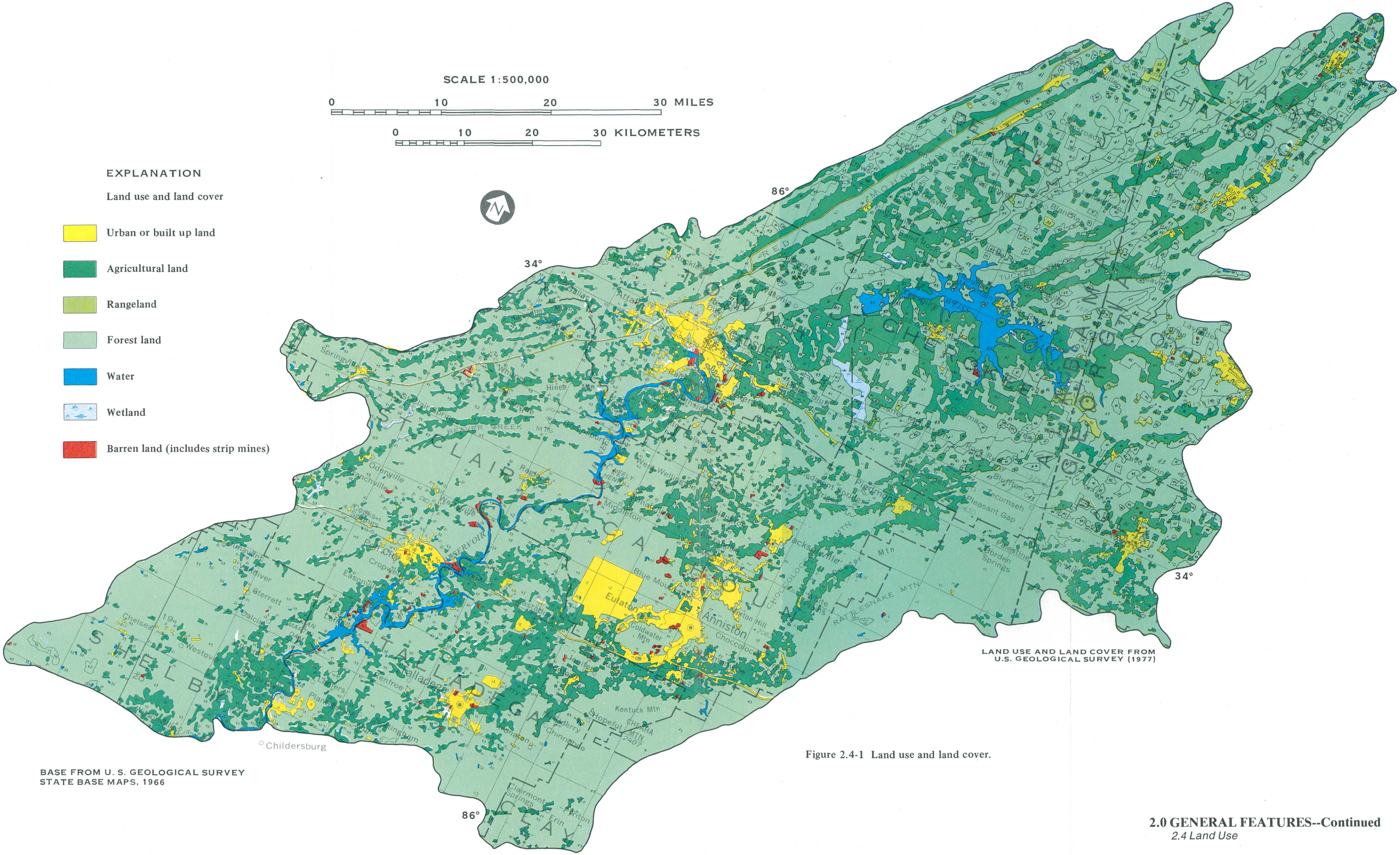


Figure 2.4-1 Land use and land cover.

Three Soil Provinces Present in Area

Area 24 contains three major soil provinces: Valley and Ridge, Appalachian Plateau or Sand Mountain, and Piedmont.

Each of the three major soil provinces consists of a number of soil associations. Associations are mappable soil bodies representing a broad landscape, having a repeating pattern of soils, and named according to the one or more most extensive soil series. The generalized soils map for Area 24 (fig. 2.5-1) shows the distribution of the Valley and Ridge, Appalachian Plateau and Piedmont provinces and their constituent soil associations. For correlative purposes Alabama nomenclature was used throughout the area. Comparable Georgia terminology is also given in fig. 2.5-1.

Soil characteristics are important determinants of the suitability of an area for particular land uses. All soils in Area 24 generally have low organic content, low natural fertility, moderate permeability rates, high acidity, and high erosion potential (Brady, 1974). Hydrologic soil groups (table 2.5-1) can be classified based on the infiltration rate for a bare soil after prolonged wetting (Mockus, 1972). Increasingly slow infiltration rates are observed in Group B through Group D soils respectively. A summary of engineering characteristics for soils in the coal fields is given in table 2.5-2.

The soils map and soil association descriptions are very generalized. Detailed information for associations in unmined areas and for individual counties is available from:

U.S. Department of Agriculture
Soil Conservation Service
P. O. Box 311
Auburn, AL 36830

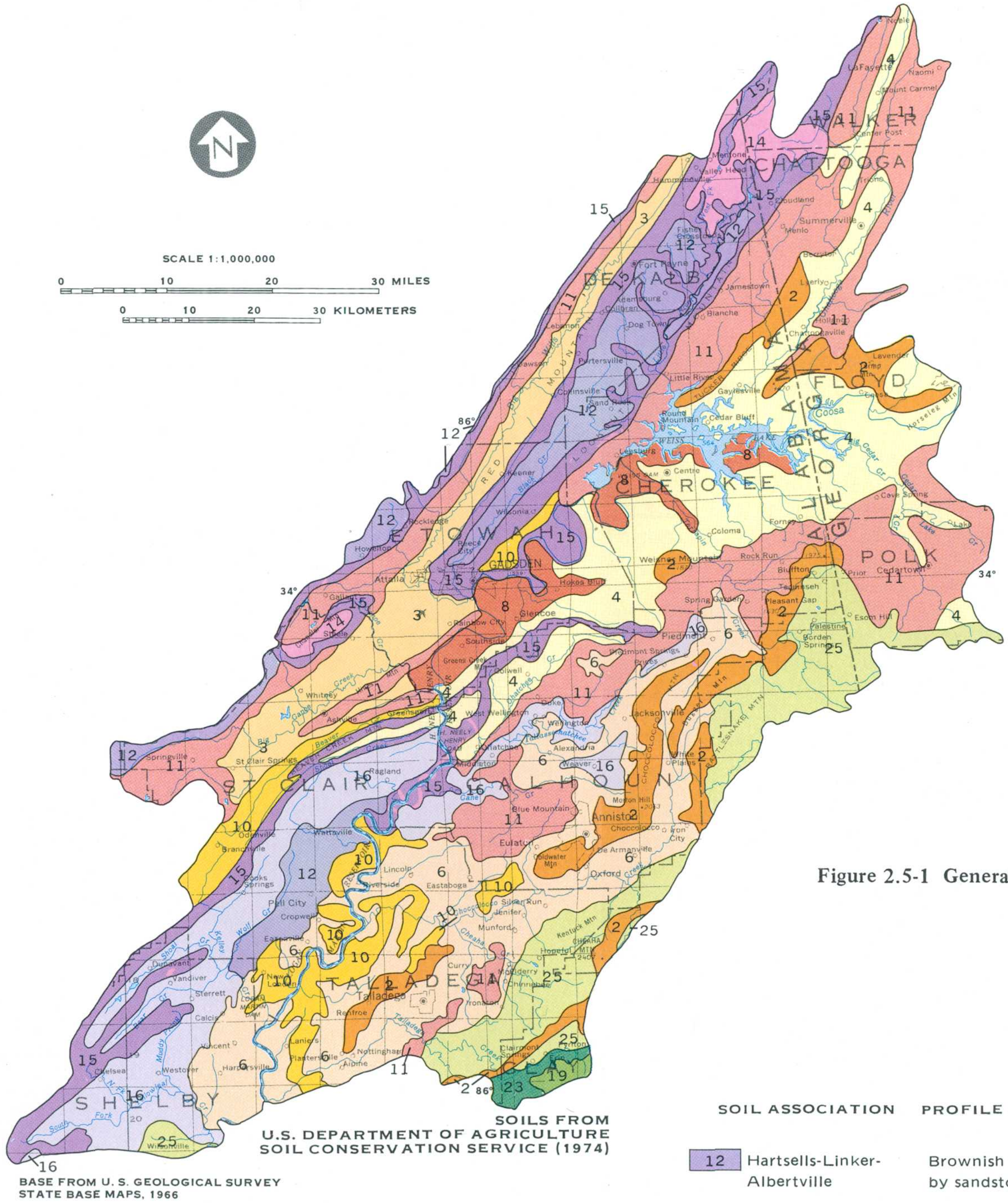
or

Agricultural Experiment Station
125 Barrow Hall
University of Georgia
Athens, GA 30602

Table 2.5-1 Hydrologic soil groups.

Albertville	C	Hector	D
Allen	B	Hiwassee	B
Bodine	B	Holston	B
Cheaha	D	Leesburg	B
Chewacla	C	Linker	B
Colbert	D	Madison	B
Conasauga	C	McQueen	C
Davidson	B	Minvale	B
Decatur	B	Montevallo	D
Dewey	B	Talbott	C
Enders	C	Tallapoosa	C
Firestone	C	Tatum	C
Fullerton	B	Townley	C
Gwinnett	B	Wynnville	C
Hartsells	B		

From: U.S. Department of Agriculture Soil Conservation Service (1979).



EXPLANATION

SOIL ASSOCIATIONS

ALABAMA — GEORGIA

Soils of the Valley and Ridge

	ALABAMA	GEORGIA
2	Cheaha-Leesburg	Nella-Townley-Hector
3	Colbert-Conasauga-Firestone	
4	Conasauga-Firestone-Talbott	Conasauga-Lyerly-Wolftever; Townley-Montevallo-Cunningham
6	Decatur-Dewey-Allen	
8	Holston-McQueen-Chewalla	
10	Minvale-Bodine-Fullerton	
11	Minvale-Fullerton	Shack-Fullerton-Bodine

Soils of the Appalachian Plateaus

	ALABAMA	GEORGIA
12	Hartsells-Linker-Albertville	
14	Hartsells-Wynnville-Albertville	Nella-Townley-Hector
15	Hector-Rockland, limestone-Allen	Hartsells-Hector
16	Montevallo-Townley-Enders	

Soils of the Piedmont Uplands

	ALABAMA	GEORGIA
19	Davidson-Hiwassee-Gwinnett	
23	Madison-Tallapoosa	
25	Tallapoosa-Tatum	Tallapoosa-Grover-Madison

Figure 2.5-1 Generalized soil associations.

Table 2.5-1 Properties of soil associations in the Appalachian Plateau province.

SOIL ASSOCIATION	PROFILE CHARACTERISTICS	DRAINAGE CLASS	PERMEABILITY CLASS	DEPTH TO BEDROCK HARD (INCHES)	DEPTH TO BEDROCK RIPABLE (INCHES)	HIGH WATER TABLE DEPTH (FEET)	SHRINK-SWELL POTENTIAL (SUBSOIL)	AVAILABLE WATER CAPACITY	DOMINANT SLOPE (PERCENT)	PH (UNITS)
12 Hartsells-Linker-Albertville	Brownish loam underlain by sandstone	well	moderately slow to moderate	20-greater than 6	40-72	greater than 6	low to moderate	moderate	2-15	4.5-5.5
14 Hartsells-Wynnville-Albertville	Brownish loamy surface layers with loamy to clayey subsoils or fragipan.* Underlain by sandstone or shale	moderately well to well	slow to moderate	20-84	-----	greater than 6 (1.5-2.5 perched)	low to moderate	moderate	0-15	4.5-5.5
15 Hector-Rockland, Limestone-Allen	Brownish, gravelly, loamy surface layers over loamy subsoils and underlain by sandstone. Large component of exposed rock	well	moderate to moderately rapid	10-20 or greater than 60	greater than 60	greater than 6	low	moderate	25-40	5.1-5.5
16 Montevallo-Townley-Enders	Shaly silt underlain by shale and sandstone	well	very slow to moderate	greater than 60	10-96	greater than 6	low to high	low	6-40	4.5-5.5

* Fragipan - Dense and brittle pan or layer in soils that owes its hardness mainly to extreme density or compactness rather than clay content or cementation; water moves through it very slowly (Brady, 1974, 603 p.).

Area 24 has a Moist Temperate Climate

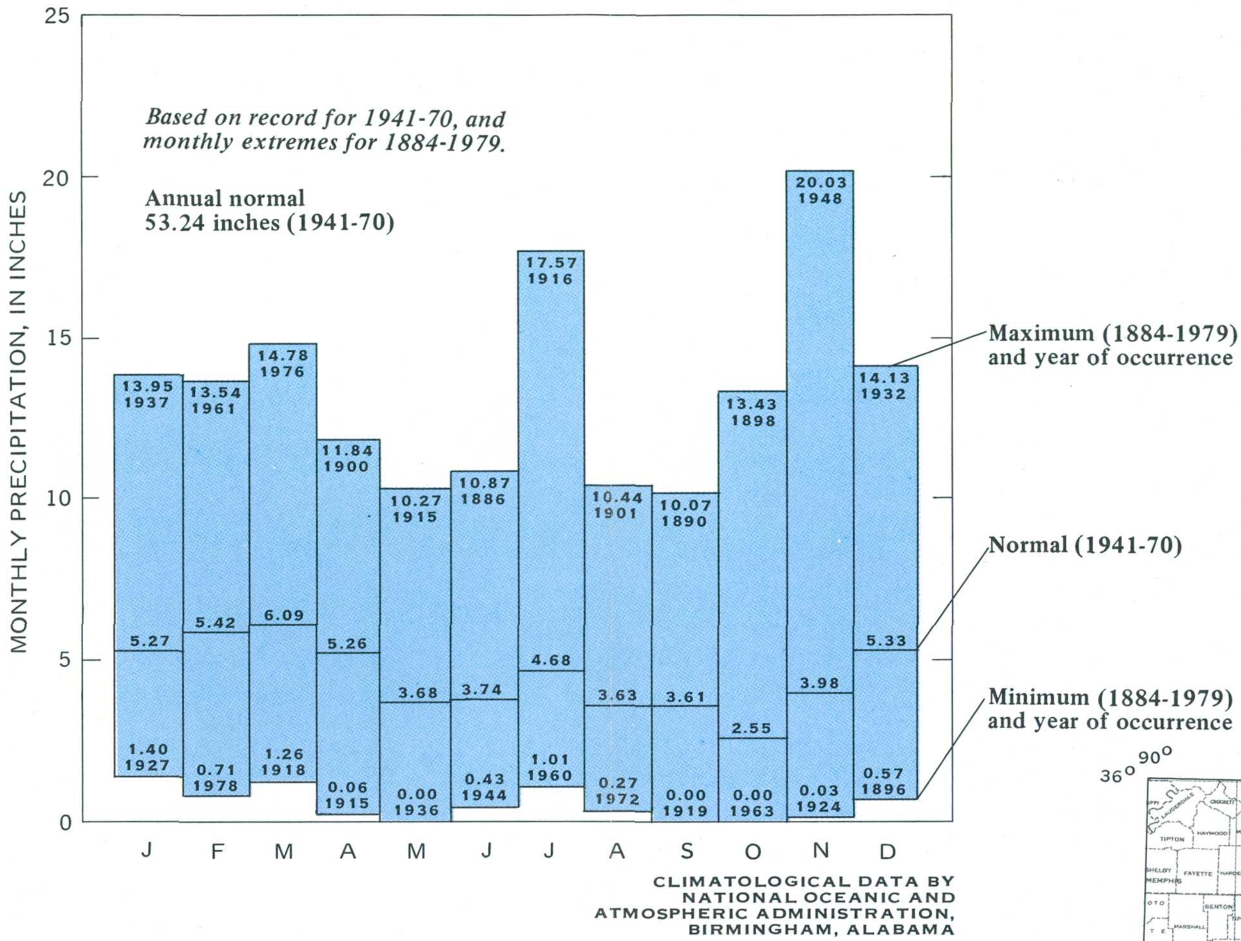
Area 24 has a moist temperate climate with the heaviest rainfall usually occurring in March and the least rainfall occurring in October.

The location of Area 24 gives it a moist temperate climate, with a mean annual rainfall that ranges from 52 inches in the northern part to 56 inches in the southern part of the area. Rainfall is fairly well distributed throughout the year. Winter is the wettest season and March the wettest month. The driest months are in the fall with October being the driest month. Thunderstorms occur throughout the year, but are most frequent during the spring and summer months; most of the rainfall in these months occurs during these storms. July has the most rainfall of the summer months. Rainless periods lasting more than 2 or 3 weeks are rare.

Mean annual precipitation, in inches, is shown in figure 2.6-1 for the period 1931-55. Distribution of rainfall by months for Gadsden is shown in figure 2.6-2. Normal precipitation is for the 30-year base period of 1941-70. The extremes for the period of record (1884-1979) are used to show variations above and below normal.

Daily observations of precipitation data may be used to develop various relationships and correlations and for other statistical analyses for use in hydrologic studies. For example, the results of an analysis using 24-hour rainfall to compute the 10-year 24-hour rainfall intensities are shown in figure 2.6-3.

Daily precipitation data are published monthly as "Climatological Data for Alabama" by the National Oceanic and Atmospheric Administration, National Climatic Center, Ashville, N. C. Statistical information on analyses and data are presented in U.S. Department of Commerce, Weather Bureau, Technical Paper No. 40 titled, "Rainfall Frequency Atlas of the United States."



Extremes of record 1884-1979, in inches

Maximum annual precipitation	77.22	(1948)
Minimum annual precipitation	36.56	(1954)

Figure 2.6-2 Precipitation at Gadsden, Etowah County, Alabama.

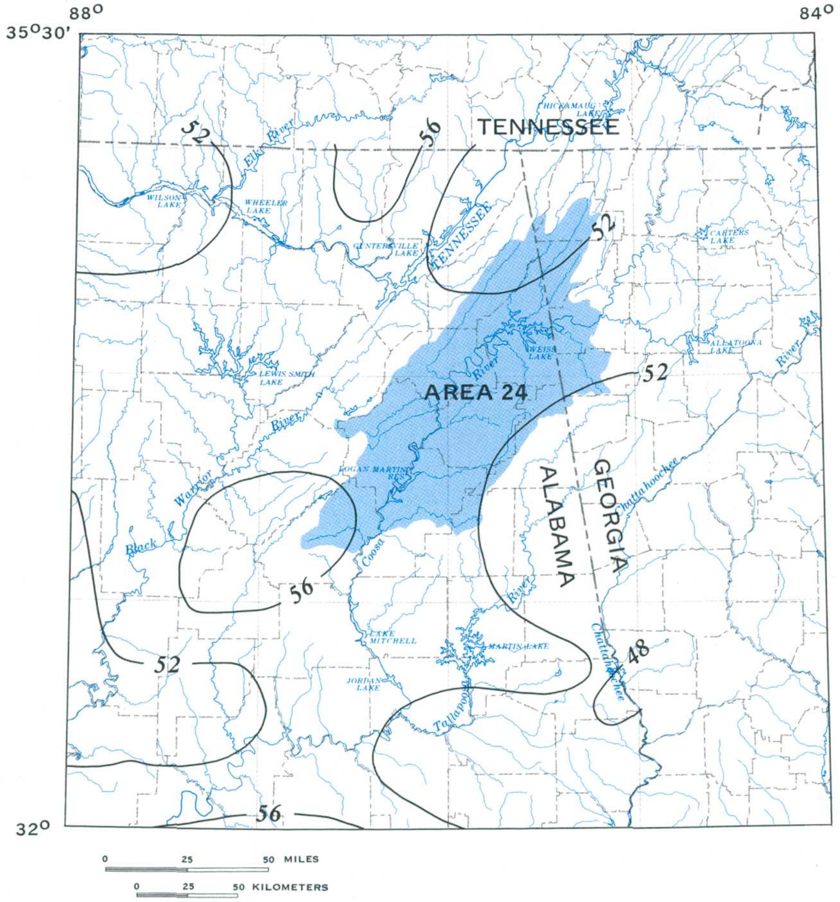
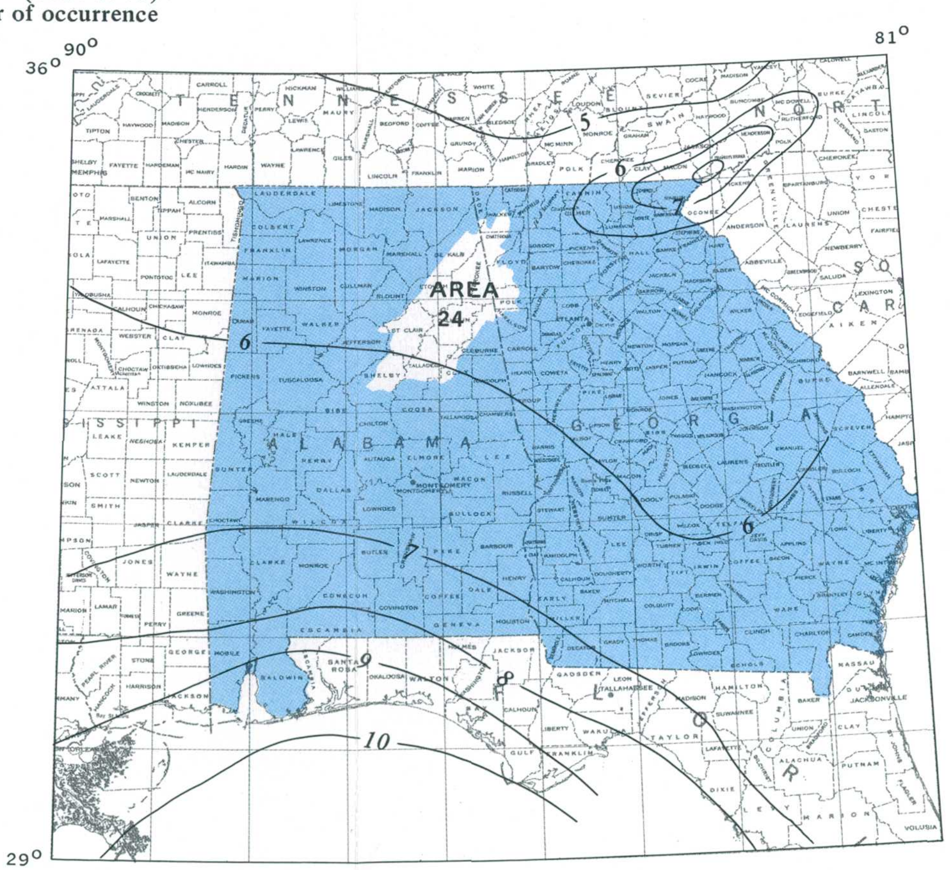


Figure 2.6-1 Mean annual precipitation, in inches, 1931-55.



CLIMATOLOGY FROM U.S. DEPARTMENT OF COMMERCE (1961)

Figure 2.6-3 10-year 24-hour rainfall intensities, in inches.

Principal Water Uses in Area 24 are for Hydroelectric and Thermoelectric Power Generation

In 1980, 26,930 million gallons per day of water was used at three dams on Coosa River for hydroelectric power generation and 692 Mgal/d were used at two thermoelectric generation facilities. Public, industrial, and rural uses totaled 301.7 Mgal/d.

Water used for hydroelectric power during 1980 at Weiss, H. Neely Henry and Logan Martin Dams was 8,583, 9,144 and 9,198 Mgal/d, respectively. These uses and the 692 Mgal/d used at the two thermoelectric power generation facilities is 99 percent of the water used in Area 24 (fig. 3.1-1). The Coosa River is the source of this water.

Water withdrawal for public, industrial, and rural use was only one percent (301.7 Mgal/d) of the water used. Water withdrawal for these uses was 84 percent from surface-water and 16 percent from ground-water sources (fig. 3.1-2). However, rural water supplies are almost entirely from ground-water sources. The water use for combined public and industrial uses for counties or parts of counties is given in table 3.1-1.

Water-use data for 1980, have been collected, compiled, and will be available through the National Water Data Exchange (NAWDEX). For details about NAWDEX see section 9.2 of this report.

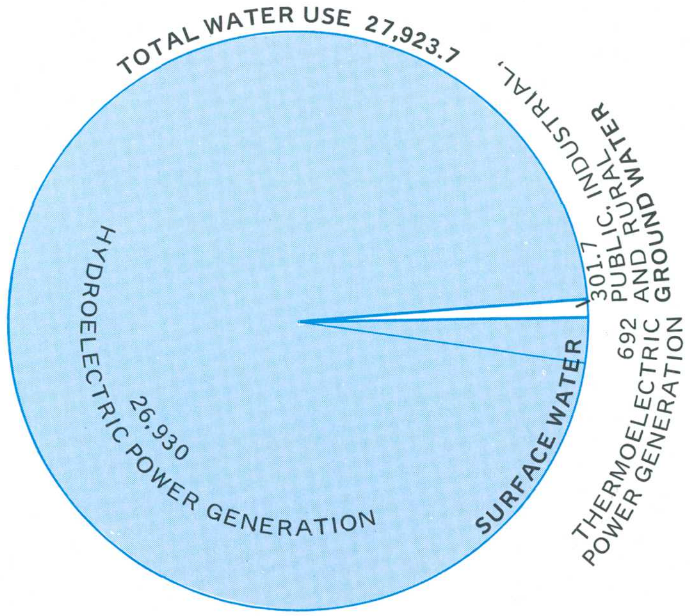


Figure 3.1-1 Total water use in 1980, in million gallons per day.

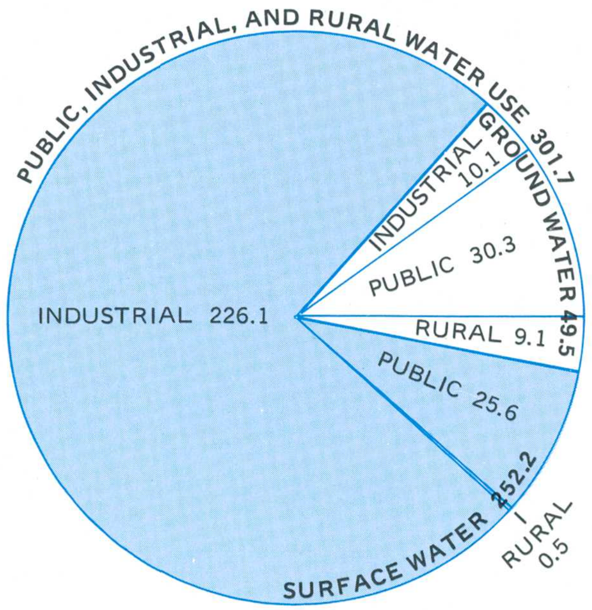
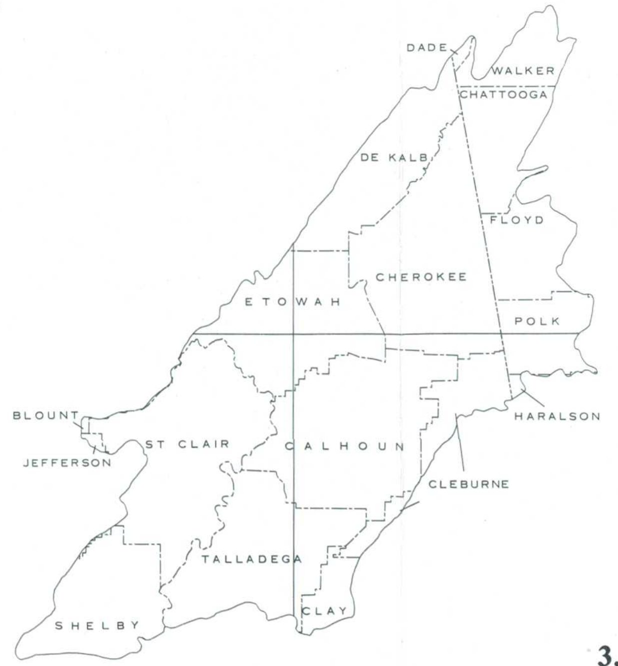


Figure 3.1-2 Public, industrial, and rural water use in 1980, in million gallons per day.

Table 3.1-1 Public and industrial water use, in million gallons per day.*

	PUBLIC AND INDUSTRIAL		THERMOELECTRIC POWER GENERATION		HYDROELECTRIC POWER GENERATION
	GROUND WATER	SURFACE WATER	GROUND WATER	SURFACE WATER	SURFACE WATER
GEORGIA					
CHATOOGA	9.09	3.31	0.0	0.0	0.0
DADE	.0	.0	.0	.0	.0
FLOYD	.28	24.45	.0	5.48	.0
HARALSON	.0	.0	.0	.0	.0
POLK	5.30	2.26	.0	.0	.0
WALKER	.42	1.60	.0	.0	.0
ALABAMA					
BLOUNT	.0	.0	.0	.0	.0
CALHOUN	15.88	5.84	.0	.0	9144 (H. Neely Henry Dam)
CHEROKEE	.01	.46	.0	.0	8583 (Weiss Dam)
CLAY	.0	.01	.0	.0	.0
CLEBURNE	.01	.05	.0	.0	.0
DE KALB	.50	2.41	.0	.0	.0
ETOWAH	1.48	159.03	.0	144	.0
JEFFERSON	.0	.0	.0	.0	.0
SHELBY	1.00	.25	.0	.0	.0
ST CLAIRE	3.21	.01	.0	.0	.0
TALLADEGA	3.10	52.00	.0	.0	9198 (Logan Martin Dam)

** Prorated for parts of counties within Area 24*
Rural use not shown



3.0 WATER USE

3.1 Water Use in 1980

Streams in Area 24 Have Use Classification

The Alabama Water Improvement Commission has classified most streams in Area 24 as Fish and Wildlife or better use.

