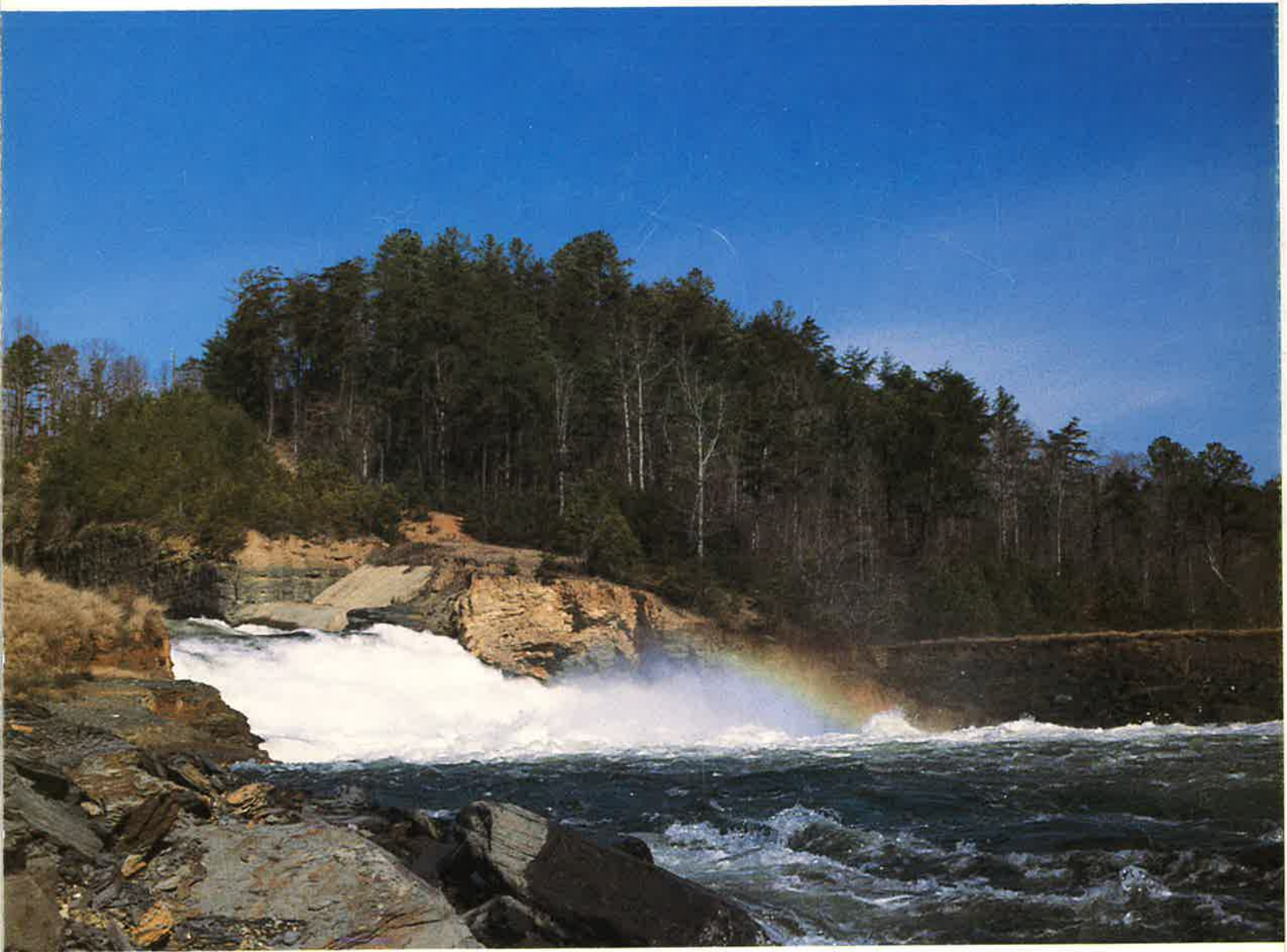


# *WATER IN ALABAMA, 1982 WATER YEAR*



*Geological Survey of Alabama  
Circular 122A*

Cover photograph by Robert M. Baker: South side of spillway below  
Lake Tuscaloosa Dam on North River, Tuscaloosa County, Alabama.

**GEOLOGICAL SURVEY OF ALABAMA**

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**WATER RESOURCES DIVISION**

James D. Moore  
Chief

**CIRCULAR 122A**

**WATER IN ALABAMA,  
1982 WATER YEAR**

By

Karen E. Richter

Tuscaloosa, Alabama  
1984



## GEOLOGICAL SURVEY OF ALABAMA

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**ERNEST A. MANCINI**  
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November 1, 1984

Honorable George C. Wallace  
Governor of Alabama  
State Capitol  
Montgomery, Alabama 36130

Dear Governor Wallace:

I have the honor to transmit herewith a report entitled "Water in Alabama, 1982 Water Year" by Karen E. Richter, which has been prepared and published by the Geological Survey of Alabama as Circular 122A.

Water is one of Alabama's most valuable natural resources. In order to plan for the most efficient use of this resource, basic data must be collected and presented in readily usable form. This report, along with its companion basic data volumes, is intended for use in answering requests for assistance with water-related problems and to provide an overview of water conditions in the State.

Respectfully yours,

*Ernest A. Mancini*

Ernest A. Mancini  
State Geologist



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# WATER IN ALABAMA, 1982 WATER YEAR

By

Karen E. Richter

## INTRODUCTION

One of Alabama's most important natural resources is its abundant water. Because of this abundance of water, there has been little emphasis on conserving a resource that in other areas of the United States is becoming increasingly scarce.