Use classification of stream reaches is shown in figure 3.2-1. The reaches as classified February 4, 1981, for Area 24 by the Alabama Water Inprovement Commission, also given in section 10.1, show most streams are classified as "Fish and Wildlife" or better (E. John Williford, written communication 1981). Use classification of stream reaches in Georgia by Georgia Department of Natural Resources (July 1980) gives the classification for Coosa River in Area 24 in Georgia as "Recreation".

Major streams and stream segments known to be receiving point source discharge have been classified by Alabama Water Improvement Commission. In every instance where a segment is not included by name, the Commission has no information to assign a particular classification, and the assumption was made by the Commission that these unnamed segments are classified as "Fish and Wildlife". These classifications will remain so unless it is demonstrated that they are improperly classified.

Although not explicitly stated in the classifications, every stream segment in addition to being considered acceptable for its designated use is also considered acceptable for any other use with a less stringent associated criteria.

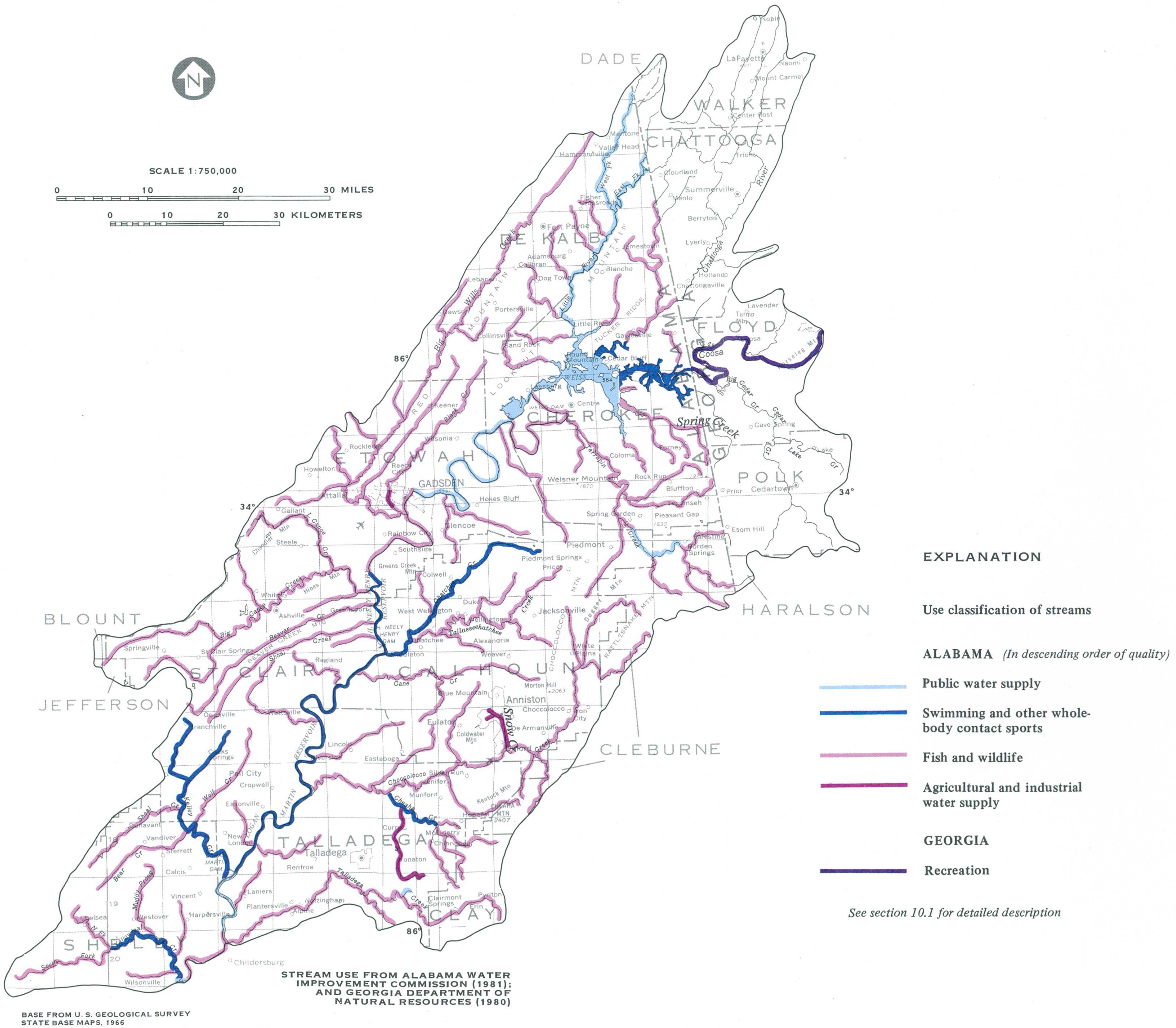


Figure 3.2-1 Stream use classification.

Information on Surface Water is Available for 77 Locations

The U.S. Geological Survey surface-water data-collection network for Area 24 was expanded in response to the Surface Mining Control and Reclamation Act of 1977 and information on surface water is now available for 77 locations.

Streamflow and water-quality information is available for 77 sites, 47 active and 27 inactive, in Area 24, plus 3 active sites near Rome, Georgia, just outside Area 24. These surface-water sites are shown on figure 4.1-1, and details for the period of record and type of data available are given in section 10.2. Before the passage of the Act, the network consisted of six active stations. The active network of the U.S. Geological Survey has been increased to 50 sites by the Survey to obtain data needed to assess the hydrology of the general area and as an aid to mine owners and operators, consulting engineers, and the Regulatory Authority in evaluating the hydrologic consequences of mining.

Water-quality data are obtained at all 50 sites. Several types of data may be collected at a particular site, but all types of data are not necessarily collected at each site. Details about period of operation and type of data as well as the actual data are available from computer storage through National Water Data Exchange (NAWDEX see section 9.2) and in published annual U.S. Geological Survey reports, "Water Resources Data for Alabama" and "Water Resources Data for Georgia."

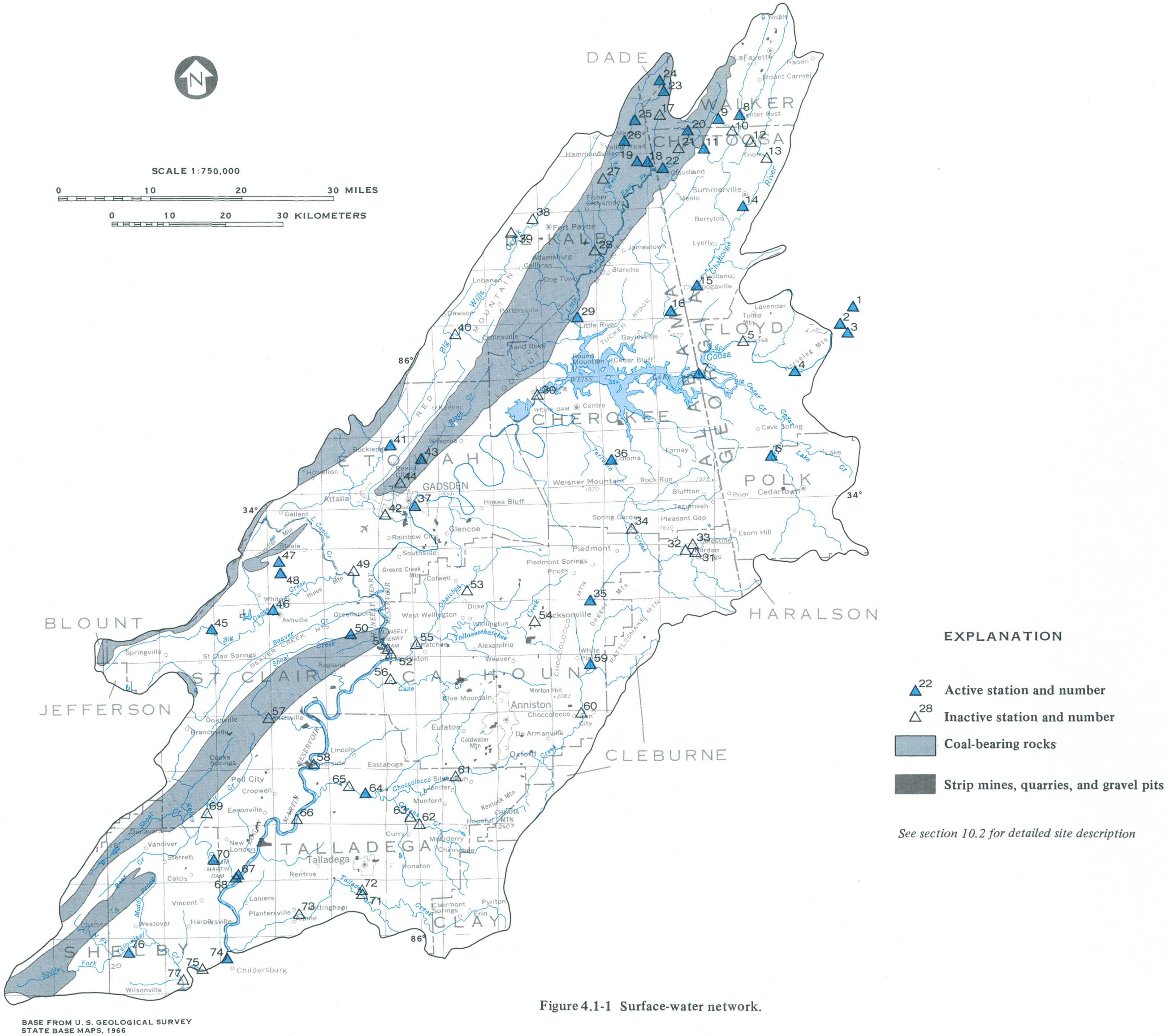


Figure 4.1-1 Surface-water network.

Information on Ground-Water Levels or Spring Discharge is Available for 44 Locations

The U.S. Geological Survey ground-water network includes 21 wells and 23 springs in Area 24.

The ground-water network in Area 24 provides water-level, spring-discharge and water-quality data. These data will aid applicants for coal-mining permits, mine owners and operators, consulting engineers, and regulatory agencies in determining the potential impact of coal mining on the ground-water resources of the permit area.

Water-level data for 21 wells and discharge data for 23 springs are available, including continuous records for 2 wells and 1 spring. The other wells and springs have been measured periodically. Locations of these wells and springs, only one of which is in coal bearing rocks, are shown on figure 4.2-1. Information including identification numbers, county, state, producing aquifer, and period of record for each site is given in section 10.3. Additional information about the type of data, including the actual data, is available from (1) the National Water Data Exchange (NAWDEX see section 9.2), (2) the National Water Data Storage and Retrieval System (WATSTORE see section 9.3), (3) published annual U.S. Geological Survey reports, "Water Resources Data for Alabama", (4) State of Georgia Department of Natural Resources publications, and (5) reports on water availability for individual counties published by the Geological Survey of Alabama. For further information concerning wells and springs in the area contact:

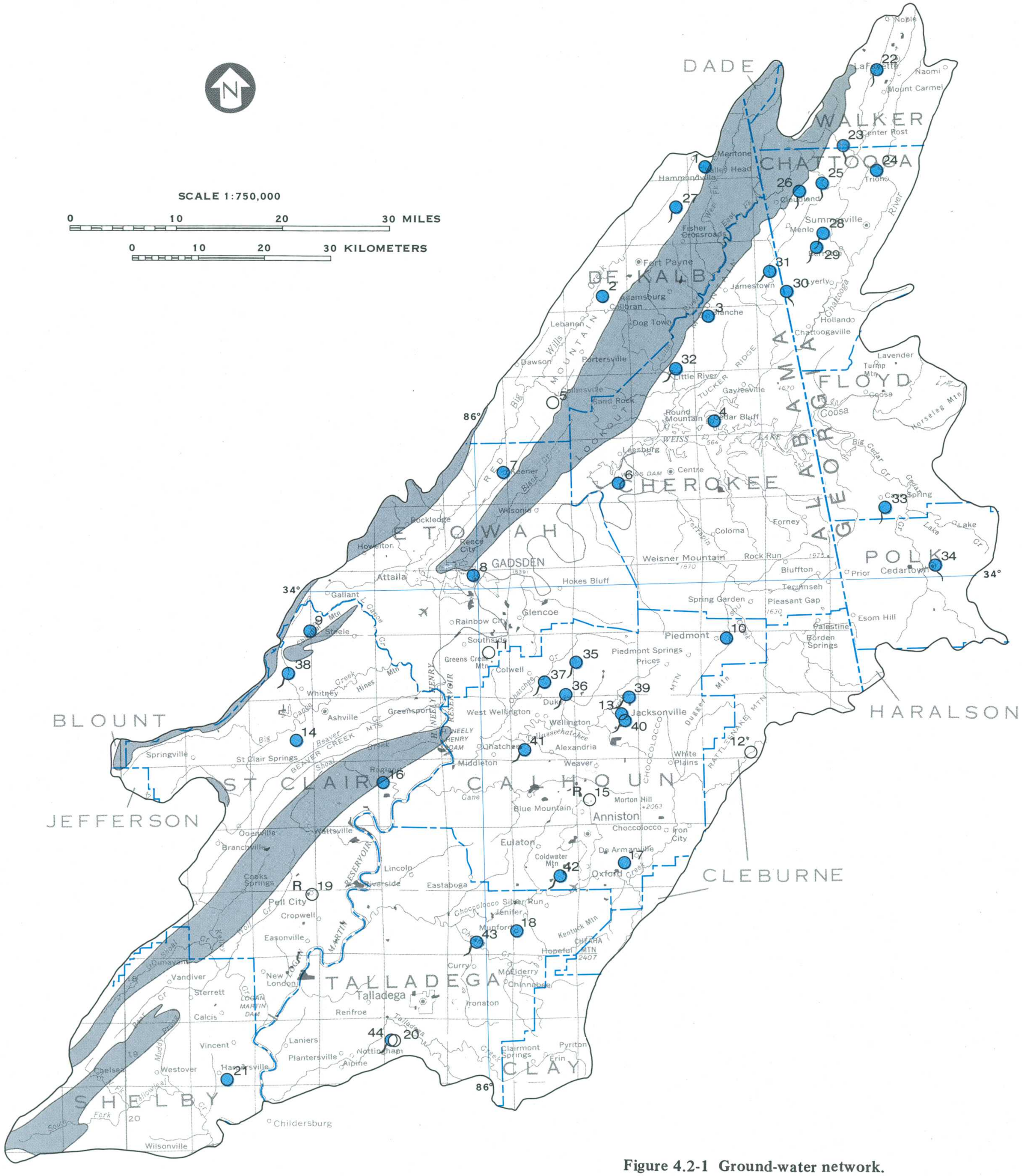
U.S. Geological Survey
Water Resources Division
Room 202, Oil & Gas Board Bldg.
P. O. Box V
University, AL 35486

Telephone: (205) 752-8104
FTS 229-2957

or

U.S. Geological Survey
Water Resources Division
6481 Peachtree Industrial Blvd.
Suite B
Doraville, GA 30360

Telephone: (404) 221-4858
FTS 242-4858



EXPLANATION

- Active observation well
- Inactive observation well
  Note: R *indicates continuous recorder*
- Spring
- 21 Site number
- Coal-bearing rocks
- Strip mines, quarries, and gravel pits

See section 10.3 for detailed site description

BASE FROM U. S. GEOLOGICAL SURVEY
STATE BASE MAPS, 1966

Figure 4.2-1 Ground-water network.

Streamflow Varies Seasonally with Rainfall and Evapotranspiration

Variations in streamflow are related to the duration and intensity of rainfall and the seasonal changes in evapotranspiration.

The seasonal pattern of streamflow in Area 24 is shown by a sample hydrograph of daily discharge (fig. 5.1-1). This hydrograph was selected because it illustrates all phases of the yearly cycle of streamflow; characteristic low flow during October, the month of lowest average rainfall; increasing flow in November and December as evapotranspiration decreases and the winter rains begin; and high flows from January to April when heavy general rains fall on wet or saturated soil. Flows recede in May and June as rainfall diminishes and evapotranspiration increases; surface runoff increases due to thunderstorm activity in July and early August; and finally, recession of flow in August and September as rains become less frequent and ground-water outflow becomes the primary source of streamflow.

A streamflow characteristic illustrated by the hydrograph is its wide variability above and below the annual average flow (fig. 5.1-1). The variability of monthly mean streamflow is shown on figure 5.1-2.

A comparison of monthly mean rainfall and runoff is illustrated by figure 5.1-3 for the 30-year base period 1941-70 for rainfall and the period of streamflow record (1944-70) for Big Wills Creek near Crudup.

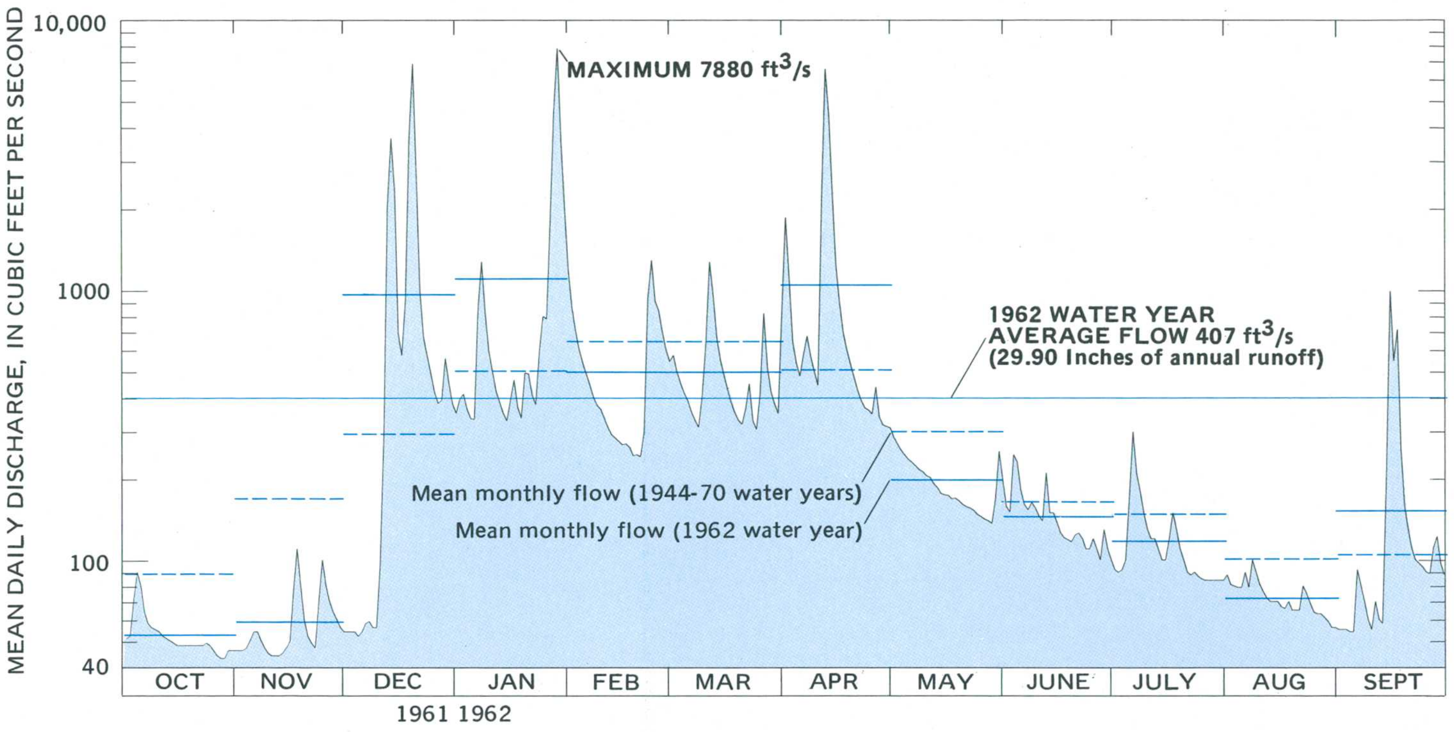
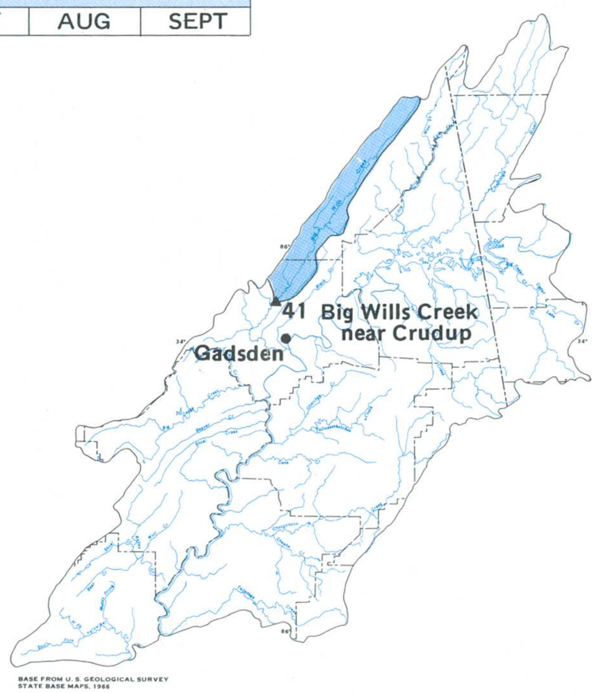


Figure 5.1-1 Daily discharge for Big Wills Creek near Crudup, Alabama (site 41), water year 1962.



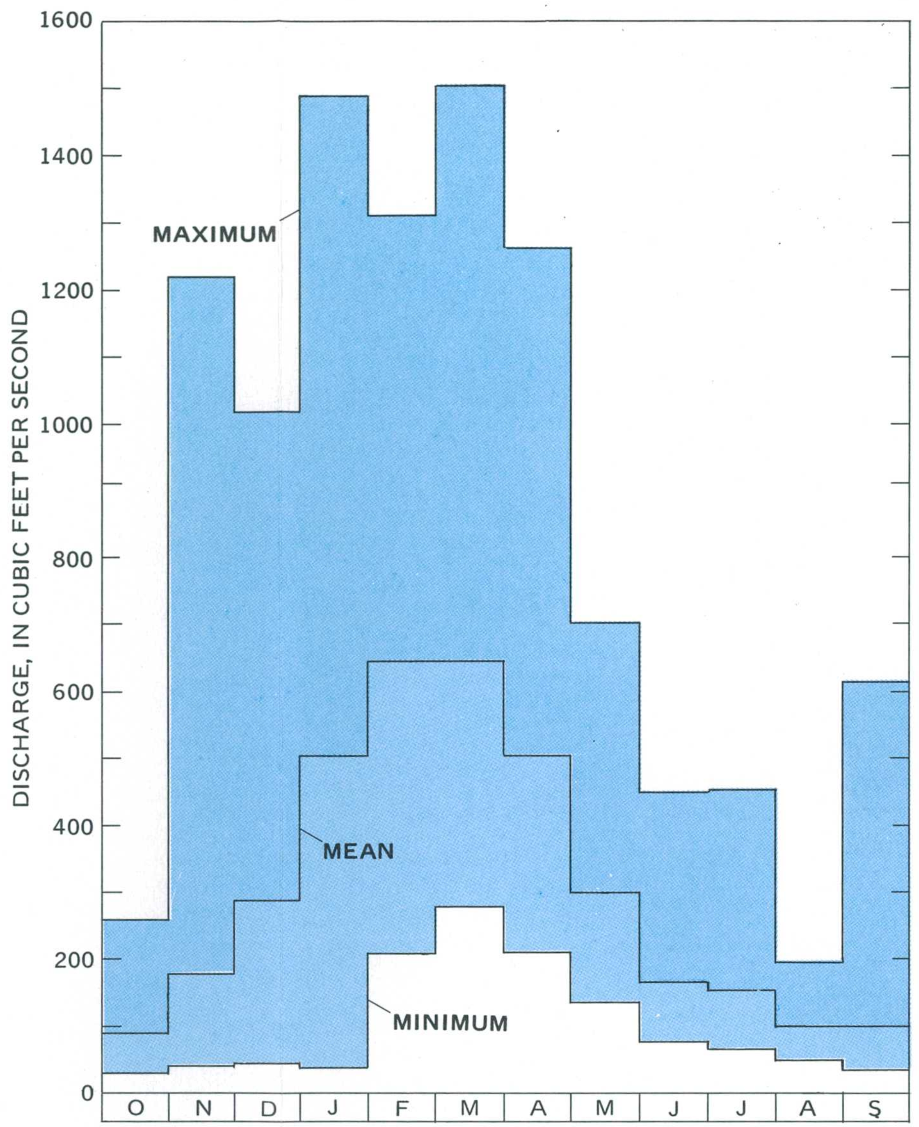


Figure 5.1-2 Maximum, mean, and minimum monthly flows for Big Wills Creek near Crudup, Alabama (site 41), 1944-70.

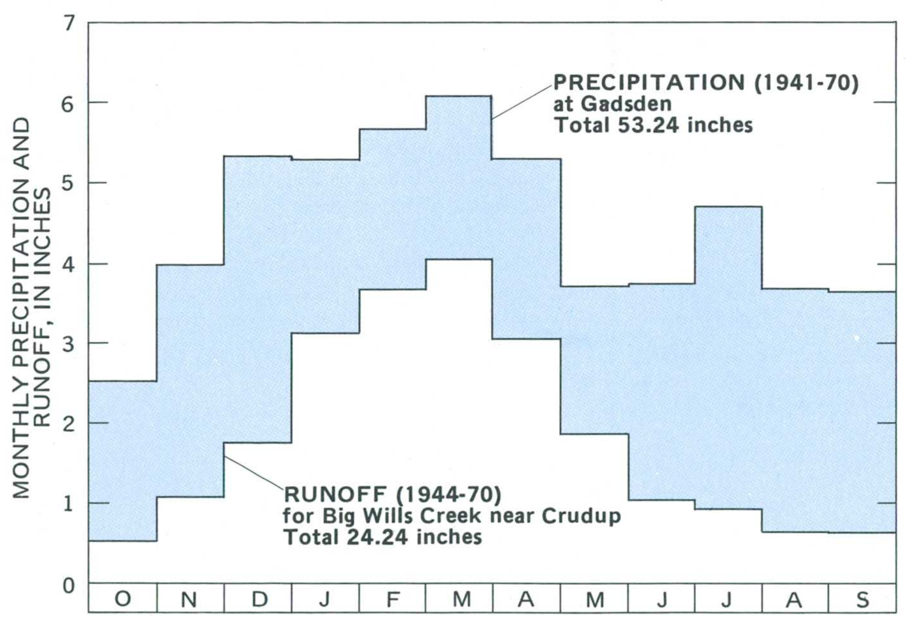


Figure 5.1-3 Monthly mean rainfall and runoff for Big Wills Creek near Crudup, Alabama (site 41), 1944-70.

Low Flow of Streams in Area 24 Varies Widely

Aquifers in Area 24 vary widely in their ability to store water, consequently, in their ability to provide water to streams during periods of no rainfall.

Effective ground-water storage in the Pottsville Formation is small. Thus, discharge of ground-water to streamflow during periods of no rainfall is not sufficient to sustain streamflow and many small streams draining the Pottsville go dry. The limestone and dolomite of the pre-Pennsylvanian rocks generally store and release enough water to sustain streamflow during dry periods. Many of the springs have very large discharges. The ability of the metamorphic rocks of the Piedmont province to store and release water depends on the amount of fracturing in the bedrock and the thickness of the weathered rock above the bedrock. The local variability of these conditions is reflected in a wide range of flow in the Piedmont province in Area 24.

The difference in the ability of aquifers or formations to provide water to maintain dry-period flow in streams is illustrated in figure 5.2-1. The low-flow index value (Bingham, 1979) shown on the map is related to the rate at which streamflow declines in dry weather. The index value is also related to the geohydrology of the area delineated.

The indices of low flow commonly used are the 7-day Q_2 and 7-day Q_{10}. The 7-day low flow is the lowest average rate of flow for 7 consecutive days in each year. It will be less than the 7-day Q_2 at intervals averaging 2 years in length and less than the 7-day Q_{10} at intervals averaging 10 years in length. The 7-day Q_2 and 7-day Q_{10} can be estimated using the following regression equations (Bingham, 1979):

$$7Q_2 = 0.24 \times 10^{-4} (G-30)^{1.07} (A)^{0.94} (P-30)^{1.51}$$

$$7Q_{10} = 0.15 \times 10^{-5} (G-30)^{1.35} (A)^{1.05} (P-30)^{2.64}$$

Where

$7Q_2$ = estimated 7 day Q_2 low flow, in cubic feet per second

$7Q_{10}$ = estimated 7-day Q_{10} low flow, in cubic feet per second

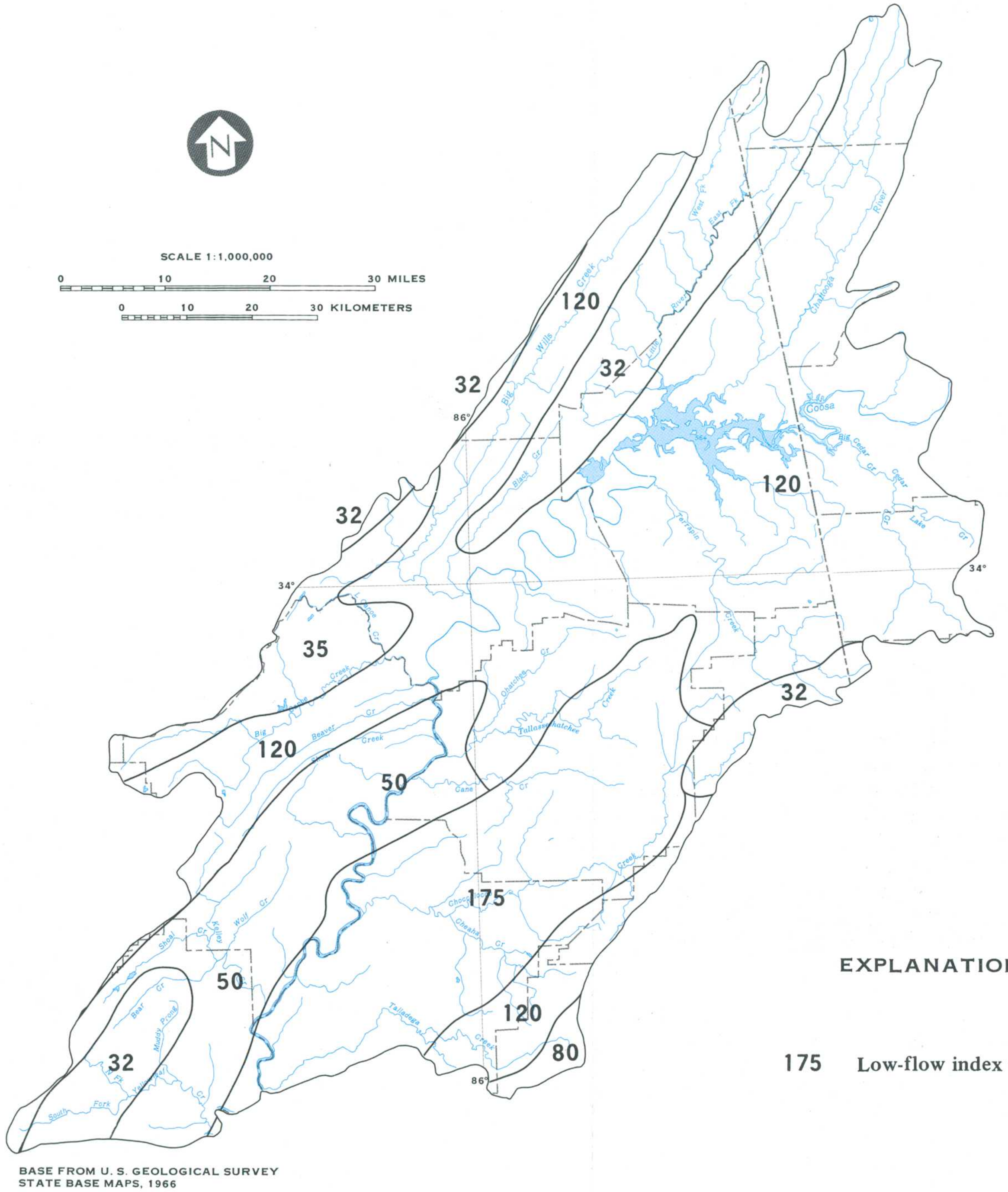
G = low-flow index value

A = contributing drainage area, in square miles

P = mean annual precipitation, in inches

Graphs computed for low-flow index values of 32 and 120 using these equations (fig. 5.2-2) show effect of the aquifers on low flow. The top lines of the bars in the graphs are the 7-day Q_2 or 7-day Q_{10} for areas with 56 inches of precipitation, and the bottom lines of the bars are for areas of 52 inches of precipitation.

These methods can be used to estimate low flow in streams with drainage areas of 5 to 2,460 mi^2. These methods derived for Alabama are considered adequate for that part of Georgia in Area 24. However, these methods should not be used for streams where the discharge is significantly altered by activities of man, nor streams where the 7-day Q_2 is less than 0.3 ft^3/s and the 7-day Q_{10} low flow is less than 0.1 ft^3/s.



EXPLANATION

175 Low-flow index value

Figure 5.2-1 Low-flow index values.

EXPLANATION

Low flows for areas with 52 to 56 inches of annual precipitation

Top line of each bar represents areas with 56 inches of annual precipitation; bottom line of each bar represents areas with 52 inches of annual precipitation

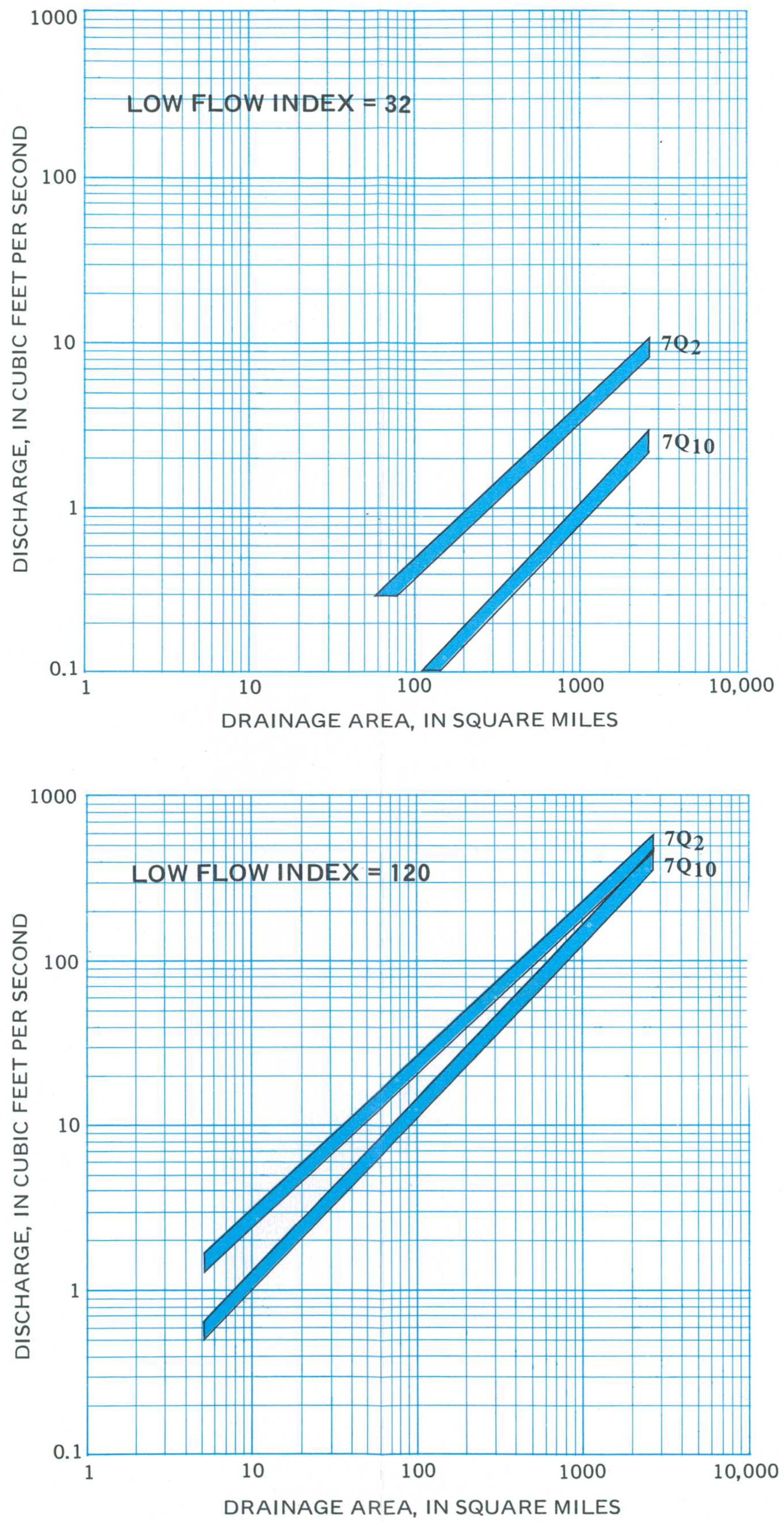


Figure 5.2-2 Relationships between low flow and drainage area for two index values and 52-56 inches of precipitation.

Flooding Chronic in Area 24

Natural conditions and cultural activities contribute to flooding in Area 24.

Flooding as the result of intensive rainfall is a natural characteristic of streams and rivers in Area 24. Floods are influenced by factors relating to land and to climate. Land factors include elevation, slope, soil composition, drainage pattern, and cultural influences. Narrow flood plains and steep slopes are characteristic of the area and contribute to rapid storm runoff. Climatic factors include seasonal distribution and intensity of storms. Examples of flood flows in response to a storm of which occurred during April 1979, are shown in figure 5.3-1.

Frequency and seasonal distribution of floods are generally related to climatic factors. Analyses of these characteristics for which data are applicable to Area 24 are contained in reports by Peirce (1954), Gamble (1965), Hains (1973), and Olin and Bingham (1977). Equations for estimating flood frequency of ungaged sites on unregulated streams draining from 1 to 15 mi^2 are contained in "Flood Frequency of Small Streams in Alabama" HPR No. 83 (Olin and Bingham, 1977).

Most of the flood damage in Area 24 is rural damage to farmlands, roads, and bridges in valleys with narrow flood plains and steep slopes. Damage also occurs near cities and towns where encroachment on the flood plains by industrial, commercial, and residential development is prevalent. Maps in Area 24 for which flood-prone areas have been estimated are on figure 5.3-2. These maps are available from either:

U.S. Geological Survey
P. O. Box V
University, AL 35486

U.S. Geological Survey
6481 Peachtree Industrial Blvd.
Suite B
Doraville, GA 30360

Alabama Office of State Planning and Federal Programs
Alabama Planning Division
State Capitol
Montgomery, AL 36130

or

Tennessee Valley Authority
Data Authority, Data Services Branch
Room 329 Evans Building
524 Union Avenue
Knoxville, TN 37902

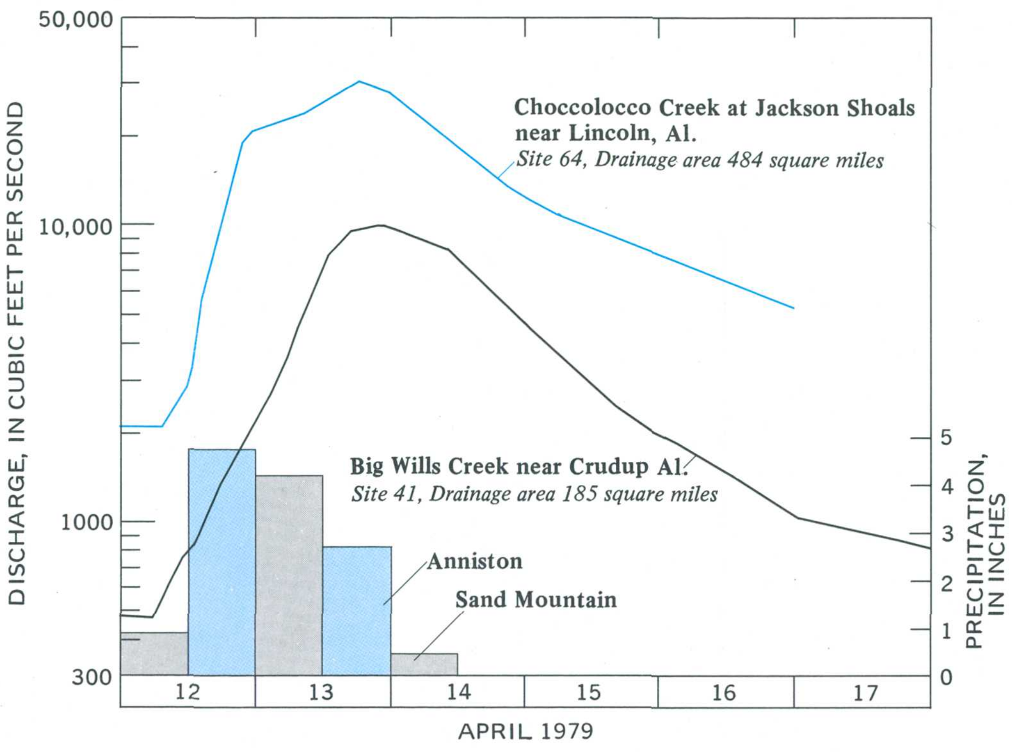
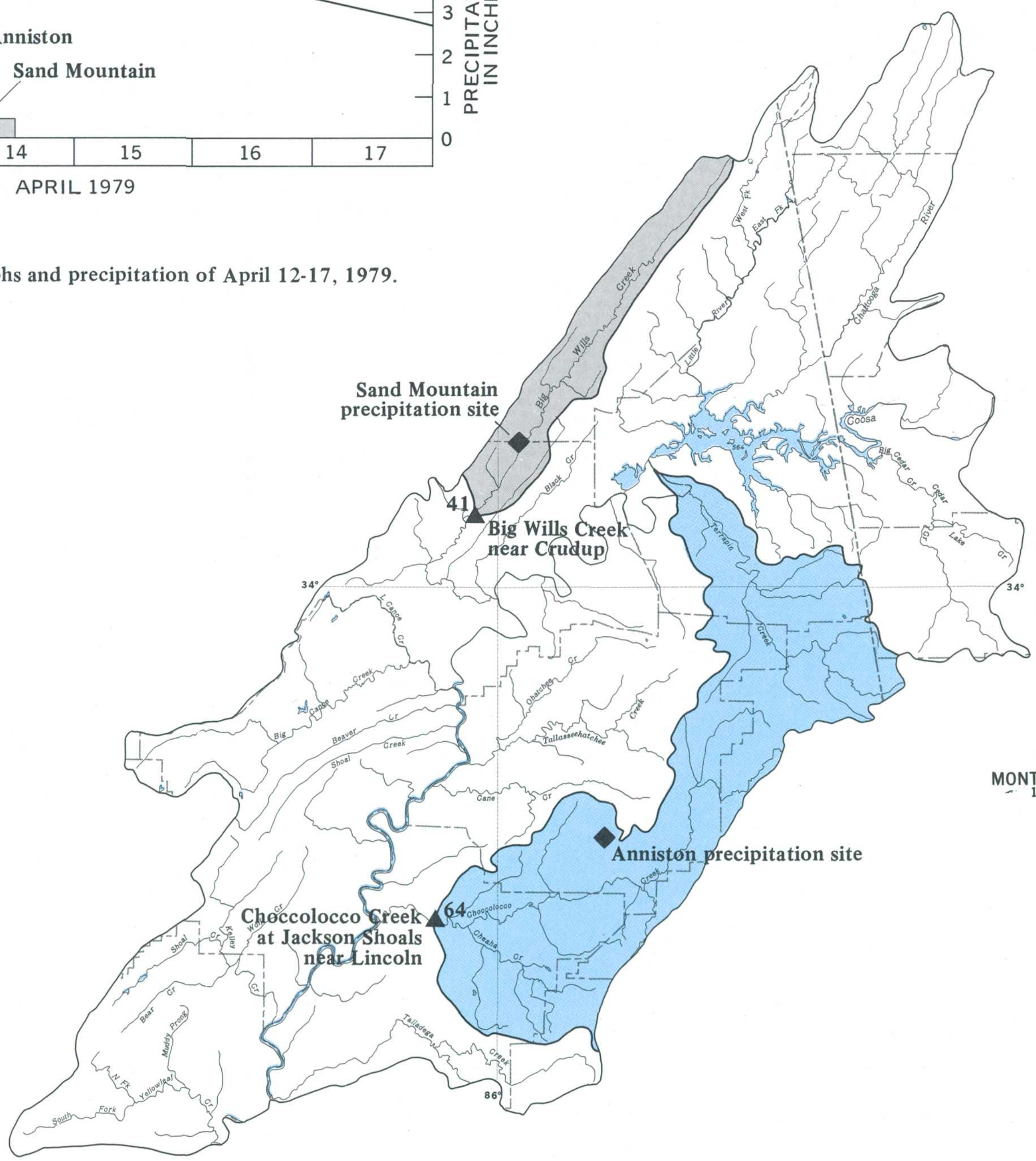


Figure 5.3-1 Flood hydrographs and precipitation of April 12-17, 1979.



BASE FROM U. S. GEOLOGICAL SURVEY
STATE BASE MAPS, 1966

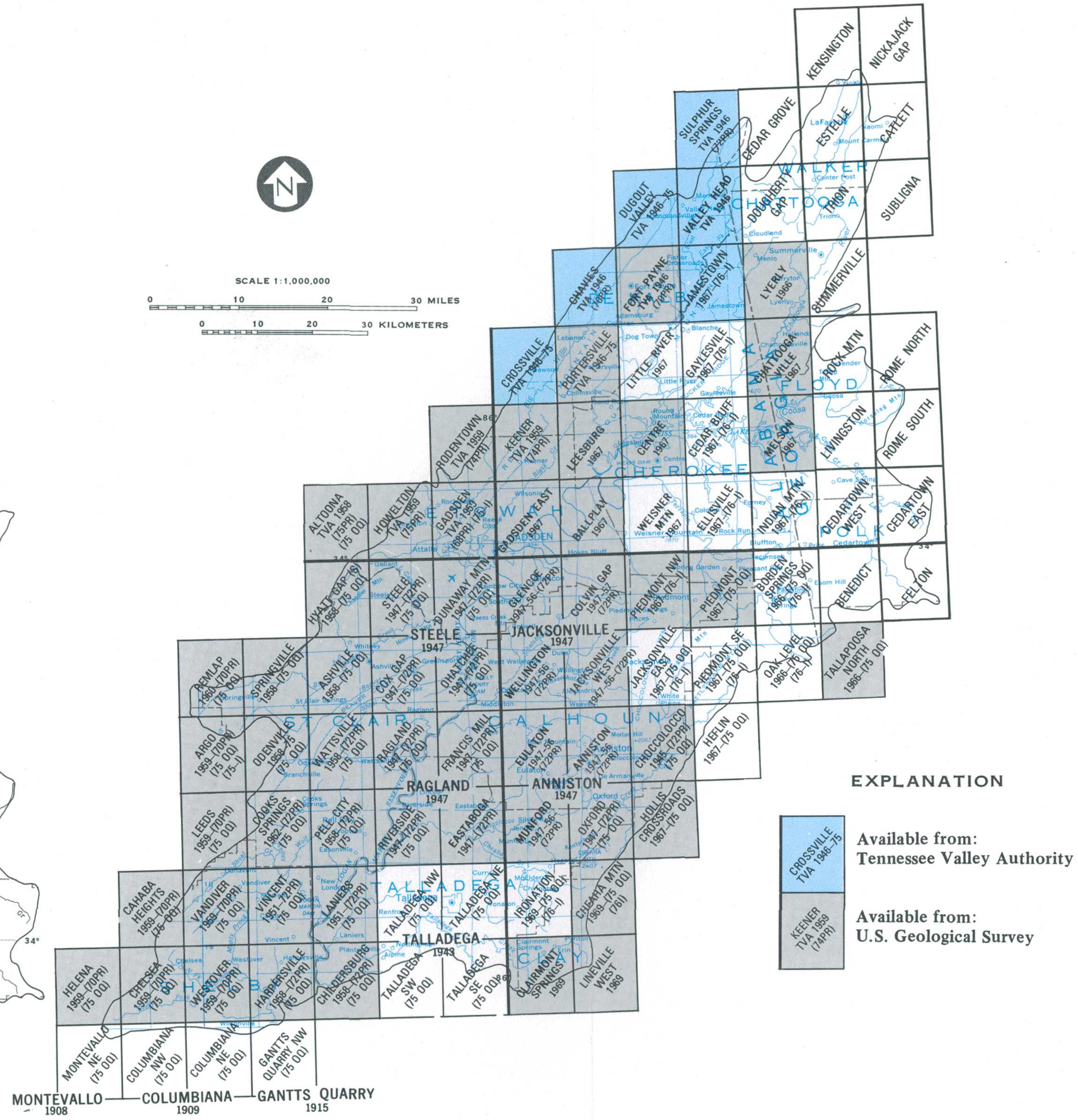


Figure 5.3-2 Index of maps of flood prone areas.

Flow of Streams Draining Coal-Bearing Rocks is Poorly Sustained

Flow of streams draining the Pottsville Formation is poorly sustained in comparison with that from pre-Pennsylvanian sedimentary rocks.

Flow-duration curves clearly reflect basin characteristics. The curves for three streams (fig. 5.4-1) draining areas of varying sizes and types of geologic outcrops are used to illustrate the effects of geology on streamflow (fig. 5.4-2). These curves are based on streamflow for the period 1960-67 for each station and plotted in unit runoff (cubic feet per second per square mile) for a more direct comparison.

The flow-duration curves reflect the effects of permeable or impermeable land surface and the ability of the ground-water reservoirs to release water to streamflow. In the Choccolocco Creek basin, the curve shows the characteristics of the pre-Pennsylvanian rocks and saprolite of the metamorphic rocks to absorb rainfall and release water during rainless periods. The curve for Little River shows the impermeable effect of the Pottsville Formation. The curve for Big Wills Creek shows the effect of the pre-Pennsylvanian rocks and the effect of Pottsville Formation along the basin divide.

As a hydrologic tool, the flow-duration curve provides a convenient means of appraising the discharge characteristics of a stream. The slope of the flow-duration curve is a measure of the variability of flow--the steeper the slope, the greater the variability. A flat slope usually indicates the presence of storage, which tends to minimize the range of flow. This storage may be either on the surface in lakes, ponds, swamps, or in the ground as ground-water storage.

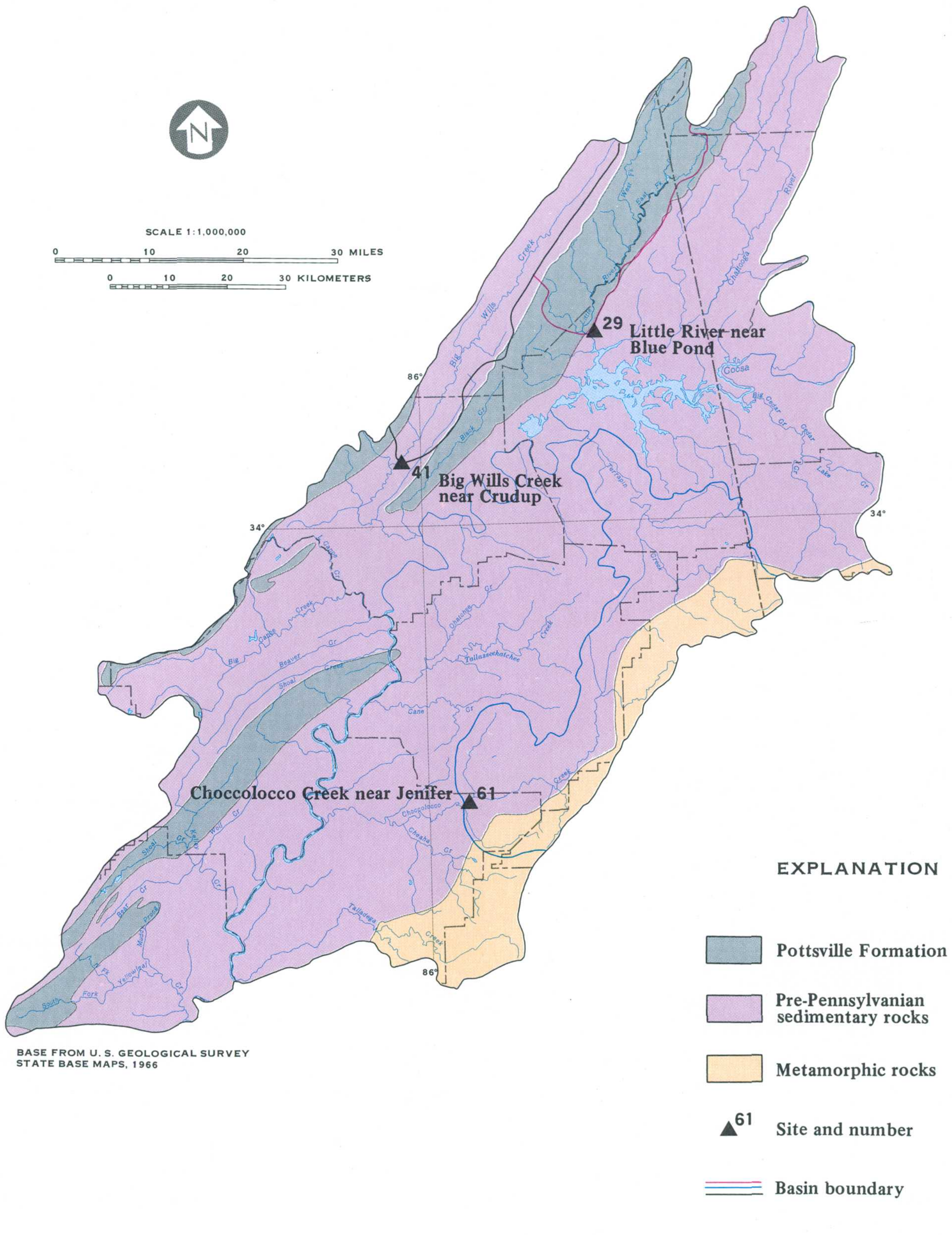


Figure 5.4-1 Geology and drainage basins for selected sites.

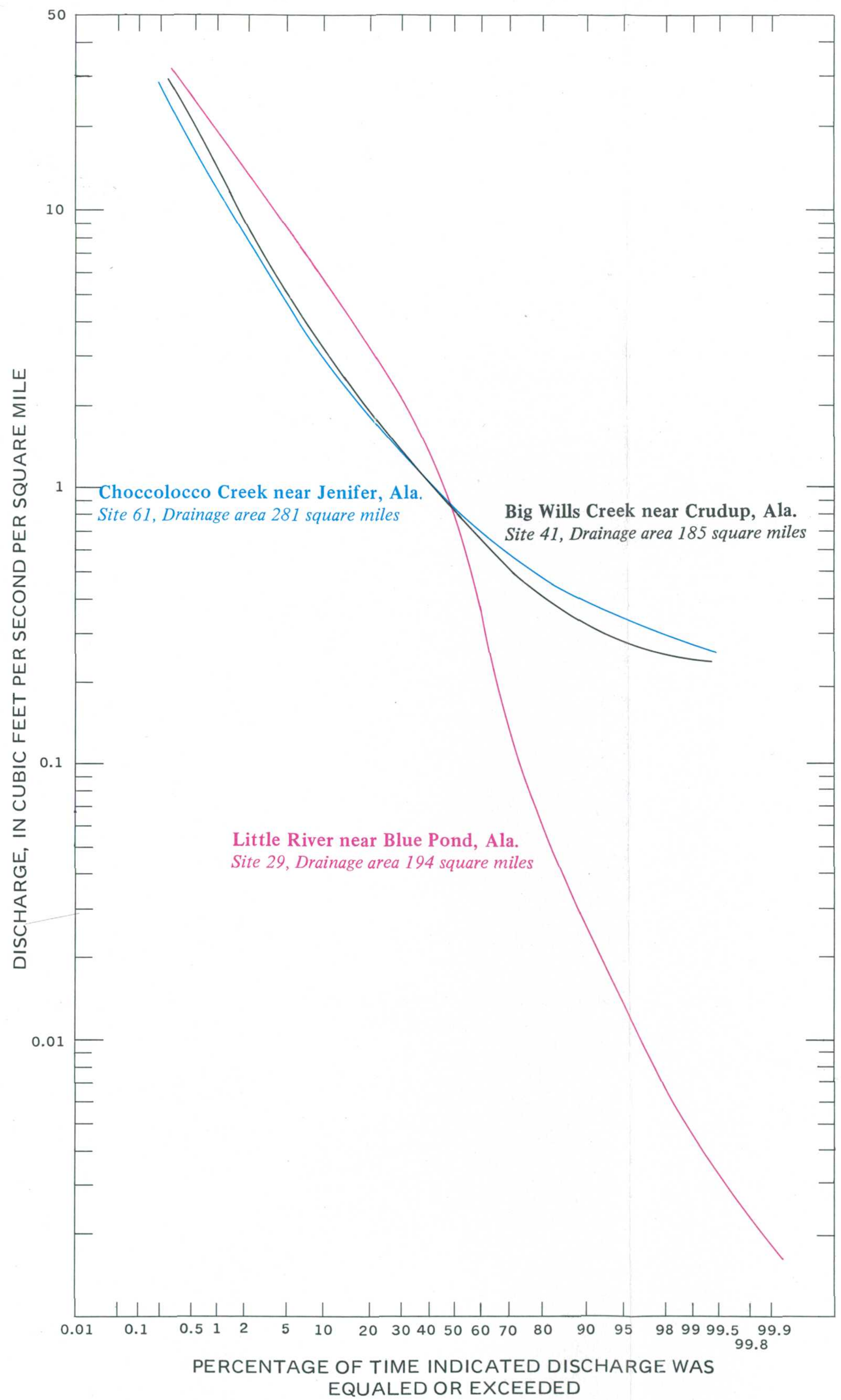


Figure 5.4-2 Representative flow-duration curves for three geologic formations.

6.0 QUALITY OF SURFACE WATER
6.1 Introduction

Man's Activity can Drastically Change the Quality of Surface Water

Surface mining, like and disruption of the land surface, often affects the quality of surface water.