However, use of water throughout Alabama increases year by year, due to increasing population and industrial growth. Per capita water use increased 170 percent between the years 1955 and 1980. Approximately 10,400 million gallons of fresh water were withdrawn every day during 1980—about 2,700 gallons per day (gpd) for every person in the State.

The Water Resources Division of the Geological Survey of Alabama is responsible for a number of programs to monitor the quality and quantity of surface and ground waters in the State, and to collect basic data necessary to develop new water supplies, expand current systems, and minimize water contamination. The basic data collection program is implemented through a statewide network of stream-gaging stations, observation wells, water-quality sampling stations, field observation, and sample collection. Data on streamflow, ground-water levels, and water quality collected through this program form the basis for many water-related research activities.

Water-resources data and water-use information are used by Geological Survey staff members in answering information requests, by personnel from other government agencies, and by the public.

This report and its companion basic data volumes are published annually and are intended for use as a comprehensive reference to water data collected by the Geological Survey of Alabama and cooperative agencies.

## HYDROLOGIC CONDITIONS

### THE HYDROLOGIC CYCLE

The hydrologic cycle, illustrated in figure 1, is basically an accounting system for the availability and movement of water. Its elements—evaporation, precipitation, transpiration, infiltration, runoff, and streamflow—are the mechanisms by which water is moved in its various forms through the environment. Although water may be temporarily stored in several ways during each phase of water movement, it is never lost to the system.

Water is evaporated from the ocean and the earth's surface and moves as vapor; it then condenses and falls as rain or snow. Part of this precipitation may run off over land into streams, where it flows into bodies of water that lose water to the atmosphere by evaporation; part percolates or infiltrates the soil where it may be intercepted by plant roots or recharge aquifers. Water utilized by plants is eventually evaporated into the atmosphere. Water that infiltrates the zone of saturation as ground water eventually reenters the cycle, either by discharging into surface bodies of water or springs, by withdrawal from wells, or by moving downdip and discharging into the ocean.

Using rates of precipitation and climate and terrain factors, the approximate amount of water entering a system, evaporating, being transpired from plants, entering streams and bodies of water, and infiltrating underground aquifers can be calculated, to yield a **water budget**. Depending upon

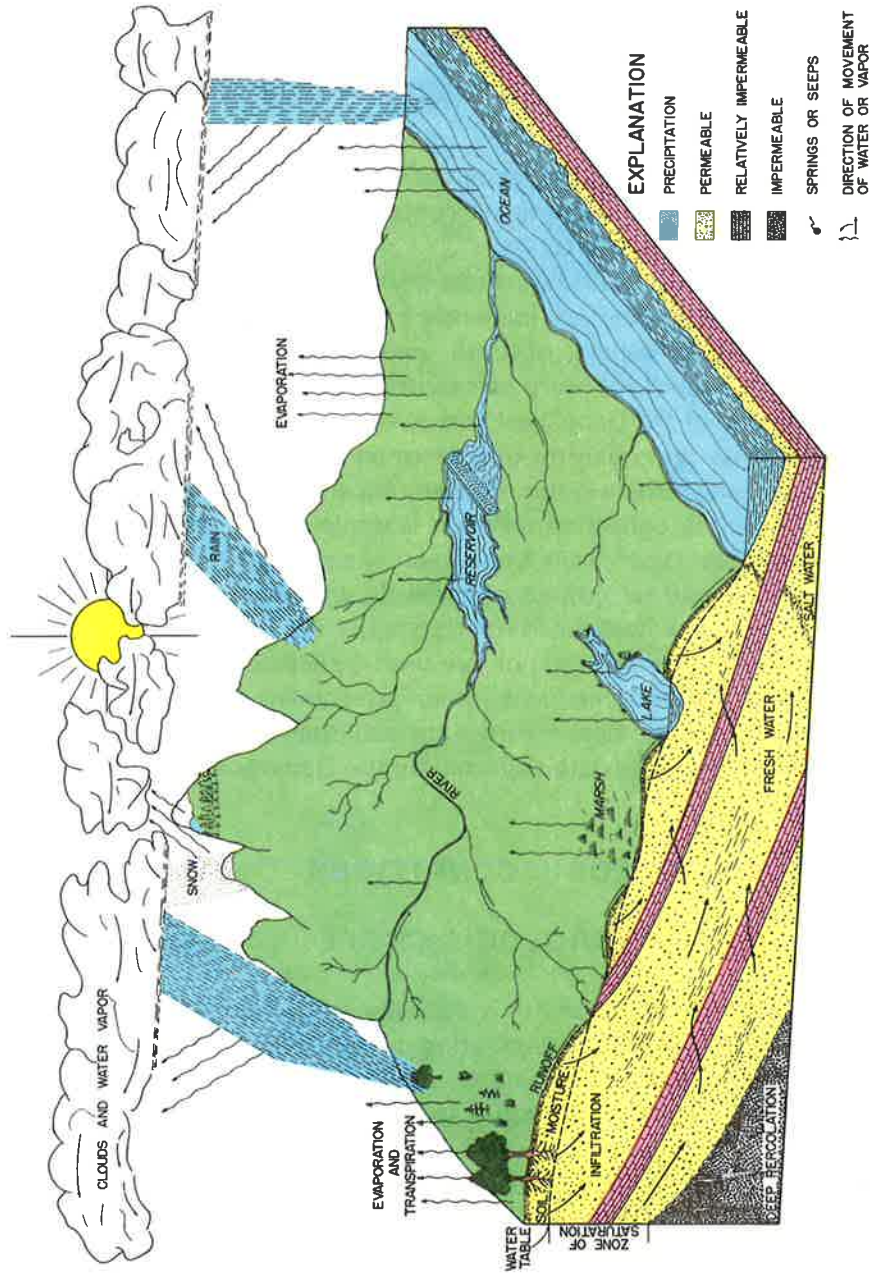


Figure 1.-- The hydrologic cycle (adapted from Jones and others, 1963, p. 5).

the degree of accuracy of the measurements used and the complexity of the calculations, water budgets may be as general as that shown in figure 2 for an entire state during a year, or specific enough to indicate the approximate runoff from a single stream basin. Water budgets may be used to indicate changes caused by any number of factors, such as change in precipitation; excessive water withdrawal; deforestation; or mining, agricultural or dredging operations.

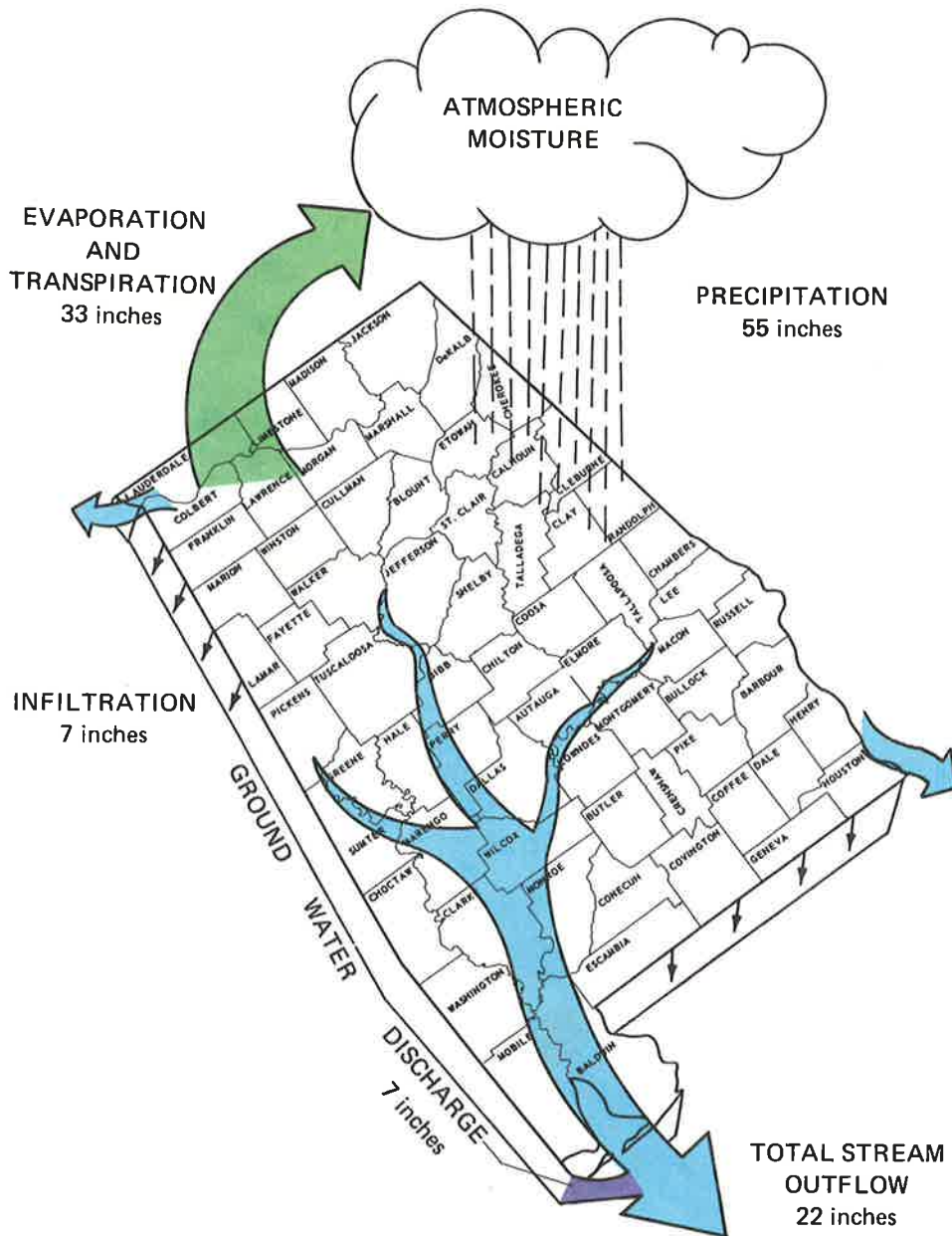


Figure 2.--Generalized water budget for Alabama.

The rate of movement of water within the hydrologic cycle and water availability is affected by several factors: climate, which controls the amount of water originally available as precipitation and the amount of water removed through evaporation and transpiration; physiography or terrain, which affects rates of precipitation and runoff; and geology, which determines the terrain, infiltration capability of soils, the occurrence and configuration of stream courses and lakes, and the storage and movement of ground water. All of these factors are interrelated. For example, the elevation and configuration of mountains may determine the type of precipitation, whether snow or rain, and where it falls; the type of rocks underlying the mountains will determine the amount of water that may enter the ground; and the climate controls precipitation amounts and affects the rate of erosion of the mountains and the development of soils that collect precipitation and deliver it to underlying aquifers.

## CLIMATE

### TEMPERATURE

Alabama's climate is characterized as humid subtropical, with mild winters, hot summers, and precipitation during all months of the year. Average annual temperatures range from 60°F in north Alabama to 68°F in southwest Alabama near Mobile Bay; average January temperatures range from 44°F in the northern part of the State to 54°F on the Gulf Coast, and average July temperatures range from 81°F in north and coastal Alabama to 82°F in central Alabama (figs. 3 and 4). No climatic data stations in the State have any average monthly temperatures below freezing (Lineback, Peirce, and Turnage, 1974).