Vegetation removal, excavation, and creation of large volumes of unconsolidated spoil material resulting from mining activities increases the potential for sediment and changes the quality of surface water. Surface-water constituents and characteristics commonly affected by surface mining include specific conductance, dissolved solids, pH, suspended sediment, iron, manganese, sulfate, and trace contstituents (fig. 6.1-1). No fixed proportion, ratio, or linearity is implied by these diagrams. The effect of mining on the quality of surface water is discussed by Harkins and others (1981).

Currently there is very little surface mining in Area 24. Therefore, water-quality data in this area generally represent baseline conditions. If suitable records were not available for delineating relationships between water quality and surface coal mining, expected results should mining become extensive in Area 24, were based on data from mined basins in Areas 22 and 23 (Harkins and others, 1980, 1981). The Pottsville Formation has similar lithology in Areas 22, 23, and 24, thus the impact of surface mining on water quality should be similar.

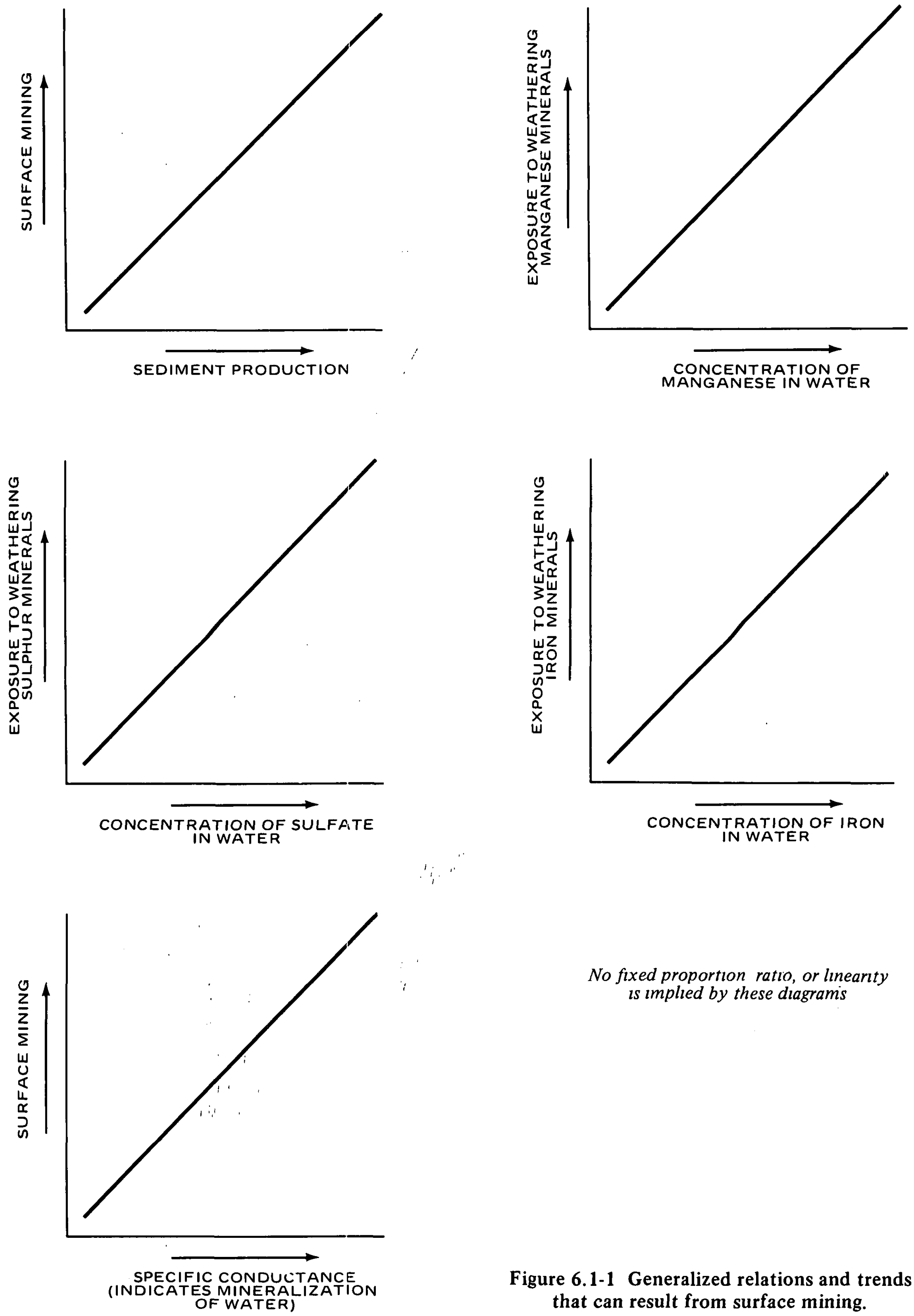


Figure 6.1-1 Generalized relations and trends that can result from surface mining.

RELATIONS AND TRENDS FROM MAY AND OTHERS (1980)

Specific Conductance and Dissolved Solids Generally are Low

Mineralization of surface water resulting from coal mining and municipal and industrial activity may result in an increase in specific conductance and dissolved solids.

Specific conductance of water is a measure of the ability of water to conduct an electric current. Because it is directly related to dissolved-solids content, it serves as an indicator of the degree of mineralization in water and commonly is used to estimate specific ion concentrations.

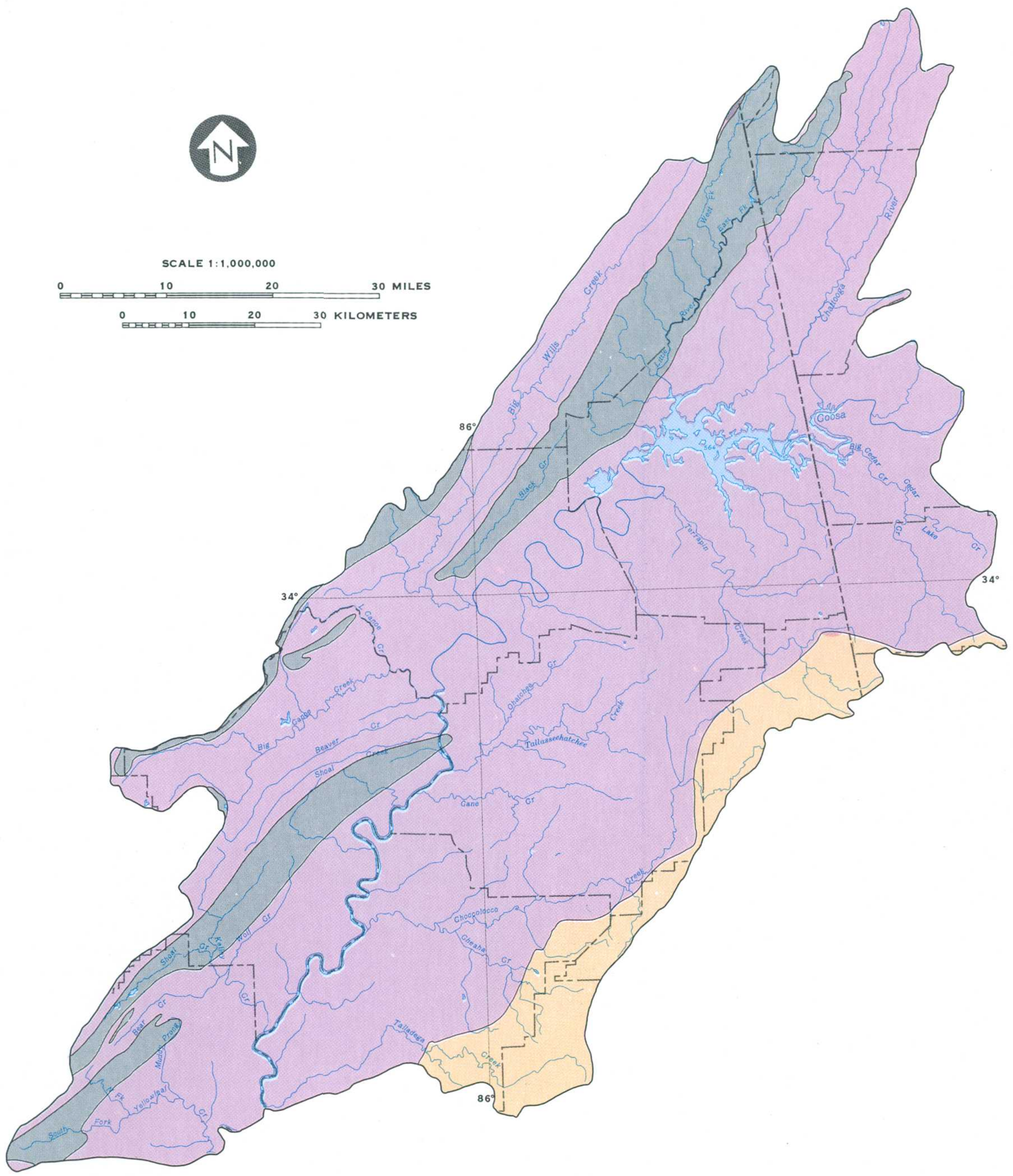
Specific conductance of surface water in Area 24 usually is low (fig. 6.2-1). Streams in and near the cities of Gadsden and Anniston and surrounding communities typically have higher specific conductances that reflect municipal and industrial waste discharges.

Dissolved-solids content of water in streams usually is derived from soluble minerals in soil and geologic strata underlying the basin. The range of specific conductance generally observed in streams draining relatively undisturbed basins in the area are shown in figure 6.2-1. Dissolved-solids concentration can be estimated from specific conductance using factors shown in figure 6.2-1 (Cherry, 1963). Water in streams draining basins underlain by metamorphic rocks and the Pottsville Formation (fig. 6.2-1) are very low in ion concentration, reflecting the relatively insoluble minerals of the formations. Greater mineral content of water in streams draining the pre-Pennsylvanian sedimentary rocks is due to the higher solubility of limestone and dolomite.

Specific conductance is generally higher during low-flow periods because of prolonged contact of water with soluble minerals in soils and rocks and less water available for dilution. During high-flow periods specific conductance is generally lower because of dilution by surface runoff. This relation is shown on figure 6.2-2 for streams draining undisturbed basins in each of the three geologic units in the area. The figure can be used to estimate specific conductance from discharge in streams draining unmined basins.

Accelerated weathering of rocks present in coal-mine spoils results in the dissolution of large quantities of pyrite and other sulfide and sulfate minerals and the production of sulfuric acid. The acidic water reacts with other minerals increasing the dissolved-solids concentrations and specific conductance.

Specific conductance observed in streams draining Area 24 ranges from 11 to 480 μmhos/cm. Based on information in Areas 22 and 23, the specific conductance of mine drainage can be as high as 3,000 μmhos/cm immediately downstream from mined areas. In general, specific conductance of water draining coal-mined areas is highly variable and depends on such factors as: (1) the presence of pyrite and other sulfide and sulfate minerals in spoil material, (2) the length of time of exposure of these minerals to weathering by air and water, and (3) the quantity of water leaving the coal-mined area. Water draining mined areas is usually highly mineralized but the mineralization generally decreases downstream because of dilution.



EXPLANATION

Geologic unit	Specific conductance In micromhos per centimeter at 25° Celsius	Factors applied to specific conductance for estimating dissolved-solids concentrations In milligrams per liter
Pottsville Formation	11-30	0.68
Pre-Pennsylvanian sedimentary rocks	48-480	0.60
Metamorphic rocks	23-96	0.90

Figure 6.2-1 Geologic formations and associated values of specific conductance.

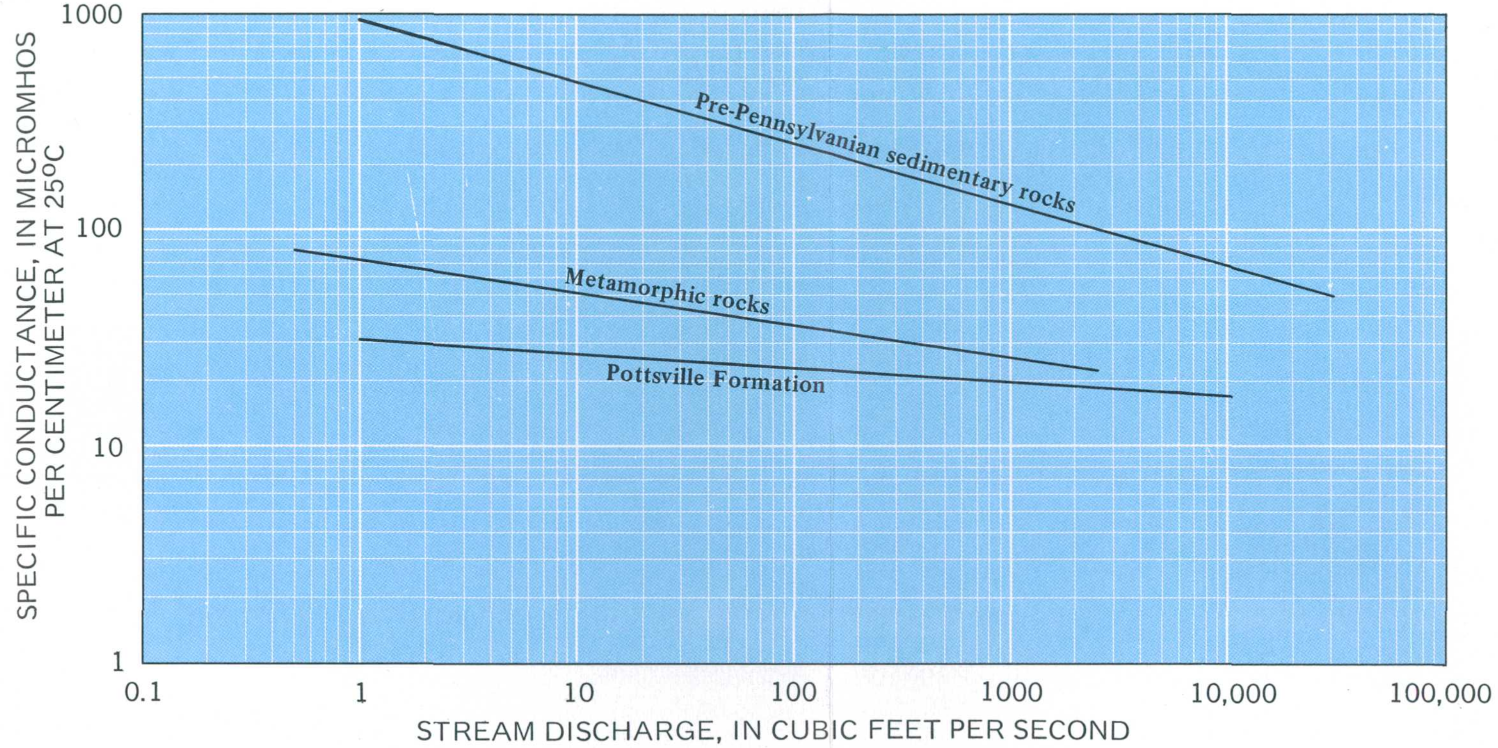


Figure 6.2-2 Discharge versus specific conductance.

Streamflow pH Values Usually Fluctuate in Near Neutral Range

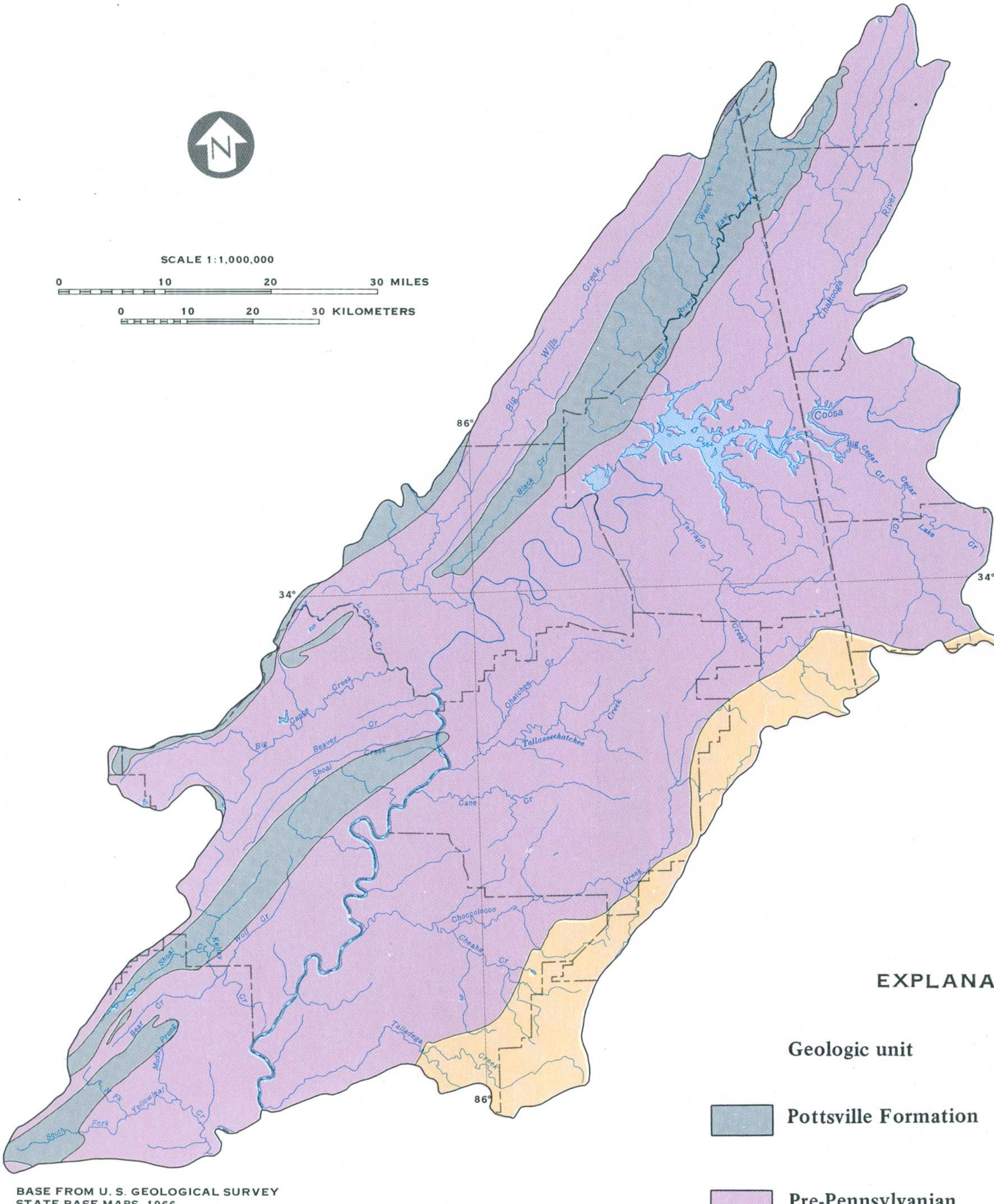
The pH of water in streams usually fluctuates in the near neutral range (6.0-8.0 units) in streams draining unmined basins.

A pH of 7.0 represents neutral water. Values less than 7.0 denote acidic water and values greater than 7.0 denote alkaline water. The pH of water exerts a strong influence on the suitability of water for industrial, municipal, and recreation purposes. Prolonged extreme pH levels (pH values less than 5.5 and greater than 9.0 units) can significantly affect the toxicity, mobility, and solubility of many chemical compounds. Extreme pH levels also increase the corrosiveness of the water and adversely affect aquatic life.

The pH of water is primarily controlled by the presence of dissolved carbon dioxide and/or the hydrolysis of salts of weak acids and strong bases. Sources of these substances generally include rainfall, weathering of rocks, and decomposition of organic matter in soils. The range of pH values generally observed in streams draining undisturbed basins is shown on figure 6.3-1. The pH of water in streams varies widely, but usually is in the near neutral range (6.0-8.0 units). Fluctuation of pH is generally related to one or more environmental factors such as geology, streamflow, and land use. The influence of geology on the pH of water in streams draining the area is shown in figure 6.3-1. The highest pH values generally occur in streams primarily underlain by carbonate strata such as limestone and dolomite of the pre-Pennsylvanian sedimentary rocks; water in most of these streams is alkaline. The lowest pH values generally occur in streams underlain by the Pottsville Formation; water in these streams usually is acidic.

pH values generally decrease with increased streamflow. During low flow the pH values in streams approach that of water in aquifers underlying the basins, and during high flow the pH values approach those of overland runoff. Overland runoff, in Area 24, is generally acidic caused by precipitation and a carbon dioxide and organic rich soil environment.

Based on information collected in Areas 22 and 23, the pH of mine effluent in Area 24 will be determined by the chemical character of spoil. In some areas, weathering of pyrite and other sulfide and sulfate minerals will result in the production of sulfuric acid. Mine drainage may have pH values that range from 2.0 to 5.0 units. Calcareous minerals, such as siderite, calcite, and ankerite, commonly occur in large quantities in spoil. In these areas, acidic mine drainage would be rapidly neutralized.



EXPLANATON

Geologic unit	Range in pH values In units
Pottsville Formation	5.5-7.6
Pre-Pennsylvanian sedimentary rocks	6.3-8.3
Metamorphic rocks	6.6-8.0

Figure 6.3-1 Geologic formations and associated range of pH.

Suspended-Sediment Concentrations are Low in Area 24

Instantaneous sediment loads from undisturbed basins generally are less than 150 tons per day.

Instantaneous sediment loads of streams draining undisturbed basins in Area 24 are usually low and range from 0.01 to 157 tons/day. Land-use activities, such as forest clearing, cultivation, road construction, and surface mining, may drastically alter natural erosion and sediment yields. During surface mining, large volumes of exposed unconsolidated spoil may be a major source of sediment, however, high sediment yields can be reduced by effective reclamation.

Most of Area 24 is characterized by hilly terrains with moderate to steep slopes and easily erodible soils. These characteristics tend to produce rapid runoff with high erosion potential. Most of the area, however, has a forest cover which lowers runoff velocities and decreases erosion and sediment yields.

Range of suspended-sediment concentration, range of suspended-sediment load, and drainage area are shown for selected stations (fig. 6.4-1 and table 6.4-1). These concentrations and loads reflect essentially unmined conditions. In general, the highest suspended-sediment concentrations occur during high flow and the lowest during low flow.

Suspended-sediment transported during most types of flow is clay and silt (finer than 0.062 mm). The particle-size composition of bed material for one determination at site 26 was 9 percent finer than 0.25 mm, 71 percent finer than 0.50 mm, and 94 percent finer than 2.0 mm.

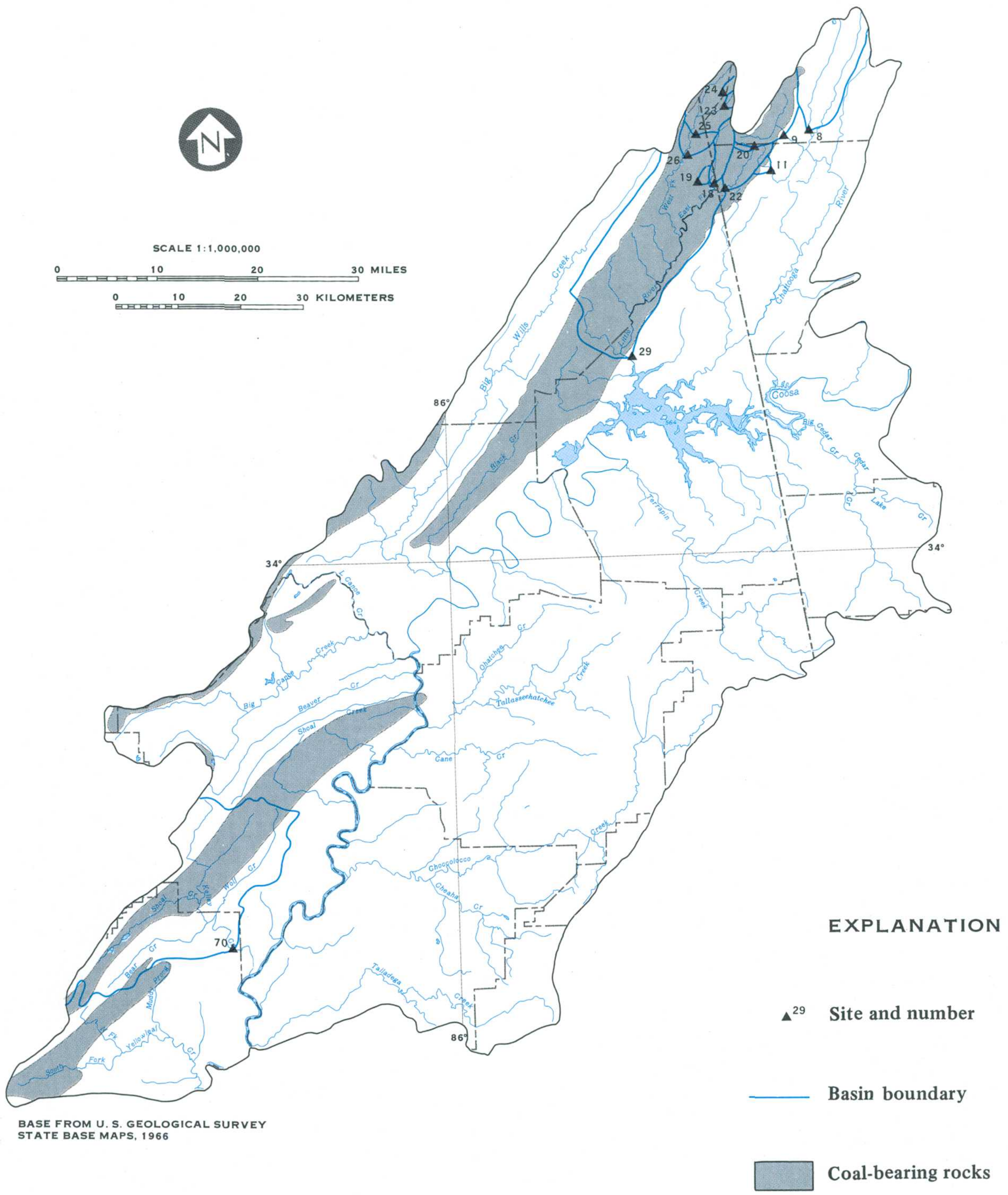


Figure 6.4-1 Suspended-sediment sampling sites.

Table 6.4-1 Suspended sediment at selected sites for 1979-80.

Site number	Range of suspended-sediment concentration (milligrams per liter)	Range of suspended-sediment loads (tons per day)	Drainage area (square miles)
8	9 - 155	0.18 - 157	32.4
9	1 - 47	.01 - 24	13.3
11	1 - 95	.01 - 24	3.39
18	1 - 70	.01 - 66	17.0
19	3 - 65	.02 - 14	3.44
20	1 - 16	.01 - 2.2	3.91
22	1 - 84	.01 - 81	12.1
23	1 - 6	.01 - .87	6.35
24	1 - 6	.01 - .19	1.30
25	1 - 16	.01 - .17	.57
26	1 - 5	.01 - 5.2	28.5
29	1 - 120	.04 - 62	194
70	12 - 34	.25 - 17	192

See section 10.2 for detailed site description

Dissolved-Iron Concentrations of Streams Draining Unmined Basins are Low

Dissolved-iron concentrations in streams draining unmined basins generally range from 0 to 350 micrograms per liter and total recoverable iron ranges from 80 to 9,400 micrograms per liter.

Dissolved-iron concentrations in streams draining unmined areas in Area 24 are generally low. Ranges and mean values of observed dissolved-iron concentrations at selected sites in streams draining unmined basins and their locations are shown in figures 6.5-1 and 6.5-2. Dissolved-iron concentrations in streams draining relatively unmined basins in Area 24 are generally less than 300 μg/L and range from 0 to 350 μg/L. Dissolved-iron concentrations exceeding 300 μg/L impart an objectionable taste to water, cause staining, and generally limit the water's use for many domestic and industrial purposes. Sources of iron in water generally include soils rich in organic material and iron bearing minerals in geologic strata underlying the basins. Large quantities of soluble iron salts can be contributed to streamflow from coal-mine spoils as a result of accelerated weathering of iron-bearing minerals such as pyrite and marcasite.

Mining in Area 24 is minimal, but it can be theorized that the impact of extensive mining would be the same as that in adjacent and similar areas. Based on information collected in coal-mined basins in Areas 22 and 23, dissolved iron concentrations will be generally high in mine effluent; however, aeration and dilution rapidly decrease the high dissolved iron. Therefore, in nearby downstream areas, dissolved-iron concentrations are generally similar to or even less than those in streams draining unmined areas. In contrast, total recoverable iron concentrations are higher in streams draining mined areas and increase with increases in suspended-sediment concentrations. Total recoverable iron in water sampled from Area 24 ranged from 80 to 9,400 μg/L.

Aeration of mine drainage with high dissolved-iron concentrations results in the formation of insoluble iron precipitates ("Yellow Boy") that can be observed coating stream bottoms and banks in many mined areas. Sorption of these precipitates on stream sediments results in high total recoverable iron concentrations. High suspended-sediment concentrations generally occur during high streamflow periods and low concentrations occur during low flow. During low flow, total recoverable iron concentrations in streamflow are nearly the same as dissolved concentrations.