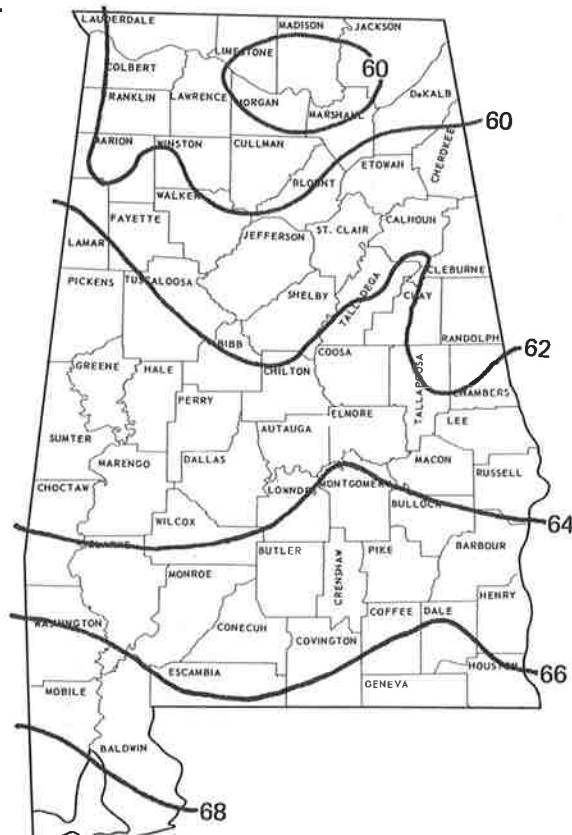


Figure 3.--Average annual temperatures (°F) (from Lineback, Peirce, and Turnage, 1974).

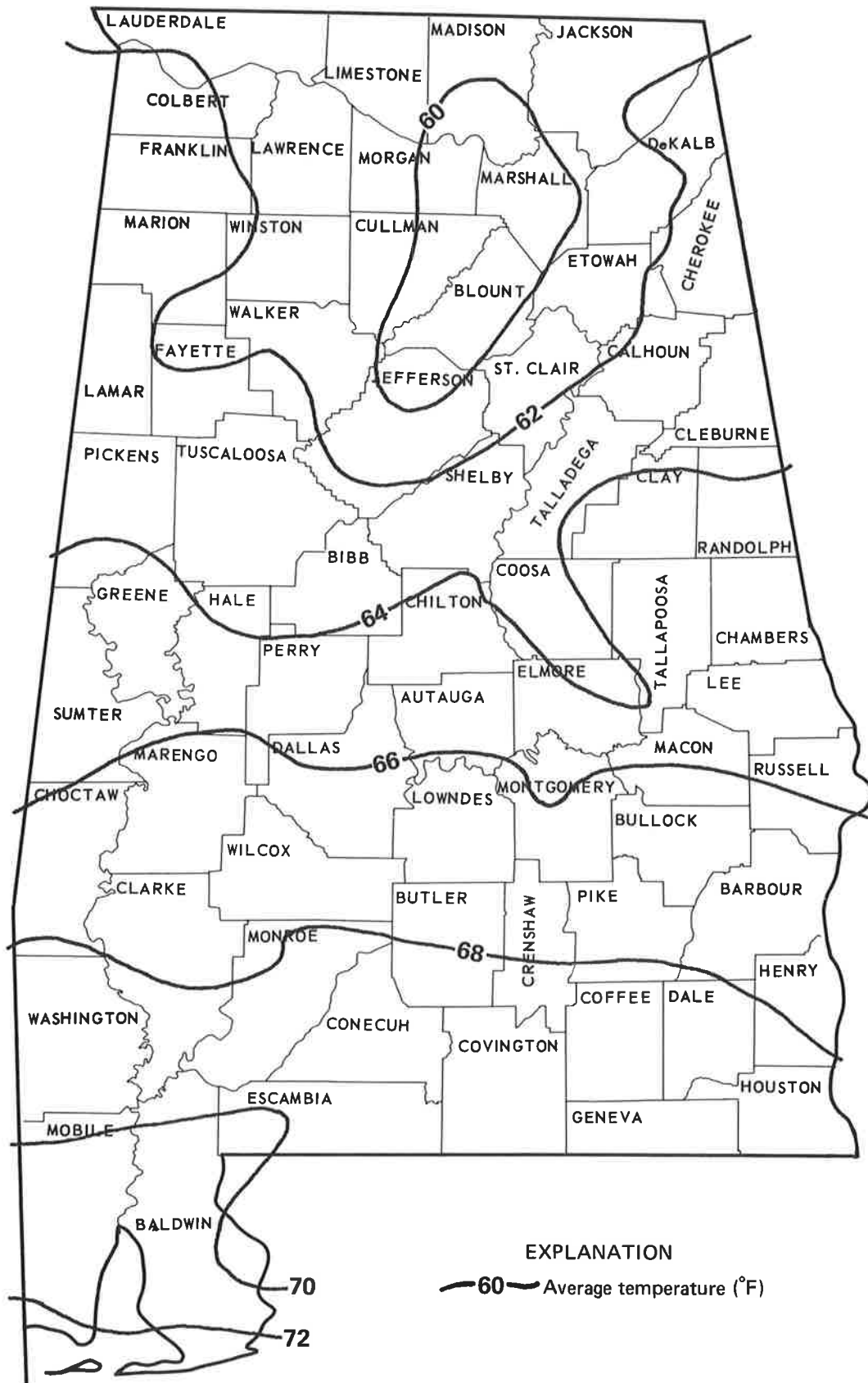


Figure 4.--Average temperatures (°F), 1982.