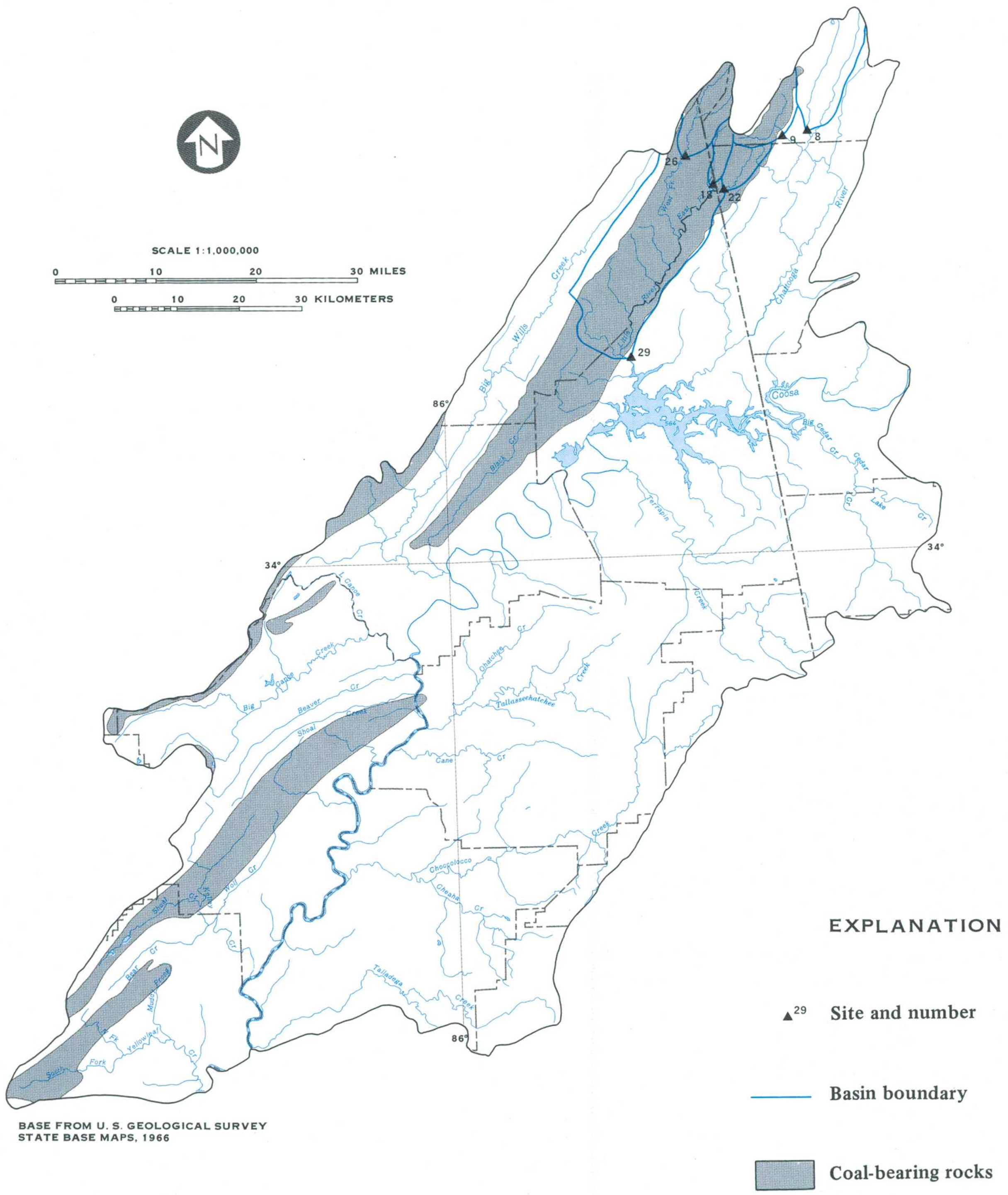


Figure 6.5-1 Dissolved-iron sampling sites.

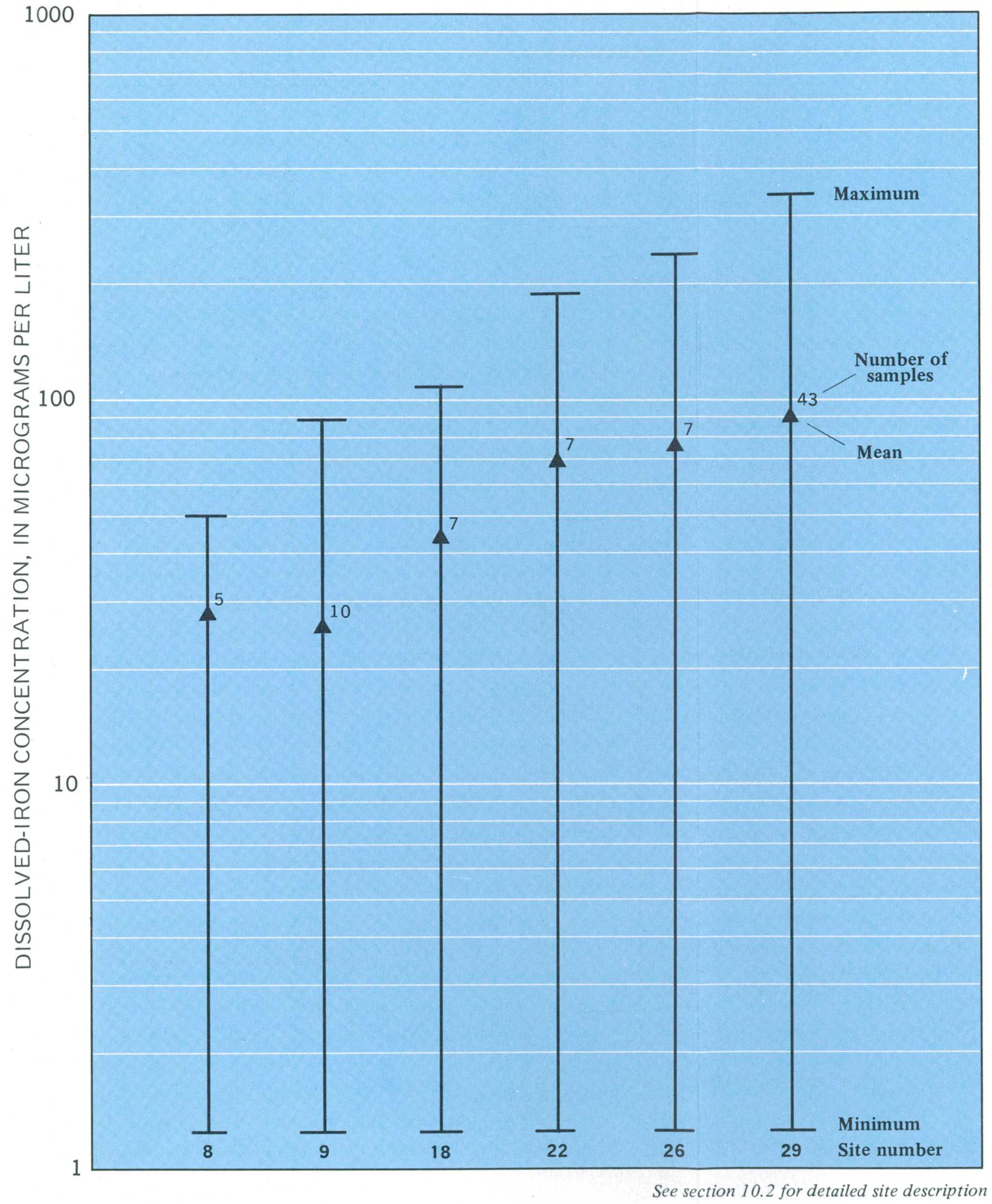


Figure 6.5-2 Mean and range of dissolved-iron concentrations at unmined sites.

Manganese Concentrations are Low in Streams Draining Unmined Areas

Dissolved-manganese concentrations from unmined basins range from 0 to 600 micrograms per liter and total recoverable manganese concentrations range from 10 to 610 micrograms per liter.

Dissolved-manganese concentrations exceeding 50 μg/L impart an objectionable taste to water, cause staining, and limit the water's use for many domestic and industrial purposes. Manganese normally occurs in small quantities in water and generally is derived from soils rich in organic material and manganese bearing minerals in strata underlying the basins.

Dissolved-manganese concentrations in streams draining relatively undisturbed basins are generally less than 300 μg/L (figs. 6.6-1 and 6.6-2), but ranged from 0 to 600 μg/L. Accelerated weathering of manganese minerals present in coal-mine spoils can produce large quantities of soluble manganese salts that are contributed to streamflow draining mined areas. Dissolved concentrations observed in mine drainage ranged from less than 10 to 20,000 μg/L in Areas 22 and 23 (Harkins and others, 1980, 1981), and similar concentrations would be expected in Area 24 should mining become extensive.

In Areas 22 and 23, dissolved-manganese concentrations in streams draining mined areas vary widely and contrast sharply with concentrations observed in streams draining unmined areas. Aeration and dilution by alkaline streams (pH greater than 7.0 units) rapidly decrease the dissolved-manganese concentrations. In acidic or near neutral (6.0 to 8.0 pH units) streams draining mined areas, the dissolved-manganese concentrations generally remain higher than those in streams draining unmined areas (Harkins and others, 1980, 1981).

Aeration of mine drainage usually increases the formation of insoluble manganese precipitates. Sorption of these precipitates on stream sediments results in an increase of total recoverable manganese. High suspended-sediment and total recoverable manganese concentrations generally occur during high streamflow and low concentrations during low flow. During low flow, total recoverable manganese concentrations are nearly the same as the dissolved concentrations. Total recoverable manganese concentrations ranged from 10 to 610 μg/L in Area 24.

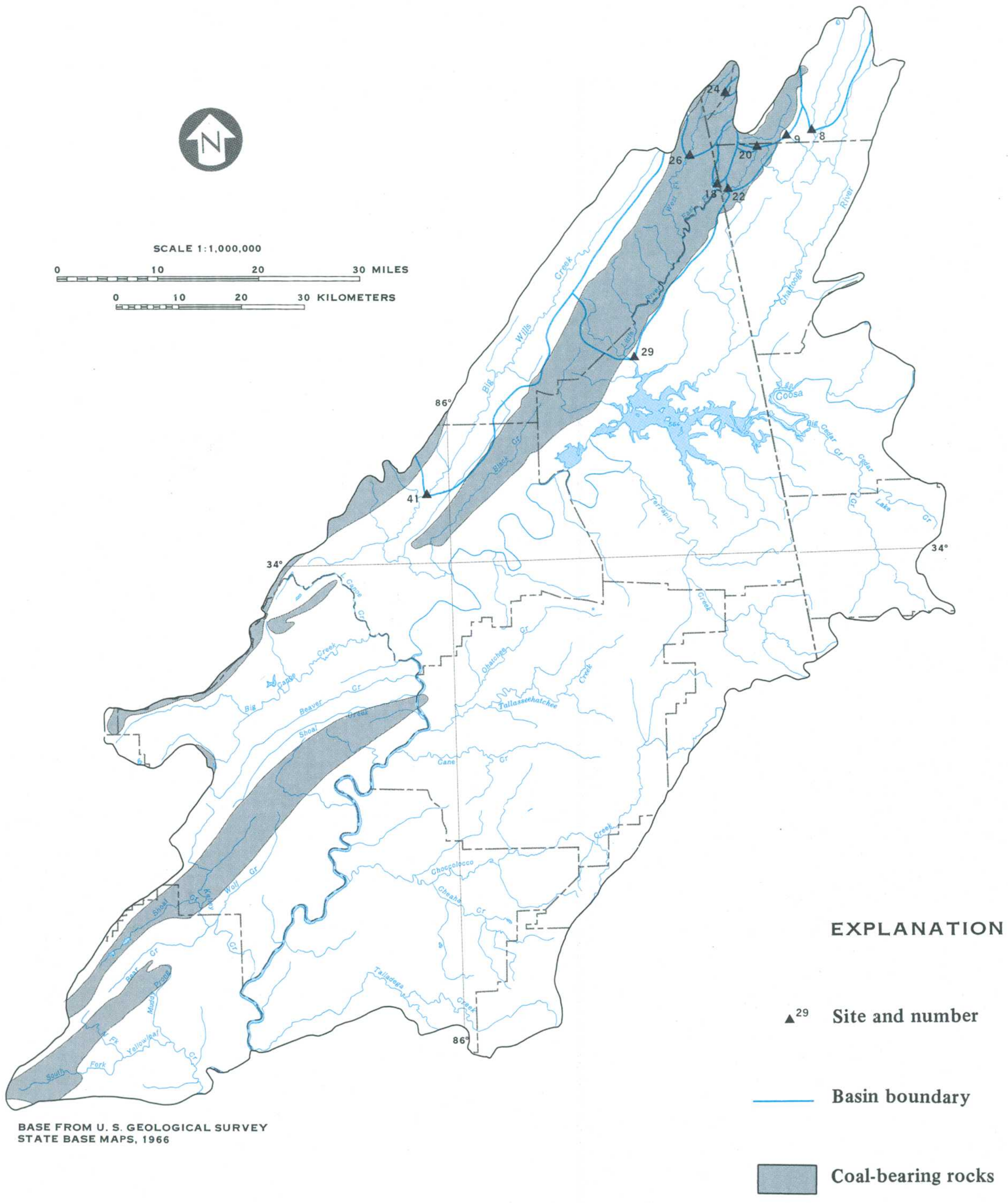


Figure 6.6-1 Manganese sampling sites.

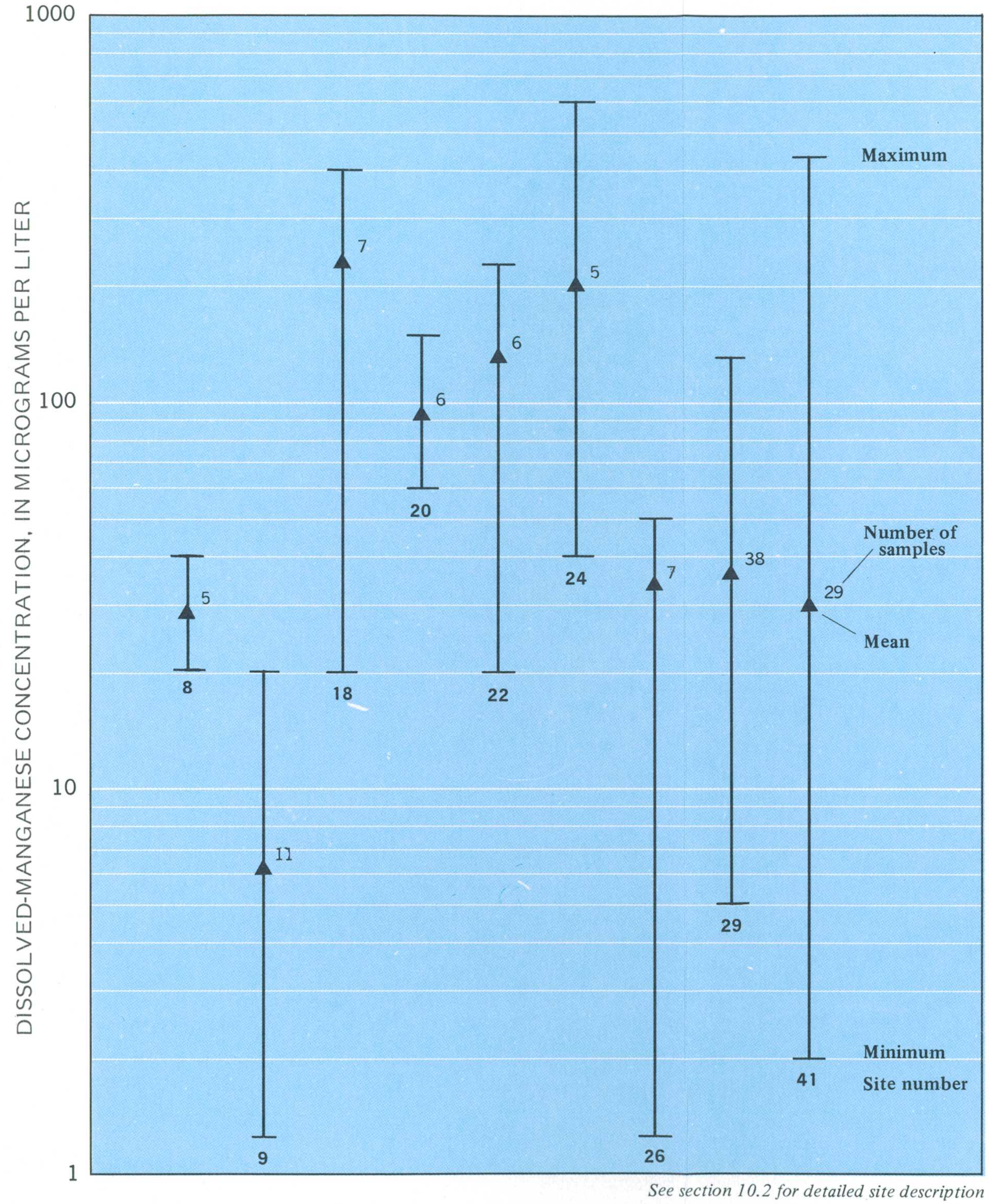


Figure 6.6-2 Maximum, mean, and minimum dissolved manganese concentrations at selected sites.

Sulfate Concentrations are Low in Streams in Area 24

Sulfate concentrations in streams generally are less than 20 milligrams per liter.

Sulfate concentrations in streams draining Area 24 range from 1.8 to 42 mg/L (figs. 6.7-1 and 6.7-2). The relatively low sulfate concentrations in streams are baseline conditions with the exception of some coal-mine drainage and municipal and industrial waste in a few streams. Sulfate concentrations in coal-mine drainage may approach 2,000 mg/L as observed in adjacent Area 22 (an area geologically similar to Area 24). Sulfate is usually the highest in concentration and the most persistent dissolved constituent in streamflow and is commonly used as an indicator of coal-mine drainage and/or municipal and industrial waste.

Variability of sulfate concentrations in streams draining coal-mine areas is primarily due to: (1) the presence of reactive minerals in spoil materials, (2) the length of time of exposure of these minerals to weathering, and (3) the quantity of water leaving the mined area. In general, sulfate concentrations are highest during low flow, due to the presence of coal-mine drainage and the lack of dilution by rainfall. In downstream areas sulfate concentrations usually decrease due to dilution.

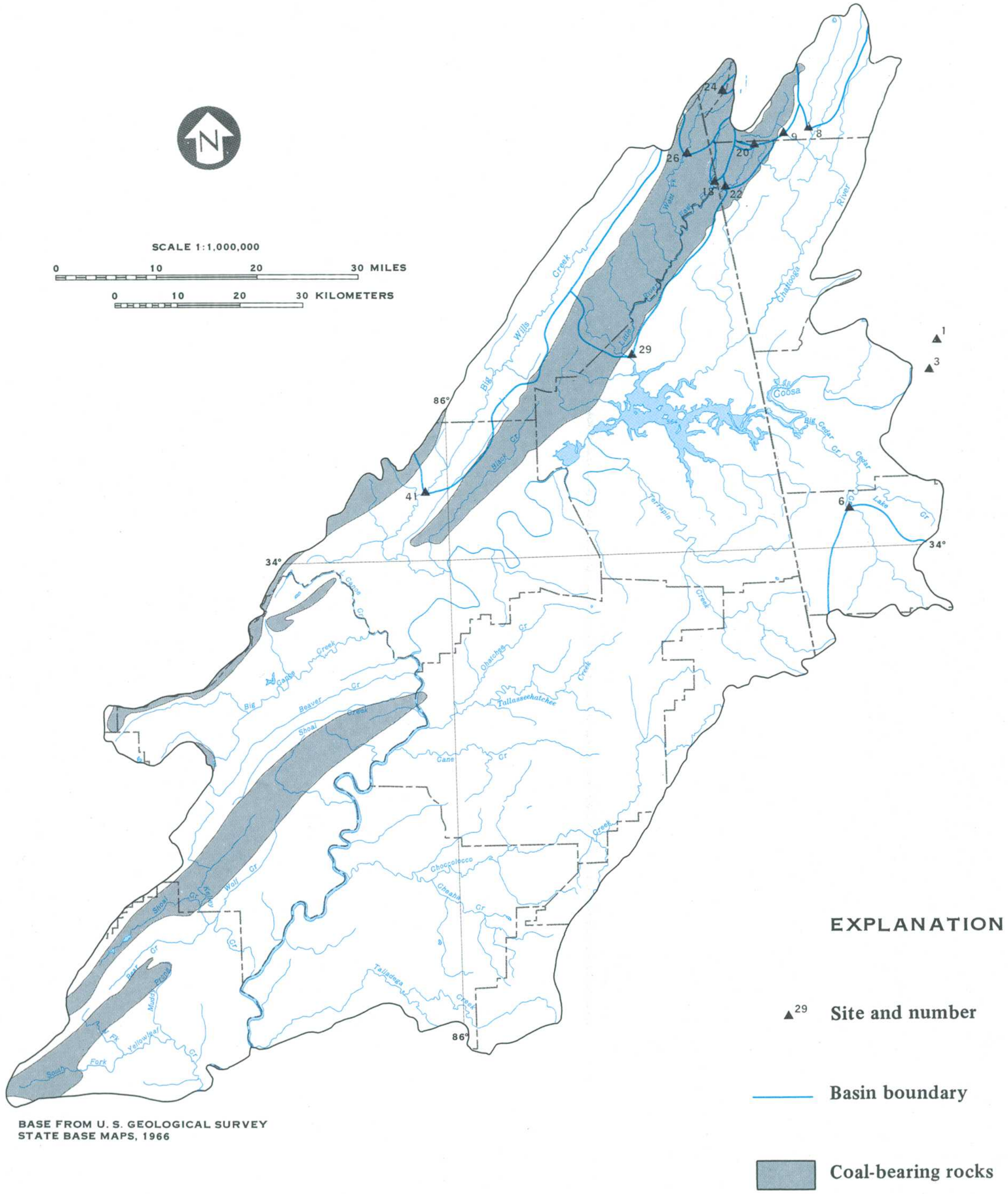


Figure 6.7-1 Sulfate concentration sampling sites.

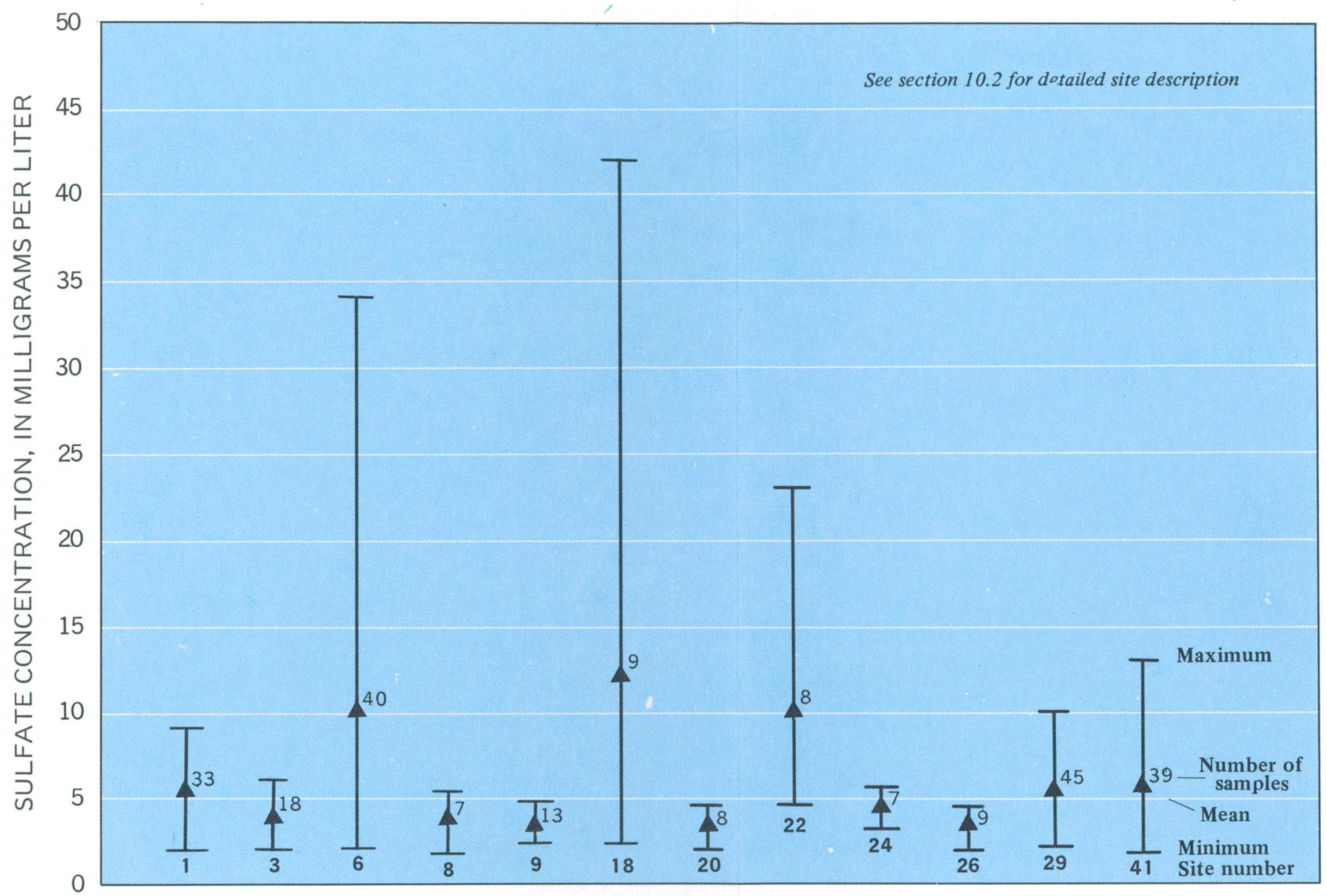


Figure 6.7-2 Maximum, mean, and minimum sulfate concentrations at selected sites.

Trace Constituents Occur in Low Concentrations

Trace constituents normally occur in low concentrations and generally are not a water-quality problem.

Trace constituents in streamflow generally are derived from soils, geologic strata underlying the basin and atmospheric fallout. In low concentrations trace constituents are essential to life; in high concentrations, some can be toxic to plants and animals.

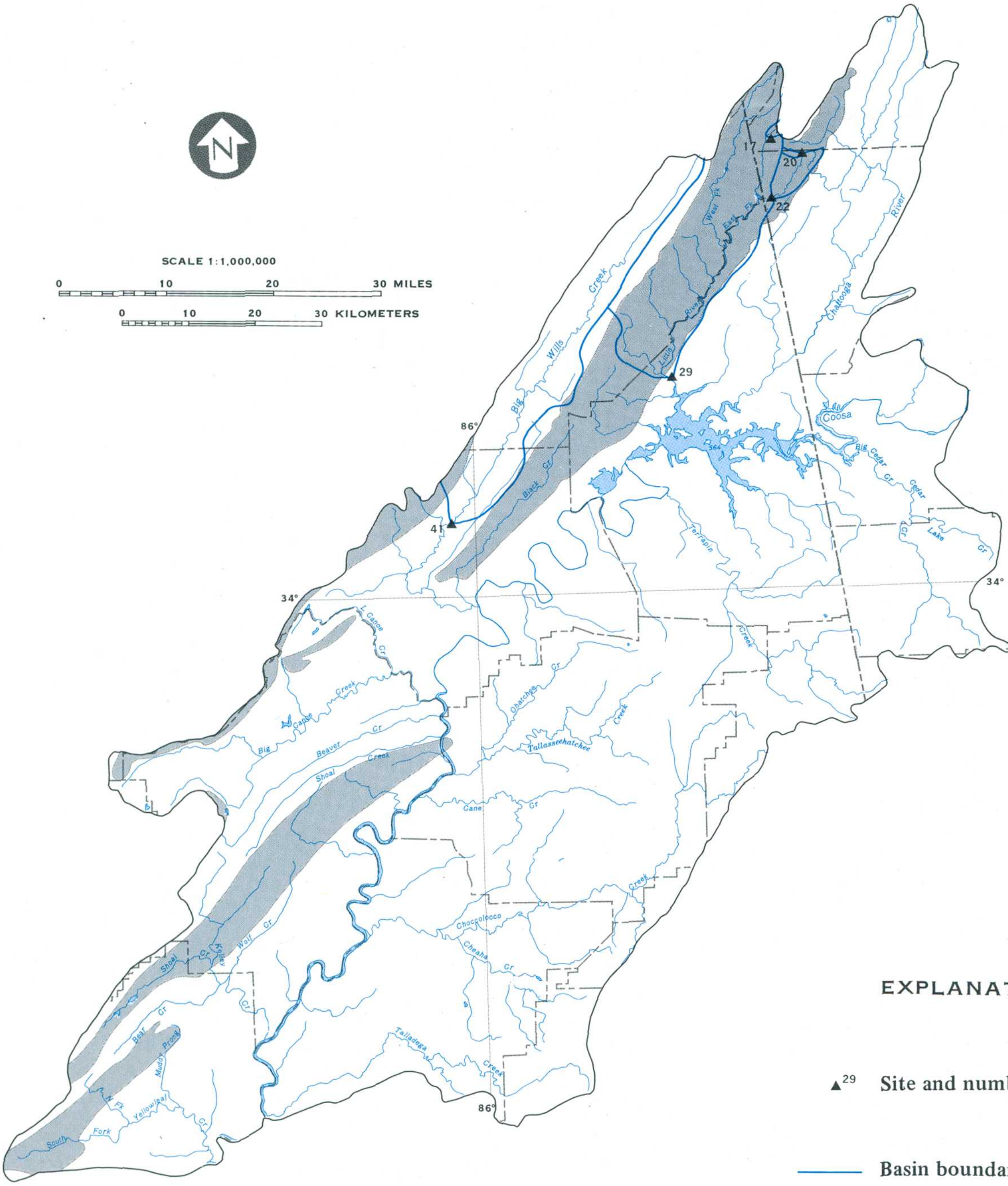
High concentrations of trace constituents in streams can occur naturally; however, high concentrations are usually associated with municipal- and industrial-waste discharge, mine drainage, or storm runoff from urban areas. In coal-mine areas accelerated weathering of pyrite present in coal-mine spoils produces acidic mine drainage that is contributed to streamflow. The acid water reacts with other minerals and can produce adverse concentrations of trace elements in mine drainage.

In Area 24, concentrations of most dissolved trace constituents are low. Concentrations of selected dissolved constituents at sites shown on figure 6.8-1 are summarized in table 6.8-1. With the exception of mercury, concentrations of all trace constituents listed in the table are within maximum limits recommended by the U.S. Environmental Protection Agency (1977a,b).

In general, dissolved trace constituents that may occur in concentrations exceeding U.S. Environmental Protection Agency recommended limits (1977a,b) in and near surface mines, usually decrease rapidly in nearby downstream reaches. The decrease in concentrations generally is caused by chemical reactions, dilution by precipitation and streamflow with near neutral pH (6.0-8.0 units), and the strong sorption attraction between trace constituents and suspended-sediments.

Table 6.8-1 Summary of selected trace-constituents concentrations at selected sites, in micrograms per liter.

Constituent	site 17				site 20				site 22				site 29				site 41			
	No	Mean	Min	Max	No	Mean	Min	Max	No	Mean	Min	Max	No	Mean	Min	Max	No	Mean	Min	Max
Arsenic	2	<1	0	1	2	<1	0	1	2	<1	0	1	20	<1	0	3	31	1	0	5
Cadmium	2	0	0	0	2	0	0	0	2	4	0	8	16	<1	0	1	6	0	0	1
Chromium	2	4	0	8	2	4	0	8	2	4	0	8	28	<1	0	1	29	0	0	3
Cobalt	--	--	--	--	--	--	--	--	--	--	--	--	18	<1	0	1	14	1	0	4
Copper	2	2	0	3	2	0	0	0	--	--	--	--	7	1	0	3	11	9	0	64
Lead	2	15	6	24	2	8	3	13	2	23	4	51	21	2	0	14	25	2	0	9
Mercury	2	<.1	0	.1	2	<.1	0	1.0	--	--	--	--	20	.4	0	2.0	22	0.3	0	3.0
Zinc	2	15	0	30	2	10	10	10	2	10	10	10	22	30	0	100	26	19	0	80



BASE FROM U. S. GEOLOGICAL SURVEY
STATE BASE MAPS, 1966

EXPLANATION

▲[29] Site and number

Basin boundary

Coal-bearing rocks

See section 10.2 for detailed site description

Figure 6.8-1 Trace constituent sampling sites.

Three Aquifer Systems Underlie Area 24

The Pottsville Formation, pre-Pennsylvanian sedimentary rocks, and metamorphic rocks crop out and receive recharge in Area 24. Direction of movement of water in these aquifers is variable.

Ground water in Area 24 is derived from precipitation that seeps downward through the soils and rocks to the zone of saturation. Direct infiltration of precipitation into the aquifers is the major means of recharge, although some aquifers receive recharge indirectly by leakage from adjacent aquifers. Recharge also may result from streams flowing over the outcrops of aquifers. Where the water level in an aquifer is below that of the stream, water may percolate through the stream channel and into the aquifer.

Almost all ground water is in motion from areas of recharge to areas of discharge. The rate of movement in most aquifers is slow and depends on the size and degree of interconnection of the water-bearing openings and the hydraulic gradient. Rocks that transmit water readily have high permeability. Among the more permeable rock units are well sorted sand and gravel, limestone with interconnected solution openings, and rocks with interconnected fracture systems. Among the least permeable units are clay, shale, and dense, consolidated rocks with no interconnecting fractures or solution openings.

Complex folding and faulting of the rock units in the area produces great variation in the direction of movement. For example, the general direction of ground water movement in St. Clair County, Alabama, is to the southeast (Causey, 1963), but in adjacent Talladega County it is to the west and southwest (Causey, 1965). Further variation is introduced locally, where water flows toward points of discharge, such as streams, wells, or springs. The path which water must take as it flows varies with the three different rock units in Area 24 (fig. 7.1-1).

Ground water in the Pottsville Formation moves along interconnected fractures and bedding planes in sandstone, conglomerate, and coal. The orientation of the fractures determines the local direction of water movement. In places, the subsoil over the Pottsville contains shale fragments and sand which absorb and store precipitation to recharge the underlying bedrock aquifer.

Fractures and bedding planes in the pre-Pennsylvanian carbonate (limestone and dolomite) rocks have been enlarged by solution. The interconnected solution openings form a system of conduits that permits relatively free movement of large quantities of ground water. The weathered zone above many of the carbonate rocks in Area 24 contains a layer of chert rubble, which receives and stores precipitation, releasing it slowly to the underlying aquifer.

Movement of water in the metamorphic rocks in Area 24 is also controlled by the existence and orientation of fractures (fig. 7.1-1) which, like those in the Pottsville Formation, are not enlarged by solution. The weathered material (saprolite) above metamorphic rocks varies in size. Where it is sand size or larger, it receives and stores water, and is a source of recharge to the underlying rocks. In many places it is silt size and tightly packed and does not release significant volumes of water.

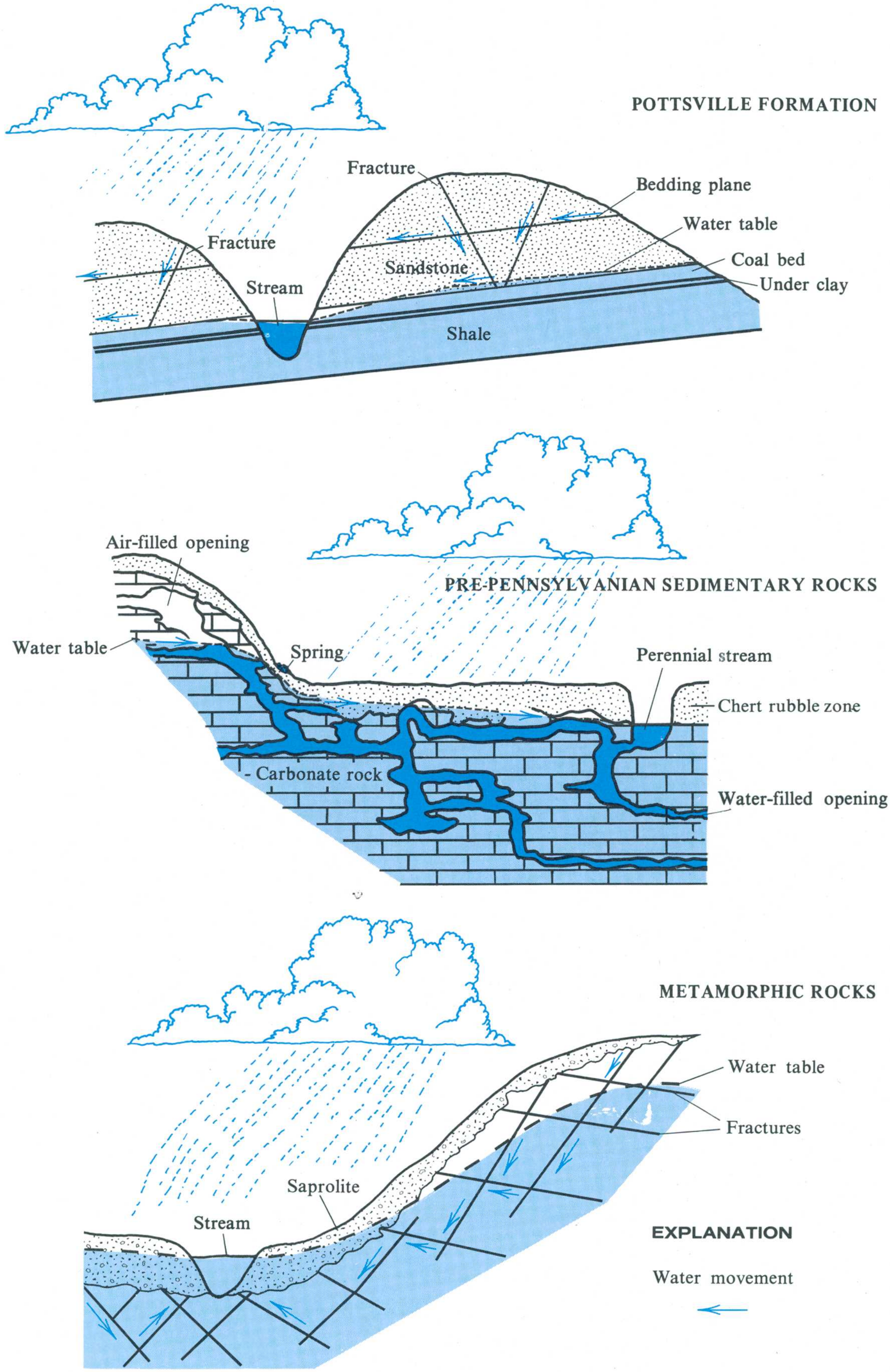


Figure 7.1-1 Water movement in three aquifer systems.

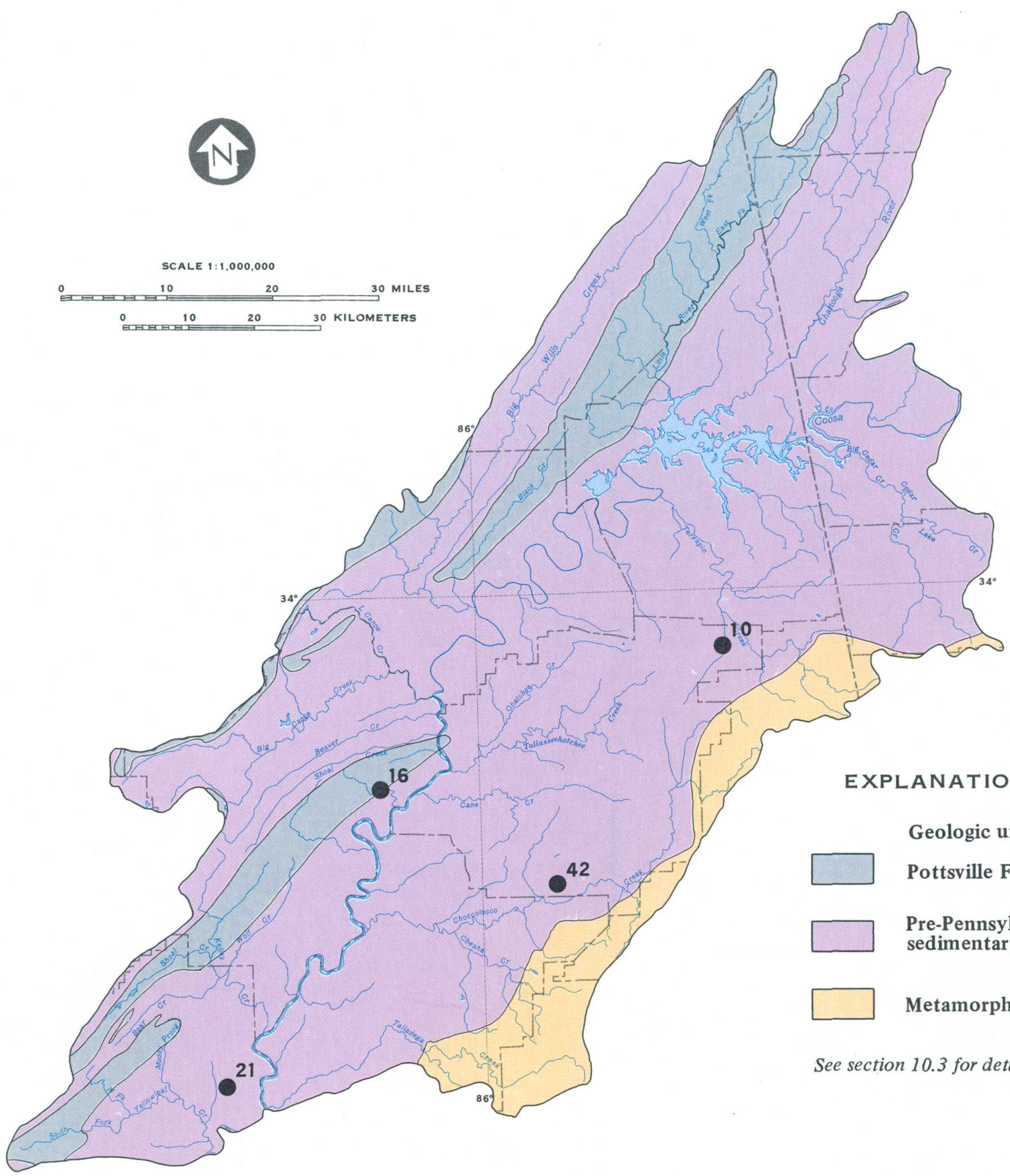
Water Levels in Area 24 Fluctuate Seasonally

Cyclic water-level fluctuations reflect seasonal variations in the rate of recharge to, and discharge from, the ground-water reservoirs.

Highest water levels occur in the spring prior to the onset of the growing season in response to recharge from precipitation. Lowest levels occur in the fall prior to the first killing frost as a result of natural discharge and evapotranspiration.

The water level in well 16, which taps the Pottsville Formation in the western part of Area 24, ranged from about 4 to 14 feet below land surface (fig. 7.2-1). Water levels in wells which tap pre-Pennsylvanian sedimentary rocks are highly variable due to faults and solution cavities. The more dense carbonate (limestone and dolomite) rocks show dampened fluctuations similar to those observed in the Pottsville Formation. Well 10 taps this type of pre-Pennsylvanian sedimentary rock in the east central part of the area. Water levels in this well ranged from about 6 to 13 feet (fig. 7.2-2). Water levels in Well 21, in the southwestern part of the area, ranged from about 17 to 48 feet (fig. 7.2-3). The large fluctuations in water levels at this site are typical of carbonate formations containing large solution openings. These large openings fill quickly by recharge and drain rapidly to points of discharge. Springs, abundant in these rocks, are major points of discharge and exhibit seasonal fluctuations. Discharge from Spring 42, located in a limestone area in the southeastern part of Area 24, ranged from 16,000 to 30,000 gal/min (fig. 7.2-4). Fluctuations in water level in these three wells and discharges of the spring are representative of those in other wells and springs in similar formations in Area 24.

Water-level records for semiannual and continuous-recorded observation wells in Area 24 may be obtained from the U.S. Geological Survey at Tuscaloosa or from the annual report "Water Resources Data for Alabama," published by the U.S. Geological Survey. Monthly and annual precipitation and air temperature records may be found in U.S. Department of Commerce Climatological Data reports for Alabama.



BASE FROM U. S. GEOLOGICAL SURVEY STATE BASE MAPS, 1966

EXPLANATION

Geologic unit

- Pottsville Formation
- Pre-Pennsylvanian sedimentary rocks
- Metamorphic rocks

See section 10.3 for detailed site description

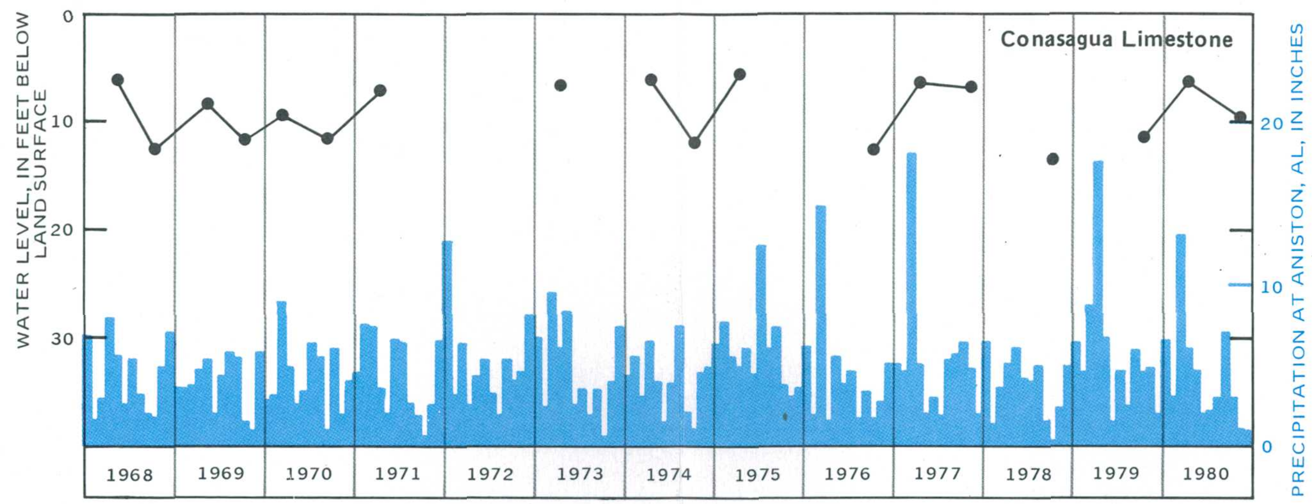


Figure 7.2-2 Water levels for site 10.

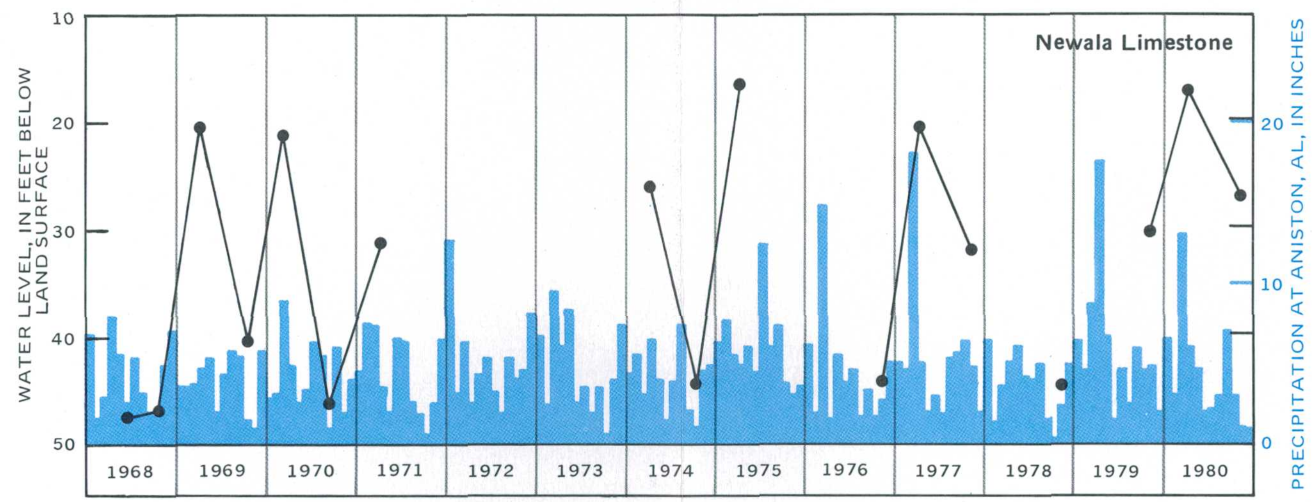


Figure 7.2-3 Water levels for site 21.

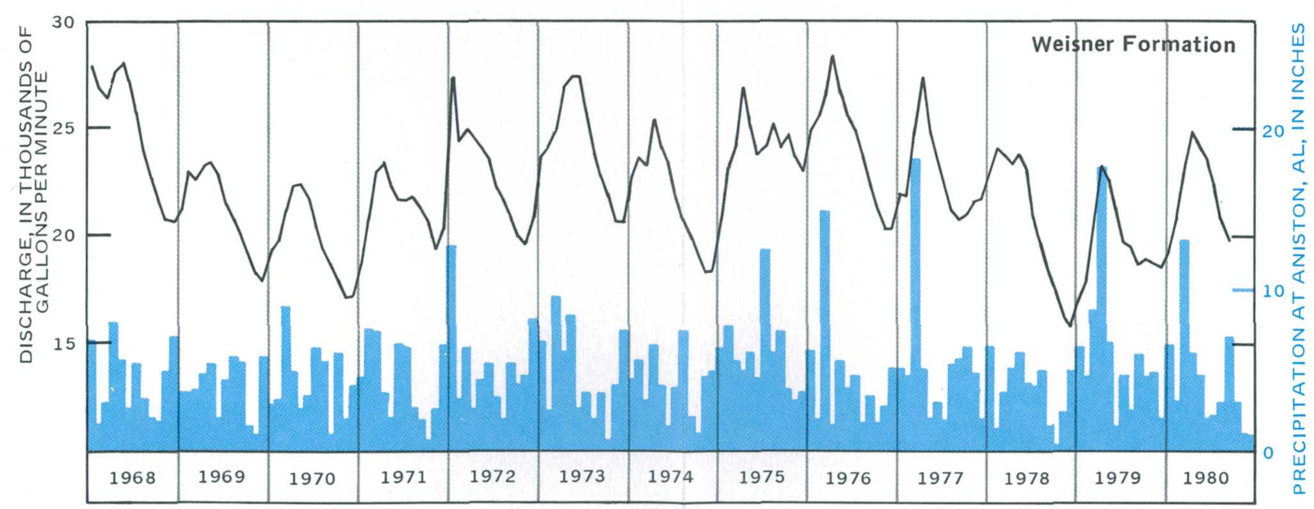


Figure 7.2-4 Discharge for site 42, Coldwater Spring near Aniston, Alabama.

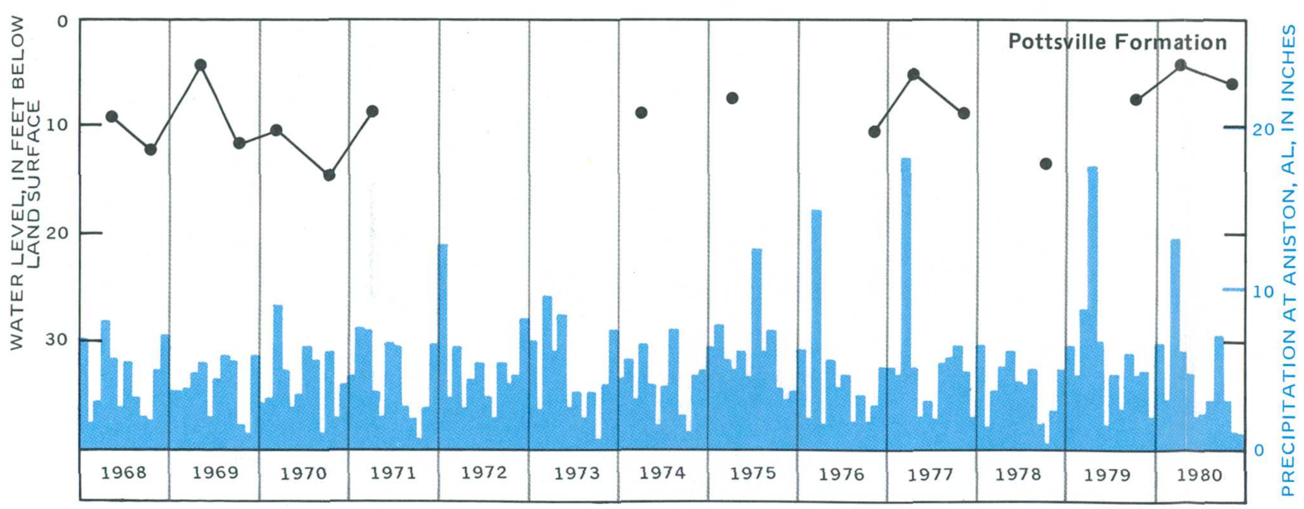


Figure 7.2-1 Water levels for site 16.

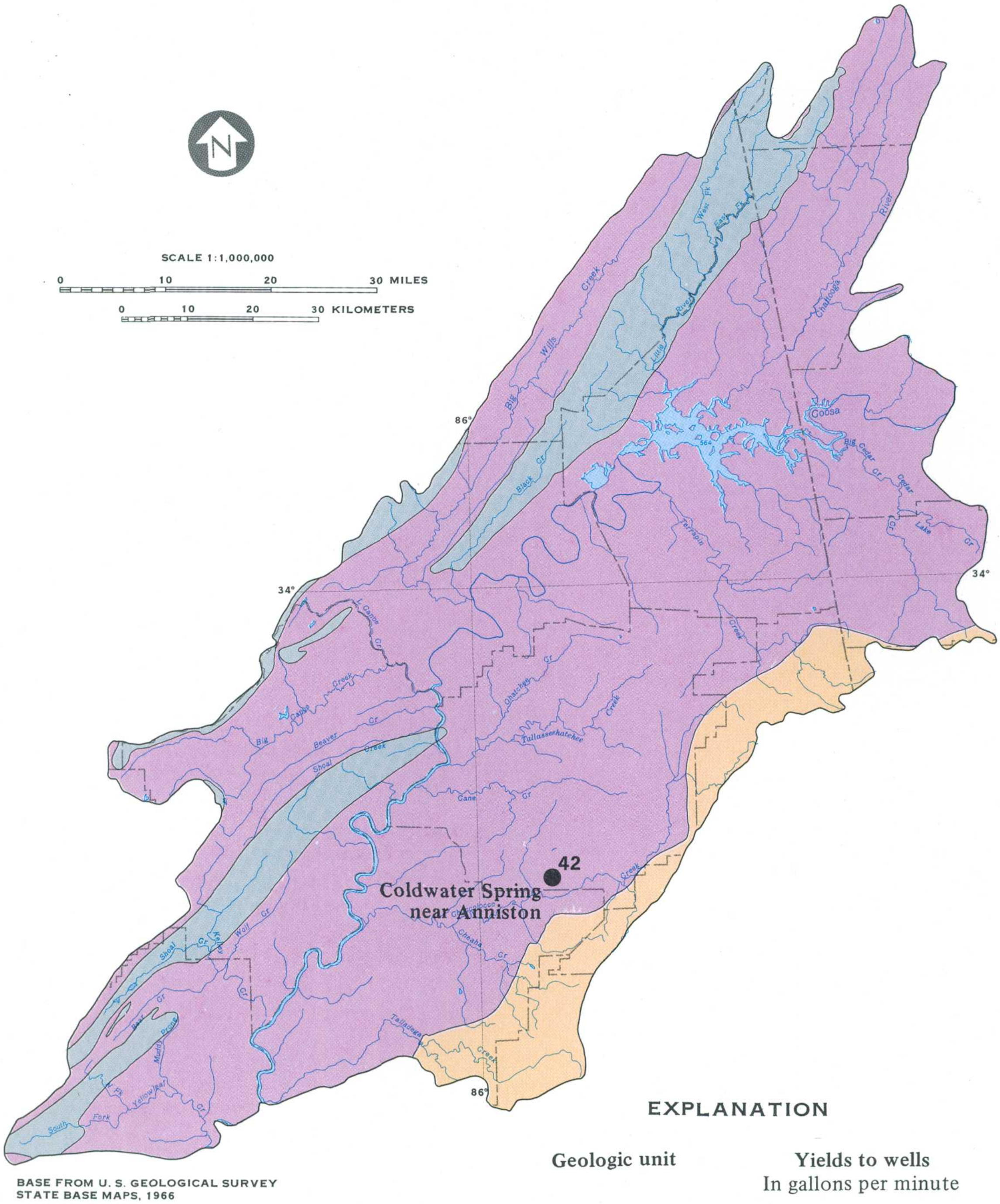
Yields to Wells Range from 2 to 1600 Gallons per Minute

The three major rock units underlying Area 24 have diverse water-bearing characteristics.

The Pottsville Formation consists of alternating beds of sandstone and shale and some coal (fig. 7.3-1). Ground water is present principally in fractures in coal beds, and in fractures, bedding planes, and in pore spaces in sandstone. Openings generally are small, and yields to wells range from less than 5 to as much as 50 gal/min. Depth to water generally is less than 30 feet in stream valleys and terraces and more than 50 feet on hills and ridges.

Availability of ground water in the pre-Pennsylvanian sedimentary rocks is related to topography, depth and extent of weathering and fracturing, existence of solution cavities, and rock type. The largest yielding aquifers are the carbonate rocks, such as limestone and dolomite, containing interconnected, solutionally-enlarged openings. Many of the limestones and dolomites in Area 24 contain an abundance of chert which remains as the rock weathers forming a rubble zone above the bedrock. Wells in dolomite produce as much as 1600 gal/min. Springs with very large flows are common in the carbonate rocks, particularly along thrust faults where the rock has been broken and crushed and is more susceptible to solution activity. The largest of these springs is Coldwater Spring near Anniston, Alabama, with an unusually large flow of as much as 30,000 gal/min (fig. 7.3-1). Other large springs have measured flows of as much as 4,800 gal/min (Causey, 1965).

In the metamorphic rocks of the Piedmont province, water availability is related to the topography, the depth and extent of fracturing, and the thickness and character of the saprolite (weathered rock). Yields to wells in the metamorphic rocks of the Piedmont province range from 2 to 250 gal/min (Alabama Water Improvement Commission, 1976).



BASE FROM U. S. GEOLOGICAL SURVEY
STATE BASE MAPS, 1966

EXPLANATION

Geologic unit	Yields to wells In gallons per minute
Pottsville Formation	Less than 5 to 50
Pre-Pennsylvanian sedimentary rocks	2 to 1,600
Metamorphic rocks	2 to 250

Figure 7.3-1 Geology and yields of water to wells.