## PRECIPITATION

Rainfall in Alabama, as in most of the southeastern states, is abundant. The average annual precipitation ranges from a low of 48 inches in west-central and east-central Alabama to a high of 68 inches on the coast (fig. 5).

In dry years, the southeastern part of the State may receive less than 30 inches of rain; in wet years rainfall in coastal Alabama may be more than 90 inches. In 1982, annual rainfall was slightly more than average in all parts of the State (fig. 6).

Very little snow falls in Alabama in normal years. Average annual snowfall ranges from 5 inches in the Tennessee Valley region to less than 1 inch in the southernmost part of the State. Although record snowfalls, such as that of February 10, 1973, may drop as much as 16 inches of snow even in south Alabama, in many years the southern half of the State has no snowfall at all.

Although Alabama has abundant rainfall, it does not all contribute to streams and lakes as runoff. Much of it either evaporates, is transpired by plants, or enters the ground-water system. By comparing figure 5 and figure 7, it is possible to see the great difference in the average amount of precipitation and the amount that can be accounted for as runoff.

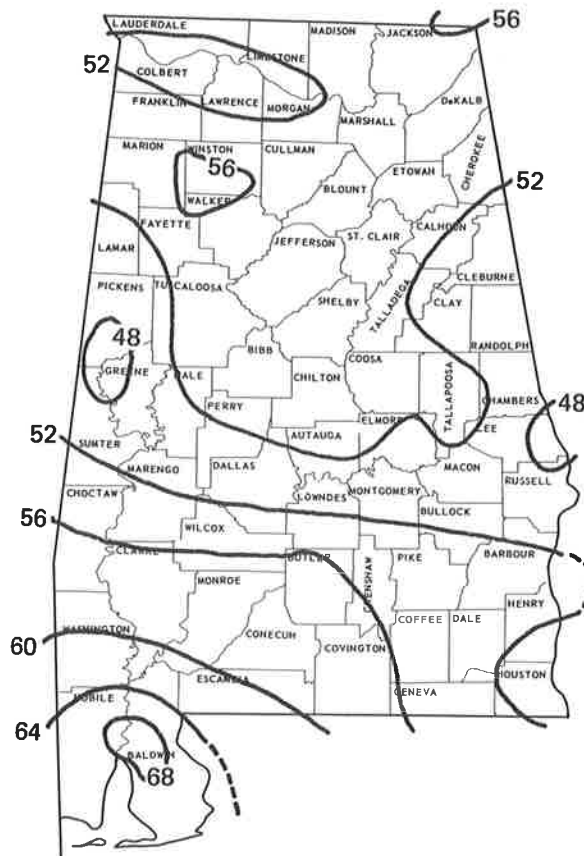


Figure 5.--Average annual precipitation, in inches, 1931-80 (from Lineback, Peirce, and Turnage, 1974).