Chemical Quality of Ground Water is Variable, but Generally Good

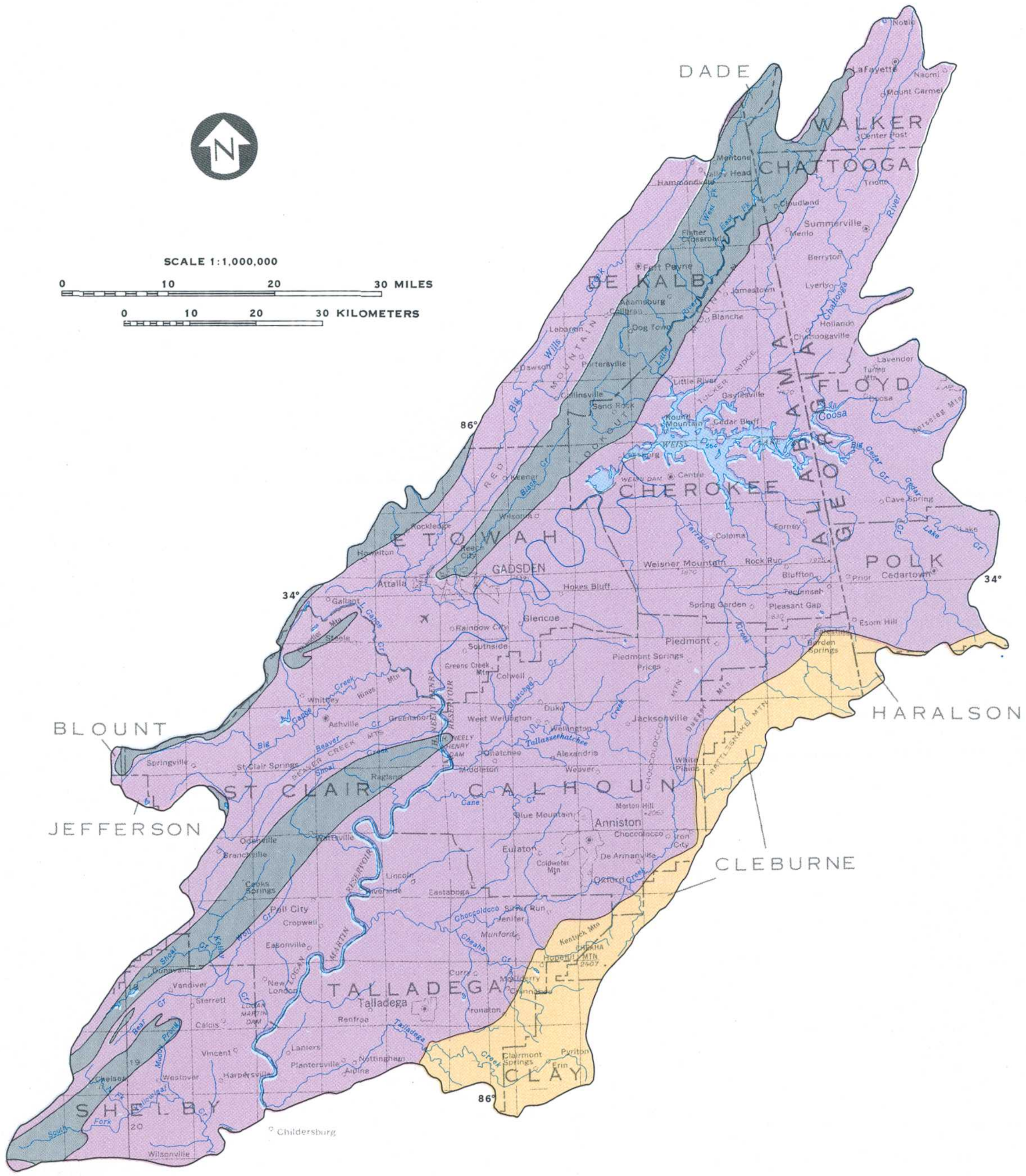
Ground water is suitable for most domestic and industrial uses, except in some local areas.

Quality of ground water in Area 24 is highly variable, but is generally good and suitable for most uses. Ranges and averages of selected chemical quality constituents in water from the geologic units are shown on figure 8.0-1. Only two constituents, iron and silica, are in concentrations that could pose a problem in the area. Locally, iron exceeds the 0.3 mg/L recommended limit for drinking water (U.S. Environmental Protection Agency, 1977a,b). Silica concentrations in ground water from the metamorphic rocks may be a problem for some industrial uses in local areas.

The chemical and physical properties of ground water depend on several variables such as composition of the aquifer, distance from recharge areas, length of time the water has been in contact with the rocks, and the overall pattern of ground-water movement. Mineralization of water in the three geologic units generally increases with depth.

Water in all three geologic units is a calcium-bicarbonate type and is very similar in chemical and physical properties. The median pH in the geologic units ranges from 7.0 to 7.7 units and average specific conductance ranges from 113 to 237 micromhos/cm, with the lowest values in the metamorphic rocks and the highest in the pre-Pennsylvanian sedimentary rocks.

Water from the Pottsville Formation and pre-Pennsylvanian sedimentary rocks has dissolved-solids concentrations generally greater than 100 mg/L. In contrast, the concentrations in water from the metamorphic rocks is generally less than 100 mg/L. Water from each of the three units varies from soft to very hard.

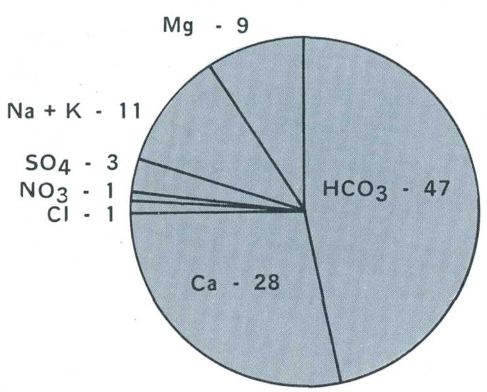


BASE FROM U. S. GEOLOGICAL SURVEY STATE BASE MAPS, 1966

Pottsville Formation

(Concentrations in milligrams per liter unless otherwise specified)

Constituent	Range	Average	Number of samples
Silica (SiO_2)	--	--	0
Iron (Fe)	.0 - 20	2.2	62
Calcium (Ca)	1.2 - 39	16	11
Magnesium (Mg)	1.1 - 11	4.4	11
Sodium (Na)	1.1 - 31	9.9	11
Potassium (K)	.2 - 1.8	.7	4
Bicarbonate (HCO_3)	11. - 368	118	62
Sulfate (SO_4)	.0 - 33	8.5	11
Chloride (Cl)	.5 - 23	4.3	62
Nitrate (NO_3)	.0 - 0.9	.3	10
pH (units)	5.9 - 8.7	7.2 (median)	62
Specific conductance (micromhos per centimeter at 25°C)	25. - 698	203	60
Hardness ($CaCO_3$)	4. - 265	69	61

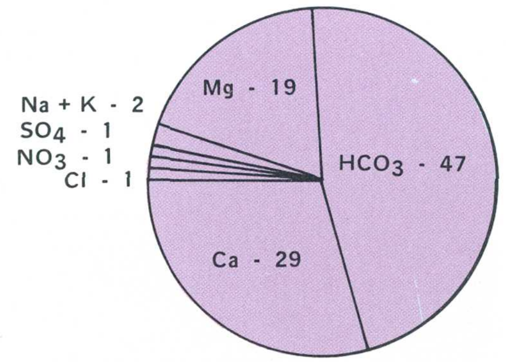


Percentage of total ion concentration in a typical water sample

Pre-Pennsylvanian sedimentary rocks

(Concentrations in milligrams per liter unless otherwise specified)

Constituent	Range	Average	Number of samples
Silica (SiO_2)	1.3 - 24	8.2	9
Iron (Fe)	.0 - 5.4	.24	113
Calcium (Ca)	6.2 - 75	30	99
Magnesium (Mg)	.2 - 19	9.8	99
Sodium (Na)	.0 - 39	3.2	88
Potassium (K)	.0 - 8.3	1.0	33
Bicarbonate (HCO_3)	25. - 296	145	182
Sulfate (SO_4)	.0 - 18	2.9	100
Chloride (Cl)	.0 - 43	3.7	183
Nitrate (NO_3)	.0 - 12	1.8	98
pH (units)	6.7 - 8.6	7.7 (median)	182
Specific conductance (micromhos per centimeter at 25°C)	56. - 450	237	128
Hardness ($CaCO_3$)	20. - 221	120	183

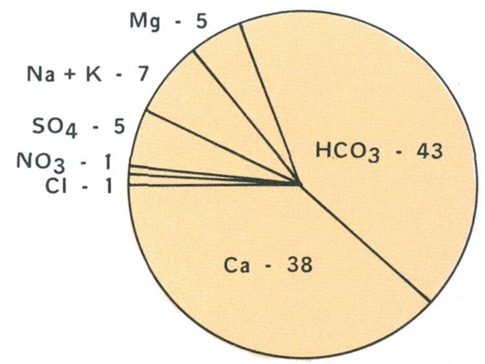


Percentage of total ion concentration in a typical water sample

Metamorphic rocks

(Concentrations in milligrams per liter unless otherwise specified)

Constituent	Range	Average	Number of samples
Silica (SiO_2)	5.4 - 37	18	15
Iron (Fe)	.0 - 6.4	0.70	91
Calcium (Ca)	.6 - 58	14	23
Magnesium (Mg)	.1 - 8.8	3.1	23
Sodium (Na)	.0 - 12	4.0	12
Potassium (K)	.2 - 2.7	1.1	12
Bicarbonate (HCO_3)	2. - 234	56	196
Sulfate (SO_4)	.0 - 12	3.7	23
Chloride (Cl)	.0 - 26	3.0	196
Nitrate (NO_3)	.0 - 5.8	.8	24
pH (units)	5.4 - 8.5	7.0 (median)	193
Specific conductance (micromhos per centimeter at 25°C)	1.3 - 439	113	185
Hardness ($CaCO_3$)	2. - 224	45	195



Percentage of total ion concentration in a typical water sample

Figure 8.0-1 Geology and typical chemical composition of ground water.

NAWDEX, WATSTORE, and OWDC Water Information

Water data are collected in coal areas by a large number of organizations in response to a wide variety of missions and needs.

Three activities within the U.S. Geological Survey help to identify and to improve access to the vast amount of existing water data. These activities are:

(1) The National Water Data Exchange (NAWDEX), which indexes the water data available from over 400 organizations and which serves as a focus to help those needing water data to determine what information is available.

(2) The National Water Data Storage and Retrieval System (WATSTORE), which serves as the central repository of water data collected by the U. S. Geological Survey, including data on the quantity and quality of both surface and ground waters.

(3) The Office of Water Data Coordination (OWDC), which coordinates Federal water-data acquisition activities and maintains a "Catalog of Information on Water Data." To assist in identifying available water-data activities in coal provinces of the United States, special indexes to the catalog are being printed and made available to the public.

A more detailed explanation of these three activities is given in sections 9.2, 9.3, and 9.4.

NAWDEX Simplifies Access to Water Data

The National Water Data Exchange (NAWDEX) is a nationwide program managed by the U.S. Geological Survey to assist users of water data or water-related data in identifying, locating, and acquiring needed data.

NAWDEX is a national confederation of water-oriented organizations working together to make their data more readily accessible and to facilitate a more efficient exchange of water data.

Services are available through a Program Office located at the U.S. Geological Survey National Center in Reston, Va., and a nationwide network of Assistance Centers located in 45 states and Puerto Rico. These centers provide convenient access to NAWDEX (fig. 9.2-1). A directory containing the names, addresses, telephone numbers, and office hours for each of the Assistance Centers can be obtained from the Program Office [Directory of Assistance Centers of the National Water Data Exchange (NAWDEX), U.S. Geological Survey Open-File Report 79-423 (revised)].

NAWDEX can assist organizations or individuals to identify and locate needed water data. The requester is referred to the organization that retains the needed data. To accomplish this service, NAWDEX maintains a computerized Master Water Data Index (MWDI) (fig. 9.2-2). The MWDI identifies sites for which water data are available, lists the type of data available for each site, and identifies the organization retaining the data. A Water Data Sources Directory (fig. 9.2-3) also is maintained that identifies the sources of water data and the locations from which data may be obtained. In addition, NAWDEX has direct access to some large water-data bases of its members and has reciprocal agreements for the exchange of services with non-member organizations.

Charges for NAWDEX services are assessed at the option of the organization providing the requested data or service. Most search assistance services are provided free by NAWDEX. Charges are assessed, however, for those requests involving computer costs, extensive personnel time, duplicating services, or other costs encountered by NAWDEX in the course of providing services. In no case, will charges assessed by NAWDEX Assistance Centers exceed the direct costs incurred in responding to the data request. Estimates of cost are provided by NAWDEX upon request and in those cases where substantial costs are anticipated.

For additional information concerning the NAWDEX program or its services contact:

Program Office
National Water Data Exchange (NAWDEX)
U.S. Geological Survey
421 National Center
12201 Sunrise Valley Drive
Reston, VA 22092

Telephone: (703) 860-6031
FTS 928-6031

Hours: 7:45 - 4:15 Eastern Time

or

NAWDEX ASSISTANCE CENTER
ALABAMA
U.S. Geological Survey
Water Resources Division
Room 202, Oil & Gas Board Bldg.
P.O. Box V
University, AL 35486

Telephone: (205) 752-8104
FTS 229-2957

Hours: 7:30 - 4:00 Central Time

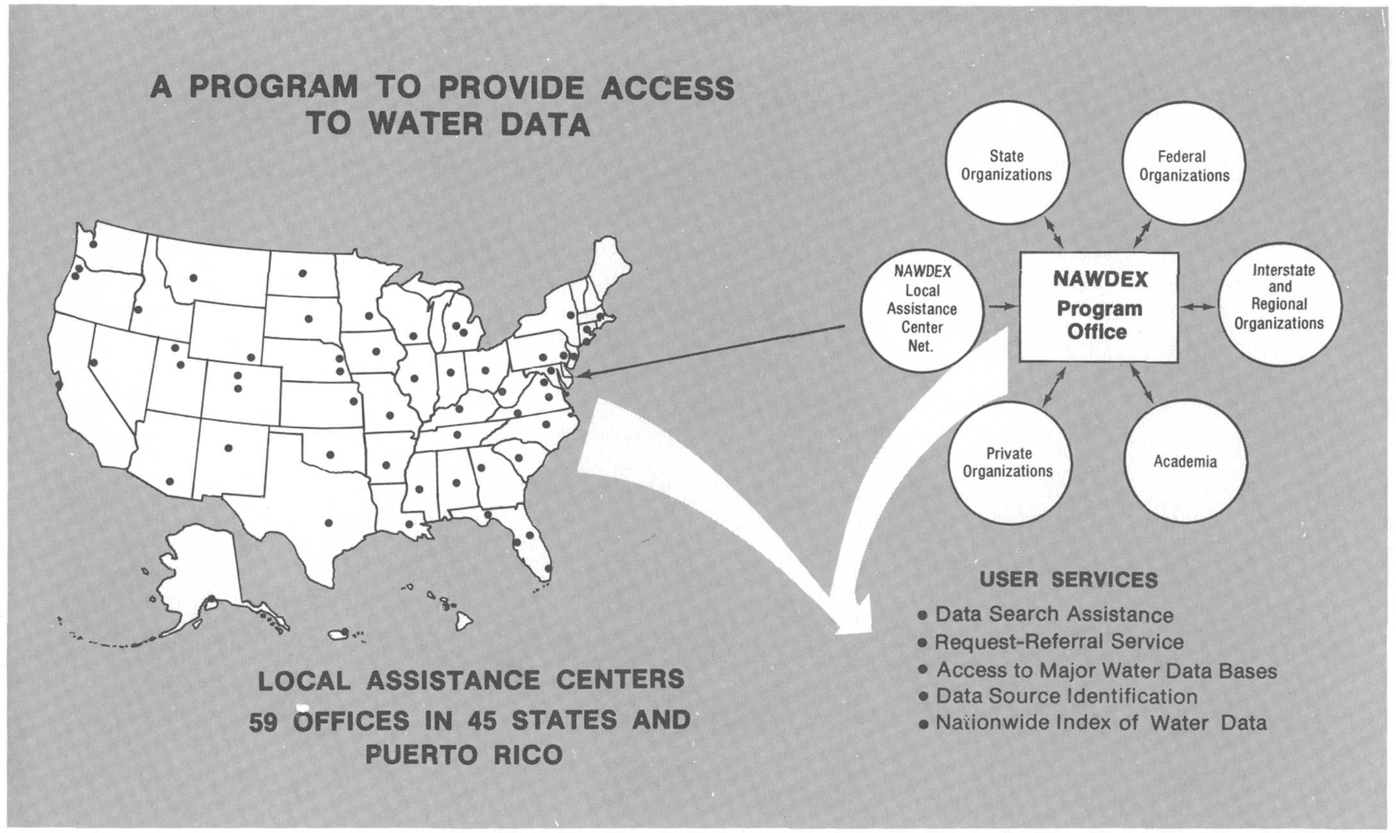


Figure 9.2-1 Access to water data.

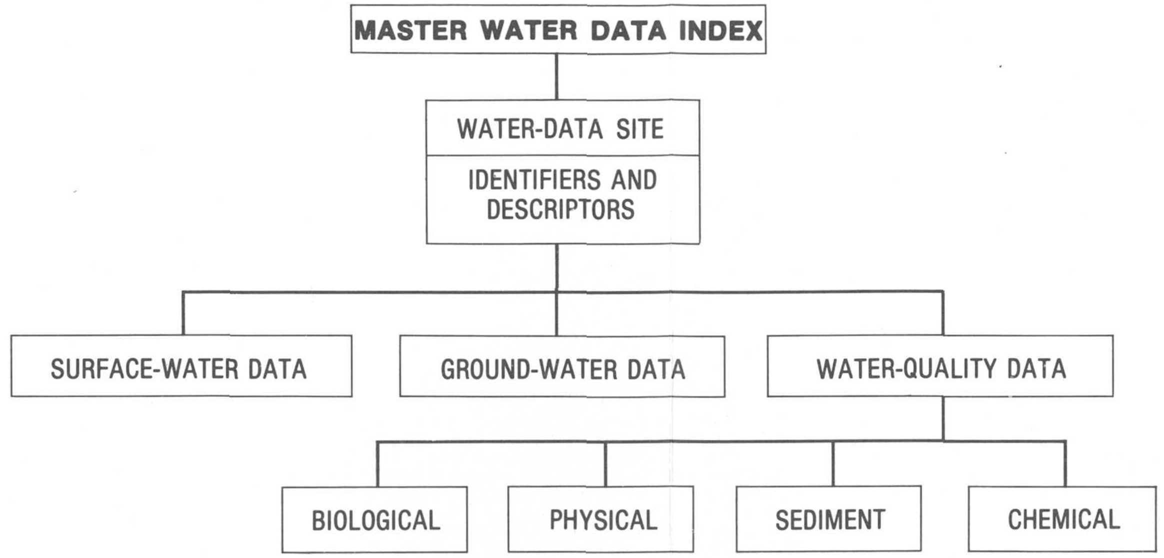


Figure 9.2-2 Master water index.

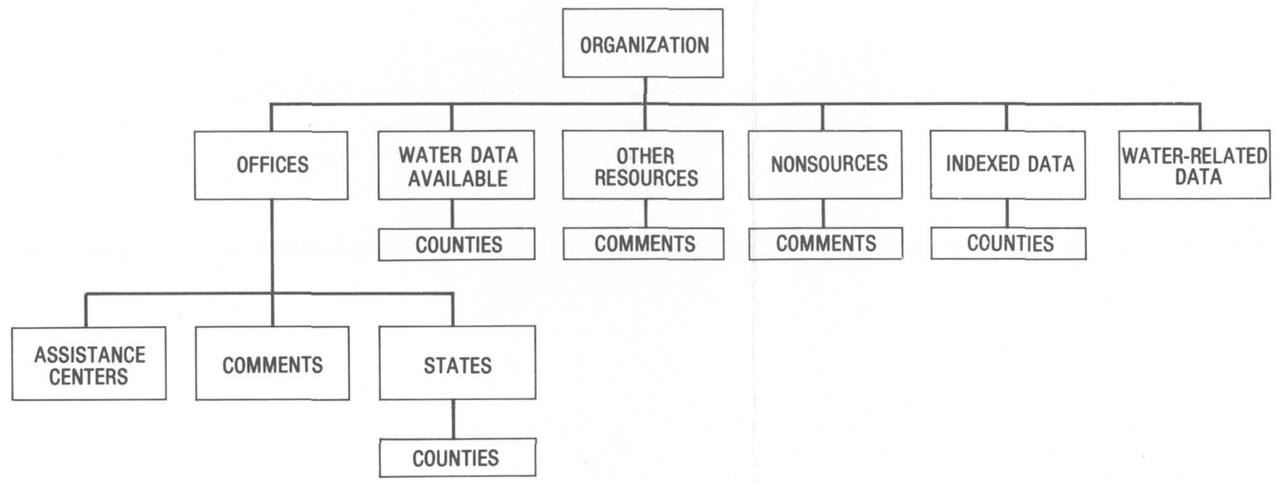


Figure 9.2-3 Water-data sources directory.

WATSTORE Automated Data System

The National Water Data Storage and Retrieval System (WATSTORE) of of the U.S. Geological Survey provides computerized procedures and techniques for processing water data and provides effective and efficient management of data-releasing activities.

The National Water Data Storage and Retrieval System (WATSTORE) was established in November 1971 to computerize the water-data system of the U.S. Geological Survey and to provide for more effective and efficient management of its data-releasing activities. The system is operated and maintained on the computer facilities of the Geological Survey at its National Center in Reston, Virginia. Data may be obtained from WATSTORE through the Water Resources Division's 46 district offices. General inquiries about WATSTORE may be directed to:

Chief Hydrologist
U.S. Geological Survey
437 National Center
Reston, VA 22092

or

U.S. Geological Survey
Water Resources Division
Room 202, Oil & Gas Board Bldg.
P.O Box V
University, AL 35486

The Geological Survey currently (1980) collects data at approximately 16,000 streamgaging stations, 1,000 lakes and reservoirs, 5,200 surface-water quality stations, 1,020 sediment stations, 30,000 water-level observation wells, and 12,500 ground-water quality wells. Each year many water-data collection sites are added and others are discontinued; thus, large amounts of diversified data, both current and historical, are amassed by the Survey's data-collection activities.

The WATSTORE system consists of several files in which data are grouped and stored by common characteristics and data-collection frequencies. The system is also designed to allow for the inclusion of additional data files as needed. Currently, files are maintained for the storage of: (1) surface-water, quality-of-water, and ground-water data measured on a daily or continuous basis; (2) annual peak values for streamflow stations; (3) chemical analyses for surface- and ground-water sites; (4) water parameters measured more frequently than daily; (5) geologic and inventory data for ground-water sites; and (6) aggregated water-use data. In addition, an index file of sites for which data are stored in the system is also maintained (fig. 9.3-1). A brief description of each file is as follows:

Station Header File: All sites for which data are stored in the Daily Values, Peak Flow, Water-Quality, or Unit Values files of WATSTORE are indexed in this file. It contains information pertinent to the identification, location, and physical description of nearly 220,000 sites.

Daily Values File: All water-data parameters measured or observed either on a daily or on a continuous basis and numerically reduced to daily values are stored in this file. Instantaneous measurements at fixed-time intervals, daily mean values, and statistics such as daily maximum and minimum values also may be stored. This file currently contains over 200 million daily values including data on streamflow, river stages, reservoir contents, water temperatures, specific conductance, dissolved oxygen concentrations, pH, sediment concentrations, sediment discharges, and ground-water levels.

Peak Flow File: Annual maximum (peak) streamflow (discharge) and gage height (stage) values at surface-water sites comprise this file, which currently contains over 400,000 peak observations.

Water-Quality File: Results of over 1.4 million analyses of water samples that describe the chemical, physical, biological, and radiochemical characteristics of both surface and ground waters are contained in this file.

Unit Values File: Water parameters measured on a schedule more frequent than daily are stored in this file. Rainfall, stream discharge, and temperature data are examples of the types of data stored in the Unit Values File.

Ground-Water Site-Inventory File: This file is maintained within WATSTORE independent of the files discussed above, but it is cross-referenced to the Water-Quality File and the Daily Values File. The file contains inventory data about wells, springs, and other sources of ground water. Site location and identification, geohydrologic characteristics, and well-construction history are some of the data included. The file is designed to accommodate 255 data elements and currently contains data for nearly 790,000 sites.

Water-Use File: This file is being developed to store and disseminate summary data about the withdrawal, return, and use of water throughout the Nation. The storage and retrieval system is needed to handle the vast amount of aggregated water-use data that will be submitted by the States.

Although all WATSTORE data files are maintained and managed at the National Center, data may be entered into or retrieved from WATSTORE at locations that are part of a nationwide telecommunication network.

Remote Job Entry Sites: Almost all of the district offices of the Water Resources Division are equipped with remote computer terminals for access to the WATSTORE system. These terminals permit rapid data entry and retrieval in response to data needs and requests.

Digital Transmission Sites: Digital recorders are used at many field locations to record values for parameters such as river stage, specific conductance, water temperature, turbidity, and dissolved oxygen. Data from these sites, recorded on 16-channel paper tape, are transmitted by telephone to the computer center at Reston, Va. In addition to this type of site, about 200 satellite-data collection platforms are being operated currently (1980) throughout the country. Battery operated radios are used as the communication link between the recorder and the satellite. Extensive testing indicates that the platforms are feasible for use in collecting real-time hydrologic data on a national scale.

Central Laboratory System: The Water Resources Division's two water-quality laboratories, located in Denver, Colorado, and Atlanta, Georgia, analyze more than 150,000 water samples per year. These highly-automated laboratories are equipped to analyze chemical constituents ranging from simple inorganics, such as chloride, to complex organic compounds, such as pesticides. The analysis results are verified by laboratory personnel and transmitted to the central computer facilities to be stored in the Water-Quality File of WATSTORE.

Water data are used in many ways by decision-makers for the management, development, and monitoring of water resources. In addition to data processing, storage, and retrieval capabilities, WATSTORE can provide a variety of useful products ranging from simple data tables to complex statistical analyses. A minimal fee, plus the actual computer cost incurred in producing a desired product, is charged to the requester.

Computer-Printed Tables: Users generally request data from WATSTORE in the form of computer-generated tables. These tables may contain either actual data or condensed indexes that indicate the availability of data. A variety of display formats is available.

Computer-Printed Graphs: Computer-printed graphs for the rapid analysis or display of data are another capability of WATSTORE. Computer programs are available to produce bar graphs (histograms), line graphs, frequency distribution curves, X-Y point plots, site-location map plots, and other similar items by means of line printers.

Statistical Analyses: WATSTORE interfaces with a proprietary statistical package, Statistical Analysis System (SAS), to provide extensive analyses of data such as regression analyses, the analysis of variance, transformations, and correlations.

Digital Plotting: WATSTORE also makes use of software systems that prepare data for digital plotting on peripheral offline plotters available at the central computer site. Plots that can be obtained include hydrographs, frequency distribution curves, X-Y point plots, contour plots, and three-dimensional plots.

Data in Machine-Readable Form: Data stored in WATSTORE can be obtained in machine-readable form for use on other computers or for use in user-provided software systems. These data are available in the standard storage format of the WATSTORE system or in the form of punched cards or card images on magnetic tape.

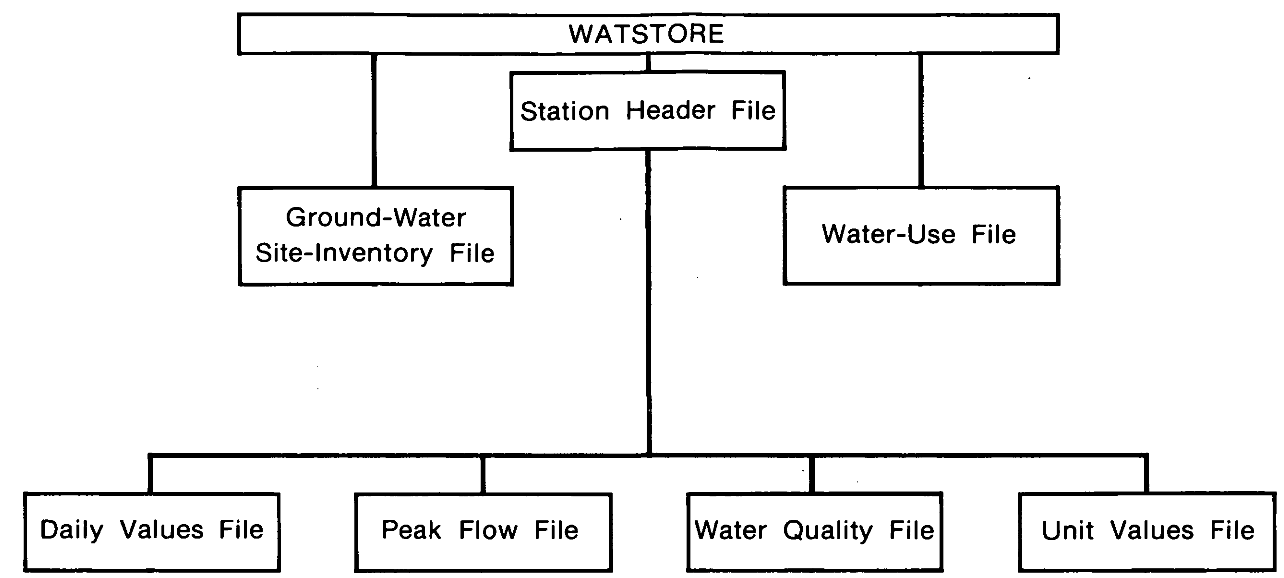


Figure 9.3-1 Index file of stored data.