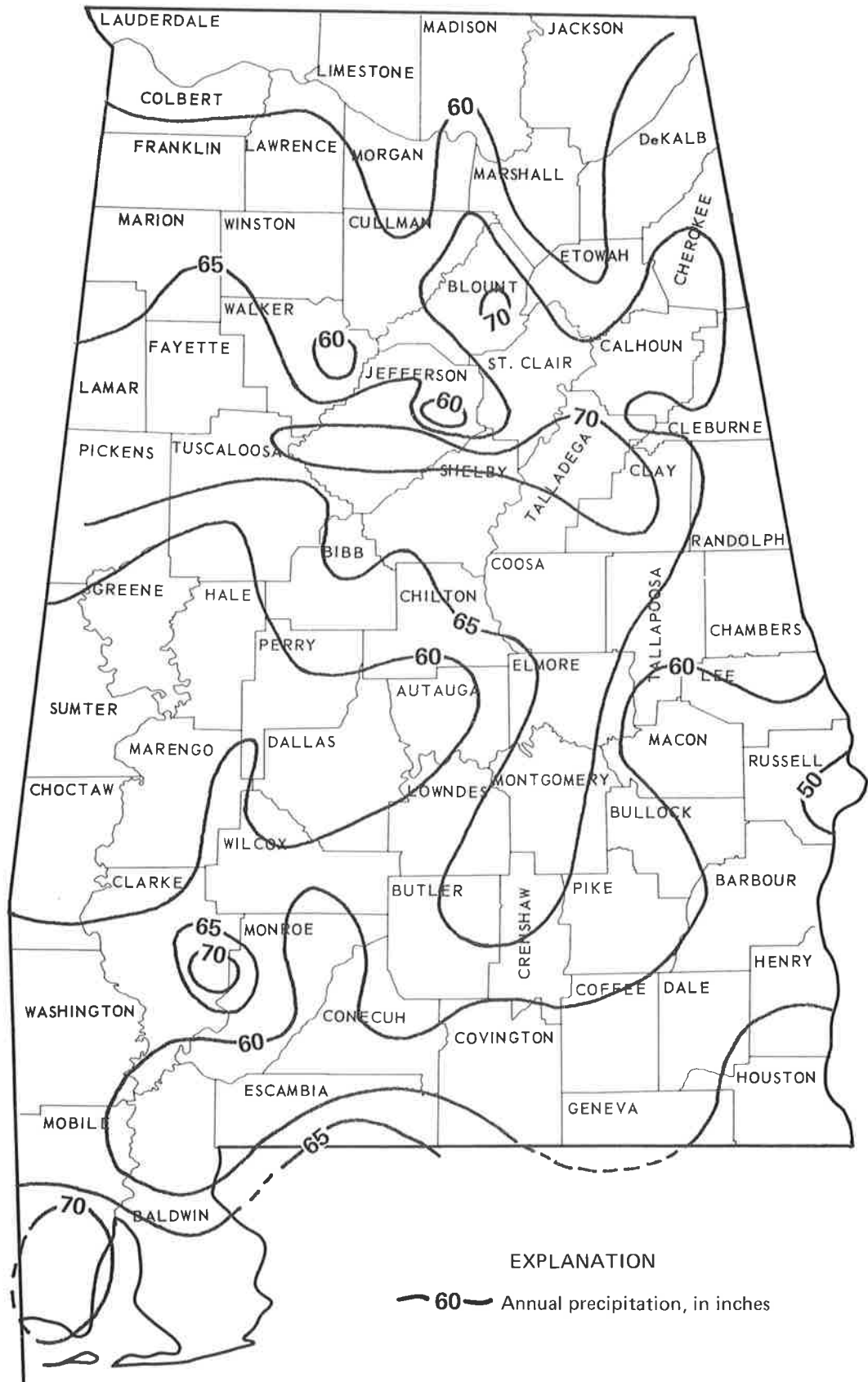


Figure 6.--Annual precipitation, in inches, 1982.

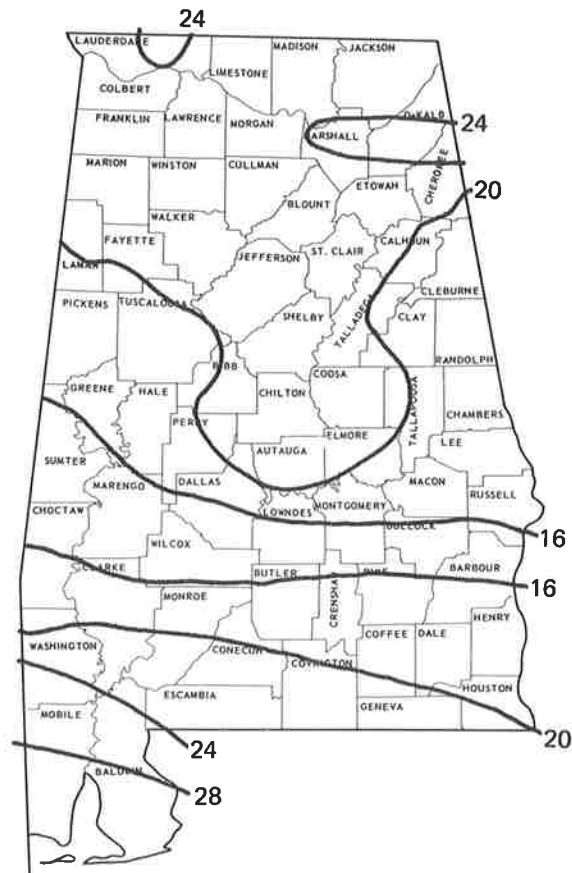


Figure 7.--Average annual runoff, in inches (from Lineback, Peirce, and Turnage, 1974).

## PHYSIOGRAPHY

Physiography plays an important part in the availability of surface and ground water. In mountainous or hilly terrain, streams are usually small and flow swiftly, with very few natural impoundments, and drain small, steep-sided valleys. Streamflow is likely to be highly variable, and many streams are intermittent. Even though precipitation may be locally abundant, the percentage of runoff is high, allowing less time for rainfall to percolate into underlying aquifers. This type of terrain is present in northeast and north-central Alabama, in the Valley and Ridge physiographic province; in north Alabama in parts of the Cumberland Plateau province; and in east Alabama in the northern part of the Piedmont province (fig. 8).

In the flat or gently inclined upland areas of the Highland Rim and northern part of the Cumberland Plateau province, large streams such as the Tennessee River and its tributaries are developed. Not only do these uplands receive discharge from more mountainous terrain outside the State, they also provide large areas of almost uniform elevation to collect precipitation; the percentage of runoff is usually low, and recharge to streams and aquifers is high.

Rolling terrain, such as that developed in parts of the Piedmont province and the Fall Line Hills section of the East Gulf Coastal Plain province, is more favorable than mountainous terrain both for development of perennial streams and for recharge of aquifers, because the runoff is considerably slower.

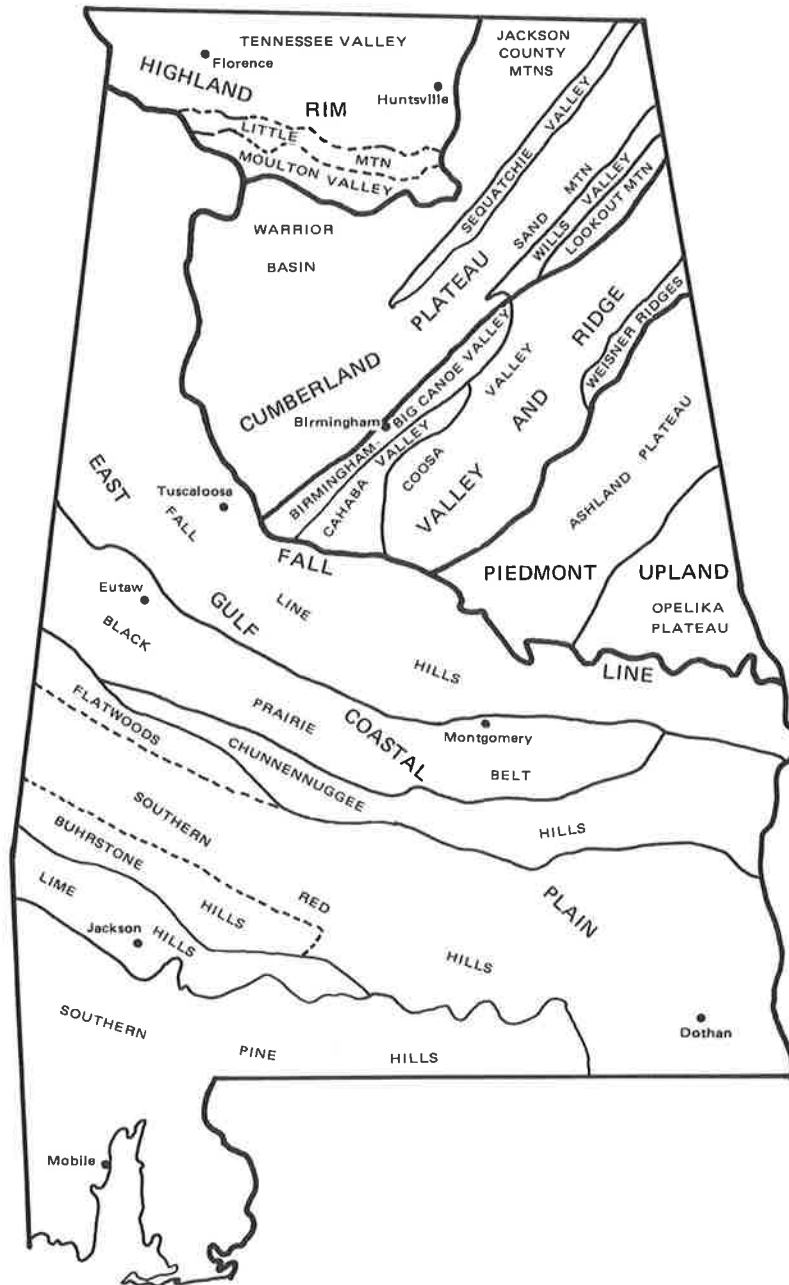


Figure 8.--Physiographic provinces of Alabama.

In most of the remaining sections of the East Gulf Coastal Plain, the terrain is flat or gently rolling, and amount of runoff is low except in extreme conditions of heavy rainfall. This allows a large amount of water to percolate into the underlying, predominantly unconsolidated aquifers, and streamflow is largely dependent on upstream discharge rather than runoff from contiguous land.

## GEOLOGY

Geology affects surface and ground water in several ways. The geologic structure and type of rocks underlying an area determine the terrain; the composition of the rocks determines the type

and thickness of water-retaining soils developed from them and affects the quality of water in contact with them; and various other rock properties such as density, induration, chemical composition, and plasticity control the ability of a rock to function as an aquifer or aquiclude.

For example, in the Alabama Piedmont, many areas have thick soils, gently rolling terrain, and abundant rainfall, all of which are conducive to fairly high ground-water recharge rates. However, the metamorphic rocks underlying the Piedmont are dense and nonporous. They do not provide suitable reservoirs except in fracture systems, and cannot store all the available recharge. Well yields are therefore usually low, and high-yielding wells are difficult to develop.

Alabama contains a variety of geologic settings. In east Alabama, the Piedmont is underlain by highly deformed metamorphic rocks and igneous intrusions of Precambrian to Paleozoic age, in a complex structural pattern characterized by low-angle thrust faults with displacements of many miles (fig. 9). The folded and faulted sedimentary rocks of Cambrian to Pennsylvanian age of the Appalachian Valley and Ridge form an outcrop belt extending from the northeast corner of the State southwestward to Bibb and Chilton Counties, where it disappears beneath Coastal Plain sediments. In the northwest, the Highland Rim and Cumberland Plateau are underlain by predominantly carbonate rocks of Ordovician to Mississippian age that dip gently southward to disappear beneath the relatively flat-lying Mississippian and Pennsylvanian sandstones and shales of the Warrior Basin in west-central Alabama. Coastal Plain deposits consisting of unconsolidated or poorly indurated sands, clays, and limestones of Cretaceous through Holocene age occur south of a line that extends in a southeast-curving arc from the northwest corner of the State to Lee County on the eastern border. These deposits thicken to the south and southwest.

## GROUND WATER

Ground water provides a reliable source of water for a large number of users in Alabama. Several large cities and many smaller towns use ground water for municipal supply, especially in south Alabama where ground water is readily available and of good quality. There are uncounted wells supplying rural domestic users and semi-public facilities such as campgrounds and marinas.

### GEOLOGIC TERRANES AND GROUND-WATER AVAILABILITY

Each of the geologic terranes in the State provides different conditions for water availability, as shown in figure 10.

In the Piedmont, few rock units have large amounts of interstitial or intergranular porosity, with the exception of a few rare quartzite or arkose units. Most ground water is stored in fractures and fault zones in relatively impermeable and nonporous rocks. Because the storage volume of fracture systems is usually low, well yields are commonly less than 50 gallons per minute (gpm), and most wells yield from 10 to 20 gpm. Rare individual wells completed in highly fractured and friable quartzites or in very large fracture zones may yield as much as 100 gpm. Figure 11 shows approximate yields of wells completed in the igneous and metamorphic formations of the Piedmont.

The Paleozoic aquifers of the Appalachian Valley and Ridge, Cumberland Plateau, and Highland Rim may be porous sandstones, such as the Hartselle Sandstone; fractured sandstone such as the Pottsville Formation; or cavernous carbonates such as the Bangor Limestone, Tusculumbia Limestone, or Chepultepec Dolomite (fig. 12). Well yields vary widely, especially in cavernous carbonates, where wells only a few hundred feet apart may differ by as much as 100 gpm in yield. High-volume springs also commonly discharge from carbonate aquifers.