Water Data Indexed for Coal Provinces

A special index, "Index to Water-Data Activities in Coal Provinces of the United States," has been published by the U.S. Geological Survey's Office of Water Data Coordination (OWDC).

The "Index to Water-Data Activities in Coal Provinces of the United States" was prepared to assist those involved in developing, managing, and regulating the Nation's coal resources by providing information on the availability of water-resources data in the major coal provinces of the United States. It is derived from the "Catalog of Information on Water Data," which is a computerized information file about water-data acquisition activities in the United States and its territories and possessions, with some international activities included.

This special index consists of five volumes (fig. 9.4-1): volume I, Eastern Coal province; volume II, Interior Coal province; volume III, Northern Great Plains and Rocky Mountain Coal provinces; volume IV, Gulf Coast Coal province; and volume V, Pacific Coast and Alaska Coal provinces. The information presented will aid the user in obtaining data for evaluating the effects of coal mining on water resources and in developing plans for meeting additional water-data needs. The report does not contain the actual data; rather, it provides information that will enable the user to determine if needed data are available.

Each volume of this special index consists of four parts: Part A, Streamflow and Stage Stations; Part B, Quality of Surface-Water Stations; Part C, Quality of Ground-Water Stations; and Part D, Areal Investigations and Miscellaneous Activities. Information given for each activity in Parts A-C includes: (1) the identification and location of the station, (2) the major types of data collected, (3) the frequency of data collection, (4) the form in which the data are stored, and (5) the agency or organization reporting the activity. Part D summarizes areal hydrologic investigations and water-data activities not included in the other parts of the index. The agencies that submitted the information, agency codes, and the number of activities reported by type are shown in a table.

Those who need additional information from the Catalog file or who need assistance in obtaining water data should contact the National Water Data Exchange (NAWDEX, see section 9.2).

Further information on the index volumes and their availability may be obtained from:

U.S. Geological Survey
Office of Water Data Coordination
417 National Center
Reston, VA 22092

Telephone: (703)860-6935
FTS 928-6935

or

U.S. Geological Survey
Water Resources Division
Room 202, Oil & Gas Board Bldg.
P.O. Box V
University, AL 35486

Telephone: (205) 752-8104
FTS 229-2957

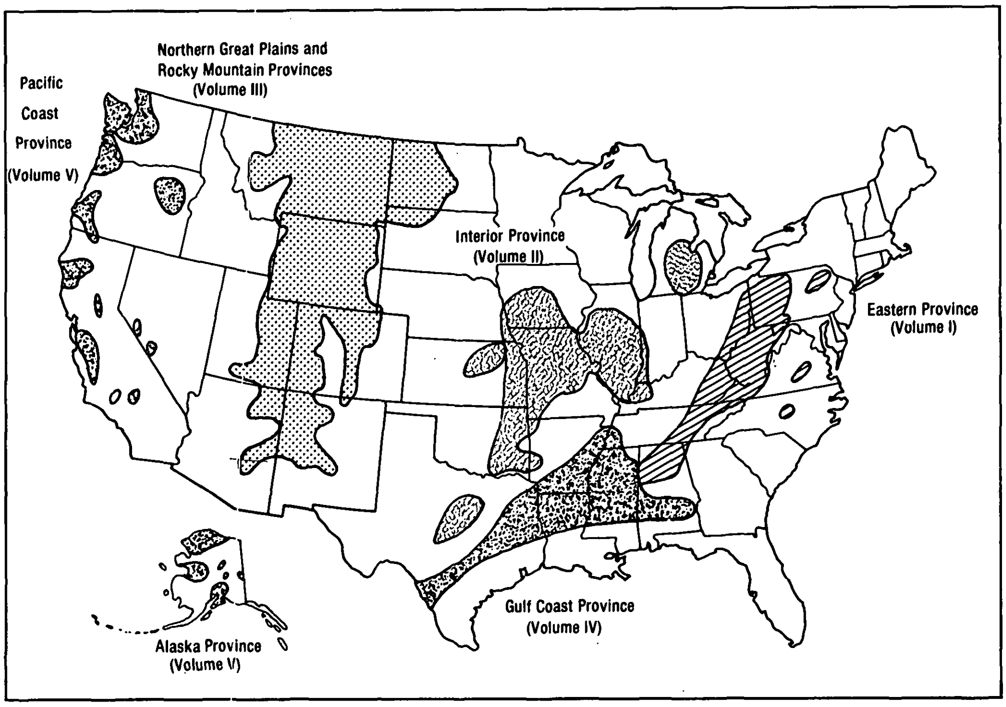


Figure 9.4-1 Areas of OWDC coal activities publications.

10.0 SUPPLEMENTAL INFORMATION FOR AREA 24

10.1 Stream Classifications

Stream Classification of Alabama and Georgia Waters

Use Classification of Alabama Streams

(in descending order of quality)

PWS Public water supply

S Swimming and other whole-body water-contact sports

F&W Fish and wildlife

A&I Agricultural and industrial water supply

IO Industrial operations

N Navigation

NOTES

* Stream classification of Georgia waters

In addition to specific notes applicable to certain basins, the following notations on individual segments may appear:

[1]Quality commensurate with this classification will not be obtained until required improvements, which may presently be in either the construction, design, or planning stage, are completed.

[2]Applicable dissolved oxygen level below existing impoundments is 4.0 mg/l.

Stream Classification of Alabama and Georgia Waters (Continued)

COOSA RIVER BASIN

Stream	From	To	Classification(s)
*Coosa River	Rome, Ga.	Alabama State line	Recreation
Coosa River (Weiss Lake)......	Spring Creek.............	Alabama-GA State line....	S/F&W
Spring Creek......	Coosa River (Weiss Lake).	Alabama-GA State line....	F&W
Chattooga River...	Gaylesville..............	Alabama-GA State line....	F&W
Chattooga River...	Coosa River (Weiss Lake).	Gaylesville..............	S/F&W
Little River......	Coosa River (Weiss Lake).	Alabama-GA State line....	PWS/S/F&W
West Fork of Little River......	Little River.............	Alabama-GA State line....	PWS/S/F&W
Coosa River (Weiss Lake)......	Weiss Dam and Weiss Dam powerhouse...............	Spring Creek.............	PWS/S/F&W
Coosa River.......	Weiss Dam powerhouse.....	Weiss Dam................	F&W
Terrapin Creek....	Borden Springs...........	Alabama-GA State line....	F&W
Terrapin Creek....	U.S. Highway 278.........	Borden Springs...........	PWS/F&W
Terrapin Creek....	Coosa River..............	U.S. Highway 278.........	F&W
Coosa River (Lake Henry)......	City of Gadsden's water supply intake......	Weiss Dam powerhouse.....	PWS/F&W
Coosa River (Lake Henry)......	McCardney's Ferry........	City of Gadsden's water supply intake......	F&W
Big Wills Creek...	Coosa River (Lake Henry-Lake Gadsden)...........	Its source...............	F&W
Lake Gadsden (Lake Henry)......	U.S. Highway 411.........	Impoundment Limits.......	F&W
Black Creek.......	U.S. Highway 431.........	Its source...............	F&W
Black Creek.......	Lake Henry (Lake Gasden).	U.S. Highway 431.........	A&I
Coosa River (Logan Martin Lake) (Lake Henry)......	Logan Martin Dam........	McCardney's Ferry........	S/F&W

Stream Classification of Alabama and Georgia Waters (Continued)

Stream	From	To	Classification(s)
Little Canoe Creek.	Big Canoe Creek.........	Its source...............	F&W
Ohatchee Creek....	Coosa River (Logan Martin Lake).....	Its source...............	S/F&W
Tallahatchee Creek.	Ohatchee Creek..........	Its source...............	F&W
Cane Creek........	Coosa River (Logan Martin Lake).....	Its source...............	F&W
Cave Creek........	Cane Creek..............	Ft. McClellan Reservation	F&W
Dye Creek.........	Coosa River (Logan Martin Lake).....	Its source...............	F&W[1]
Choccolocco Creek.	Coosa River (Logan Martin Lake).....	Its source...............	F&W
Snow Creek........	Choccolocco Creek.......	Its source...............	A&I
Coldwater Creek...	Choccolocco Creek.......	Its source...............	F&W
Cheaha Creek......	Choccolocco Creek.......	Lake Chinnabee...........	S/F&W
Kelly Creek.......	Cheaha Creek............	Its source...............	A&I
Eastaboga Creek...	Choccolocco Creek.......	Its source...............	F&W
Coosa River (Lay Lake)........	River Mile 89 (1 1/2 miles above Talladega Creek)..	Logan Martin Dam.........	PWS/F&W
Kelly Creek.......	Coosa River (Lay Lake)..	Its source...............	S/F&W
Wolf Creek........	Kelly Creek.............	Its source...............	S/F&W[1]
COOSA RIVER (Lay Lake)........	Southern RR Bridge (1 1/3 miles above Yellowleaf Creek).......	River Mile 89 (1 1/2 miles above Talladega Creek)...	F&W[2]
Talladega Creek...	Coosa River (Lay Lake)..	Its source...............	F&W
Mump Creek........	City of Talladega's water supply reservoir dam ...	Its source...............	PWS/F&W
Mump Creek........	Talladega Creek.........	City of Talladega's water supply reservoir dam	F&W

Stream classification of Alabama and Georgia Water (Continued)

Stream	From	To	Classification(s)
Coosa River (Lay Lake)........	Lay Dam.................	Southern RR Bridge (1 1/3 miles above Yellowleaf Creek)........	PWS/S/F&W
Yellowleaf Creek..	Coosa River (Lay Lake)..	Its source...............	S/F&W

From Water Use Classifications of waters by Alabama Water Improvement Commission, Feb. 4, 1981, and Water Use Classifications for surface waters by Georgia Department of Natural Resources, July 1980.

Surface-water stations

Site number (fig. 4.1-1)	Station		Location		Drainage area (mi^2)	Period and type of record			
	Number	Name	Latitude ° ' "	Longitude ° ' "		Discharge	Chemical quality	Sediment	Biological
1	02388500	Oostanaula River at Rome, Ga.	34 18 02	085 08 30	2115	1940-81	1907,1941-42, 1958-60,1962-74, 1976		
2	02388520	Oostanaula River at Rome Intake, Rome, Ga.	34 16 13	085 10 24	2145	.....	1974-81		
3	02396000	Etowah River at Rome, Ga.	34 15 26	085 09 30	1819	1902-21, 1939-81	1941, 1957-58, 1962-81		
4	02397000	Coosa River near Rome, Ga.	34 12 01	085 15 24	4036	1897-1904, 1928-32, 1937-59, 1963-81	1937, 1957-58, 1962-81		
5	02397100	Coosa River near Coosa, Ga.	34 14 50	085 21 20	4108	.....	1958		
6	02397500	Cedar Creek near Cedartown, Ga.	34 03 38	085 18 41	115	1943-73	1962-81		
7	02397530	Coosa River at State Line Ala.-Ga.	34 11 54	085 26 46	4362	.....	1974-81		
8	02397810	Duck Creek near Center Post, Ga.	34 37 08	085 20 49	32.4	.....	1979-81	1979-81	
9	02397830	Harrisburg Creek near Hawkins, Ga.	34 36 02	085 23 21	13.3	1979-81	1979-81	1979-81	
10	02397845	Spring Creek near Trion, Ga.	34 35 04	085 21 55	24.0	.....	1975-77		
11	02397860	Teloga Creek near Neal Crossing, Ga.	34 33 16	085 25 08	3.39	.....	1976, 1977, 1979-81		
12	02397880	Chattooga River at Trion, Ga.	34 33 44	085 20 07	115	.....	1958, 1960-61		
13	02397950	Chattooga River at Trion, Ga.	34 32 40	085 18 37	162	.....	1947		
14	02398000	Chattooga River at Summerville, Ga.	34 28 03	085 20 19	192	1937-81	1937, 1957-58, 1962-81		
15	02398037	Chattooga River at Chattoogaville, Ga.	34 20 08	085 26 43	281	.....	1974-81		
16	02398300	Chattooga River above Gaylesville, Ala.	34 17 25	085 30 33	368	1959-81	1949, 1962-68 1970-72, 1974, 1977		
17	02398534	Hale Branch at Cove Road near Cloudland, Ga.	34 35 43	085 29 53	.....	.....	1976-77		
18	02398580	Middle Fork Little River near Valley Head, Ala.	34 32 18	085 31 33	17.0	.....	1976-77, 1979-81	1979-81	
19	02398582	Brush Creek at DeKalb County Road 106 near Mentone, Ala.	34 32 07	085 31 46	3.44	.....	1979-81	1979-81	
20	02398600	Gilreath Creek near Cloudland, Ga.	34 34 05	085 27 17	3.91	.....	1976-77, 1979-81	1979-81	

Surface-water stations (continued)

Site number (fig. 4.1-1)	Station		Location		Drainage area (mi^2)	Period and type of record			
	Number	Name	Latitude ° ' "	Longitude ° ' "		Discharge	Chemical quality	Sediment	Biological
21	02398610	East Fork Little River above Cloudland, Ga.	34 32 14	085 28 46	9.33	.....	1976		
22	02398620	East Fork Little River at State Highway 48 near Cloudland, Ga.	34 31 22	085 30 20	12.1	.....	1976-77, 1979-81	1979-81	
23	02398857	East Fork of West Fork Little River near Head River, Ga.	34 38 16	085 30 25	6.35	.....	1979-81	1979-81	
24	02398860	Long Branch at Head River, Ga.	34 39 49	085 30 18	1.30	.....	1979-81	1979-81	
25	02398863	West Fork Little River tributary near Mentone, Ala.	34 36 04	085 32 37	.57	.....	1979-81	1979-81	
26	02398865	West Fork Little River near Valley Head, Ala.	34 35 11	085 33 49	28.5	.....	1976-77, 1979-81	1979-81	
27	02398880	West Fork Little River near Fort Payne, Ala.	34 30 30	085 36 32	.....	.....	1967		
28	02399000	Little River near Jamestown, Ala.	34 23 52	085 37 37	121	1922-49	1964-69		
29	02399200	Little River near Blue Pond, Ala.	34 17 20	085 40 50	194	1958-81	1965-81	1979-81	
30	02399500	Coosa River at Leesburg, Ala.	34 10 19	085 45 14	5270	1937-58	1957-58, 1960		
31	02399800	Little Terrapin Creek near Borden Springs, Ala.	33 54 54	085 27 57	15.9	1960-65	1962-68		
32	02399801	Borden Wheeler Spring near Piedmont, Ala.	33 54 55	085 28 03	.....	1956-60			
33	02399810	Borden Spring near Piedmont, Ala.	33 55 10	085 28 36	.....	1956-60			
34	02400000	Terrapin Creek near Piedmont, Ala.	33 57 23	085 34 38	115	1944-54, 1956-63	1949, 1956-58		
35	02400033	Nances Creek near White Plains, Ala.	33 50 43	085 40 00	4.6	1970-81			
36	02400100	Terrapin Creek at Ellisville, Ala.	34 03 54	085 36 51	258	1962-81	1948		
37	02400500	Coosa River at Gadsden, Ala.	34 00 37	085 59 52	5800	1926-61	1948-49, 1951, 1955, 1957, 1960, 1962-81		
38	02400680	Big Wills Creek near Fort Payne, Ala.	34 26 17	085 46 02	.....	1967			
39	02400690	Jacks Creek near Fort Payne, Ala.	34 25 05	085 48 18	.....	1971-73			
40	02400750	Big Wills Creek near Collinsville, Ala.	34 15 56	085 55 06	.....	.....	1960		
41	02401000	Big Wills Creek near Crudup, Ala.	34 05 53	086 02 17	185	1943-81	1949, 1963-73, 1975-81		1978
42	02401080	Big Wills Creek at Gadsden, Ala.	33 59 27	086 02 43	.....	1967			

Surface-water stations (continued)

Site number (fig. 4.1-1)	Station Number	Station Name	Location Latitude ° ' "	Location Longitude ° ' "	Drainage area (mi^2)	Period and type of record: Discharge	Chemical quality	Sediment	Biological
43	02401093	Black Creek near Reese City, Ala.	34 04 48	085 58 45	44.9	1967, 1978-81	1967, 1979, 1981	1979-81	
44	02401100	Black Creek (near Bellevue) near Gadsden, Ala.	34 02 28	086 01 12	.....	.....	1960, 1967		
45	02401370	Big Canoe Creek near Springville, Ala.	33 48 49	086 22 54	45.0	1979-81			
46	02401390	Big Canoe Creek at Ashville, Ala.	33 50 23	086 15 46	148	1965-81	1948-49, 1960, 1966-81		
47	02401450	Gulf Creek near Steele, Ala	33 55 05	086 15 08	9.89	1976-81			
48	02401460	Gulf Creek at U.S. Highway 11 near Ashville, Ala.	33 54 08	086 14 51	14.2	1978-81			
49	02401500	Big Canoe Creek near Gadsden, Ala.	33 54 11	086 06 37	.....	1938-1965			
50	02401590	Shoal Creek near Ragland, Ala.	33 48 08	086 07 02	27.6	1967-68, 1979	1967, 1968 1979-81	1979-81	
51	02401620	Coosa River at H. Neely Henry Dam near Ohatchee, Ala.	33 47 02	086 03 12	.....	1966-81			
52	02401622	Coosa River below H. Neely Henry Dam near Ohatchee, Ala.	33 47 00	086 03 11	.....	1966-81			
53	02401700	Ohatchee Creek at Reads, Ala.	33 52 14	085 54 01	.....	1956-60			
54	02401800	Tallahatchee Creek near Wellington, Ala.	33 48 57	085 52 22	.....	1956-1960	1956-57		
55	02401895	Ohatchee Creek at Ohatchee, Ala.	33 46 48	085 59 53	.....	.....	1956-57		
56	02401915	Cane Creek at Francis Mill, Ala.	33 43 44	086 02 38	.....	.....	1956-57		
57	02401990	Broken Arrow Creek near Pell City, Ala.	33 40 07	086 16 45	.....	1967			
58	02402500	Coosa River at Riverside, Ala.	33 36 30	086 11 57	.....	1896-1916	1948, 1957, 1960		
59	02403135	Choccolocco Creek near White Plains, Ala.	33 44 38	085 40 12	.....	1956-60			
60	02403200	Choccolocco Creek at Choccolocco, Ala.	33 39 48	085 41 16	.....	1956-60	1956-57, 1960, 1967		

Surface-water stations (continued)

Site number (fig. 4.1-1)	Station: Number	Station: Name	Location: Latitude ° ' "	Location: Longitude ° ' "	Drainage area (mi^2)	Period and type of record: Discharge	Chemical quality	Sediment	Biological
61	02404000	Choccolocco Creek near Jenifer, Ala.	33 34 14	085 55 50	.....	1903-1971	1948-49 1962-70		
62	02404235	Cheaha Creek at Ala. Highway 21 near McElderry, Ala.	33 30 12	086 00 17	.....	.....	1967-68		
63	02404245	Cheaha Creek near Talladega, Ala.	33 30 37	086 00 58	.....	.....	1960, 1962-68		
64	02404400	Choccolocco Creek near Lincoln, Ala.	33 32 54	086 05 49	484	1960-81	1962-68, 1973, 1976-81		
65	02404500	Choccolocco Creek near Lincoln, Ala.	33 33 38	086 07 35	.....	1938-53	1948,1957, 1962-63		
66	02405000	Coosa River near Cropwell, Ala.	33 31 17	086 13 34	.....	1941-58	1948		
67	02405200	Coosa River at Logan Martin Dam near Vincent, Ala.	03 25 32	086 20 13	.....	1976-81			
68	02405202	Coosa River below Logan Martin Dam near Vincent, Ala. (Tail)	33 25 30	086 20 20	.....	1976-81			
69	02405325	Wolf Creek near London, Ala.	33 31 22	086 23 52	.....	1967			
70	02405500	Kelly Creek near Vincent, Ala.	33 26 51	086 23 13	192	1951-76, 1979	1952-54,1962-68, 1969-70, 1972-73, 1979-81	1979-81	
71	02405800	Talladega Creek above Talladega, Ala.	33 22 38	086 01 22	.....	.....	1962-70		
72	02406000	Talladega Creek near Talladega, Ala.	33 23 24	086 06 45	.....	.....	1948, 1951, 1962, 1971		
73	02406500	Talladega Creek at Alpine, Ala.	33 21 34	086 14 03	.....	1900-04, 1939-51	1949, 1963-68, 1971		
74	02407000	Coosa River at Childersburg, Ala.	33 17 30	086 21 50	8390	1913-81	1948-49,1954, 1956, 1960, 1962-81		
75	02407040	Coosa River below Childersburg, Ala.	33 16 30	086 25 16	.....	1967-81			
76	02407500	Yellowleaf Creek near Wilsonville, Ala.	33 18 23	086 33 04	.....	1951-67	1953-54,1962-69, 1980-81		
77	02407520	Yellowleaf Creek at Wilsonville, Ala.	33 15 36	086 27 03	.....	1967, 1981			

Ground-Water Stations

Wells

Site Number (fig. 4.2-1)	Site identification number	County & State	Local number	Aquifer	Period of record
1	343715085364401	DeKalb, Ala.	J-10	Maury Formation and Fort Payne Chert	1966, 1968-71, 1973-81
2	342343085471701	DeKalb, Ala.	V-6	Newala Limestone	1966, 1968-71, 1973-81
3	342200085363501	Cherokee, Ala.	F-4	Maury Formation, Fort Payne Chert, and Tuscumbia Limestone	1961, 1968-71, 1973-81
4	341323085362401	Cherokee, Ala.	J-12	Limestone of Conasauga Formation	1961, 1968-71, 1973-81
5	341504085521301	DeKalb, Ala.	GG-7	Maury Formation and Fort Payne Chert	1966, 1968-71, 1973-77
6	340833085454201	Cherokee, Ala.	O-15	Limestone of Conasauga Formation	1961, 1968-71, 1973-81
7	340924085570301	Etowah, Ala.	C-16	Bangor Limestone and Pennington Formation	1959, 1968-71, 1973-81
8	340103086004601	Etowah, Ala.	O-5,Eto-1	Limestone of Conasauga Formation	1961-68 (WSP 1803,1978), 1969-71, 1973-81
9	335653086162601	St. Clair, Ala.	C-5	Monteagle Limestone and Hartselle Sandstone	1968-71, 1973-81
10	335529085353701	Calhoun, Ala.	I-33	Limestone of Conasauga Formation	1957, 1968-71, 1973-81
11	335439085584201	Etowah, Ala.	T-21	Conasauga Formation	1968-69
12	334616085332201	Cleburne, Ala.	H-3	Slate	1968-70
13	334919085460801	Calhoun, Ala.	L-73, CAL-2	Limestone of Conasauga Formation	1960-68 (WSP 1803,1978), 1969-70, 1974-81
14	334742086180601	St. Clair, Ala.	L-17	Limestone of Conasauga Formation	1960, 1968-71, 1973-81
15	334218085491701	Calhoun, Ala.	CAL-1	Conasauga Formation	1960-78*
16	334414086093401	St. Clair, Ala.	S-14	Sandstone of Pottsville Formation	1968-71, 1974-81

Ground-Water Stations (Continued)

Wells

Site Number (fig. 4.2-1)	Site identification number	County & State	Local number	Aquifer	Period of record
17	333659085462201	Calhoun, Ala.	V-69	Limestone of Conasauga Formation	1958, 1976-81
18	333148085571201	Talladega, Ala.	F-8	Copper Ridge Dolomite and Chepultepec Dolomite	1962, 1968-71, 1974-81
19	333525086163701	St. Clair, Ala.	Stc-1	Maury Formation, Fort Payne Chert, and Floyd Shale	1962-78*
20	332310086091001	Talladega, Ala.	R-3	Copper Ridge Dolomite and Chepultepec Dolomite	1962, 1968-71, 1974-75
21	332012086253601	Shelby, Ala.	G-12	Newala Limestone	1968-71, 1974-81

Springs

Site Number (fig. 4.2-1)	Ground Water Site identification number	Surface Water Site identification number	County & State	Local number	Name of Spring	Aquifer	Period of record
22	344159085184901		Walker, Ga.		Buzzard Roost Spring	Knox Group	1949,1954,1956,1960
23	343854085214701		Walker, Ga.		Dickson Spring	Mississippian, Undifferentiated	1956, 1961, 1971-72
24	343330085191201		Chattooga, Ga.		Trion Spring	Knox Group	1954, 1961, 1967
25	343211085244201		Chattooga, Ga.		Knox Spring	Conasauga Formation	1950, 1961
26	343154085270501		Chattooga, Ga.		Blowing Spring	Mississippian, Undifferentiated	1950, 1961
27	343100085392301	02400550	DeKalb, Ala.	N-3	Allen Spring near Valley Head	Fort Payne Dolomite	1968-71, 1973-81
28	342825085243201		Chattooga, Ga.		Montgomery Spring	Knox Group	1950, 1954, 1961
29	342719085251101		Chattooga, Ga.		Perennial or Hurley Spring	Knox Group	1950, 1954, 1961
30	342348084285401		Chattooga, Ga.		Moses Spring	Knox Group	1950, 1954, 1961

Ground-Water Stations (Continued)

Springs

Site Number (fig. 4.2-1)	Ground Water Site identification number	Surface Water Site identification number	County & State	Local number	Name of Spring	Aquifer	Period of record
31	342537085302701	02398201	Cherokee, Ala.	D-4	Berry Spring near Jamestown	Ordovician	1968-70, 1973-81
32	341748085394901	02399205	Cherokee, Ala.	G-9	Congo Spring	Maury Formation	1955, 1962, 1968-71, 1973-81
33	340617085200701		Floyd, Ga.		Cave Spring	Knox Group	1950, 1962, 1964
34	340052085152901		Polk, Ga.		Cedartown Spring	Newala Limestone	1950, 1954, 1964
35	335357085502901	02401650	Calhoun, Ala.	G-57	Unnamed spring near Webster Chapel	Chepultepec Dolomite and Copper Ridge Dolomite	1975-78
36	335108085514401	02401775	Calhoun, Ala.	F-68	Seven Spring	Newala Limestone	1956-60, 1968-70, 1973-81
37	335219085535301	02401695	Calhoun, Ala.	F-42	Read's Spring	Newala Limestone	1956-60
38	355345086184101	02401387	St. Clair, Ala.	E-5	Muckleroy Spring near Whitney	Bangor Limestone	1948-49, 1960, 1970-81
39	335050085452501	02401730	Calhoun, Ala.	L-1	Germania Spring	Conasauga Formation	1957-60, 1965, 1974-75 1977-81
40	334849085454501	02401745	Calhoun, Ala.	L-21	Big Spring at Jacksonville	Conasauga Formation	1956-60, 1965
41	334634085560101	02401850	Calhoun, Ala.	M-91	McCullars Spring	Ordovician	1957-58, 1968-70, 1973-81
42	333610085553301	02403500	Calhoun, Ala.	W-12	Coldwater Spring near Anniston	Weisner Formation	1928, 1944-48, 1952, 1954, 1956-74 1975-81*
43	333100086010201	02404240	Talladega, Ala.	G-14	Cedar Spring	Chepultepec Dolomite	1962, 1975-81
44	332313086093001	02406300	Talladega, Ala.	R-2	Grogan Spring	Chepultepec Dolomite	1963, 1974-81

* Continuous record of water levels or discharge

Terms Used in Report Defined

Technical terms that occur in this Hydrologic Report are defined.

Bed material is the unconsolidated material of which a streambed, lake, pond, reservoir, or estuary bottom is composed.

Bottom material specifically includes anthropogenic matter in addition to natural solid material in bed material.

Cubic feet per second per square mile [$(ft^3/s)mi^2$] is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Cubic foot per second (ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute or 0.02832 cubic meters per second.

Discharge is the volume of water (or more broadly, volume of fluid plus suspended material), that passes a given point within a given period of time.

Mean discharge is the arithmetic mean of individual daily mean discharges during a specific period.

Instantaneous discharge is the discharge at a particular instant of time.

Dissolved refers to the amount of substance present in true chemical solution. In practice, however, the term includes all forms of substance that will pass through a 0.45-micrometer membrane filter, and thus may include some very small (colloidal) suspended particles. Analyses are performed on filtered samples.

Drainage area of a stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontribution areas, within the area unless otherwise noted.

Drainage basin is a part of the surface of the Earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Gage height (G.H.) is the water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage", although gage height is more appropriate when used with a reading on a gage.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Micrograms per gram ($\mu g/g$) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element per unit mass (gram) of sediment.

Micrograms per liter ($\mu g/L$) is a unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Milligrams per liter (mg/L) is a unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represent the mass of solute per unit volume (liter) of water. Concentration of suspended sediment also is expressed in mg/L, and is based on the mass (dry weight) of sediment per liter of water-sediment mixture.

Partial-record station is a particular site where limited streamflow and/or water-quality data are collected systematically over a period of years for use in hydrologic analyses.

Sediment is solid material that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope, soil characteristics, land usage, and quantity and intensity of precipitation.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Suspended-sediment concentration is the velocity-weighted concentration of suspended sediment in the sampled zone (from the water surface to a point approximately 0.3 ft above the bed) expressed as milligrams of dry sediment per liter of water-sediment mixture (mg/L).

Specific conductance is a measure of the ability of water to conduct an electrical current. It is expressed in micromhos per centimeter (μmhos/cm) at 25°C. Specific conductance is related to the type and con centration of ions in solution and can be used for approximating the dissolved-solids concentration of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream, and it may vary in the same source with changes in the composition of the water.

Stage-discharge is the relation between gage height (stage) and volume of water per unit of time, flowing in a channel.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

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