Structurally deformed rocks may yield large quantities of water to wells; for example, wells completed in the Fort Payne Chert, which is usually fractured in areas of structural deformation,

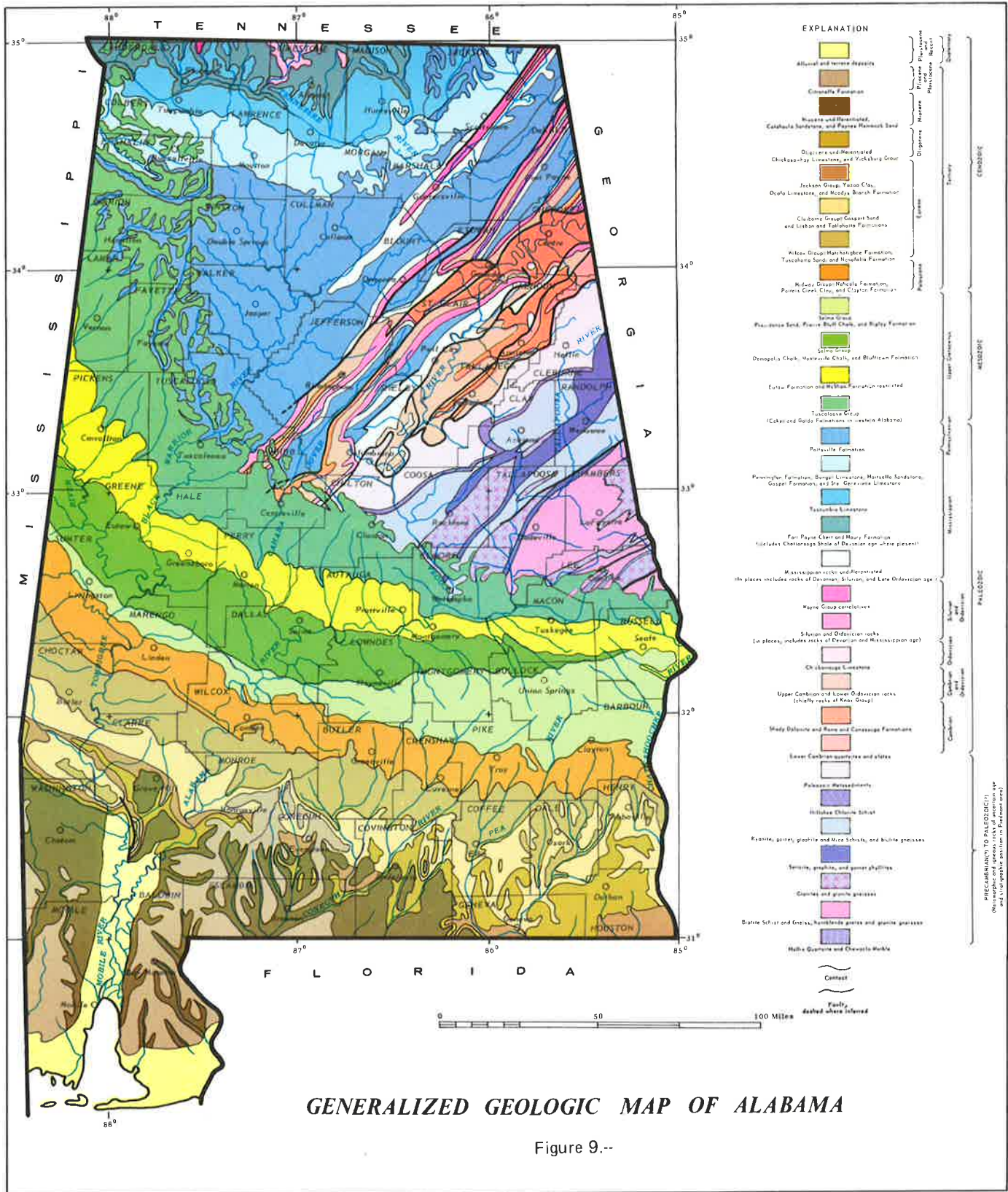


Figure 9.--

Modified from U.S. Geological Survey, 1932, Geologic map of the United States.



Figure 10.--Potential yields of aquifers in Alabama.

	GENERAL LOCATION	HIGH RANK METAMORPHIC ROCK	LOW RANK METAMORPHIC ROCK
METAMORPHIC AND IGNEOUS ROCKS	NORTHERN PIEDMONT	<p style="text-align: center;">Wedowee Group                      Hatchett Creek Group <math>\cong</math> Mad Indian Group                      Poe Bridge Mtn. Group <math>\cong</math> Higgins Ferry Group                      Emuckfaw Formation                      Jackson Gap Group                      Amphibolite and Ultramafic Rock                      Granite and Granite Gneiss                      Cataclastic Rock</p>	<p style="text-align: center;">Unity Group                      Talladega Group                      Sylacauga Marble Group                      Kahatchee Mountain Group</p>
	INNER PIEDMONT	<p style="text-align: center;">Dadeville Group                      Agricola Schist                      Granites and Granite Gneiss                      Amphibolite, Mafic, and                      Ultramafic Rock</p> <p style="text-align: center;">Opelika Group</p> <p style="text-align: center;">Dabase Dike</p>	
	SOUTHERN PIEDMONT	<p style="text-align: center;">Pine Mountain Group                      Hollis Quartzite*                      Chewacla Marble*                      Manchester Schist</p> <p style="text-align: center;">Halawaka Schist                      Whatley Mill Gneiss                      Granite and Granite Gneiss                      Uchee Group                      Motts Gneiss                      Phenix City Gneiss                      Moffitts Mill Schist                      Cataclastic Rock                      Diabase Dike</p>	

Commonly yields 10 to 50 gpm per well.

Commonly yields less than 10 gpm per well.

\* Individual wells may yield more than 100 gpm, especially in Lee County.

Note: Names of several rock units in the Alabama Piedmont have been proposed and are in common usage, but have not been formally accepted.

Figure 11.--General well yields in metamorphic and igneous rocks of the Alabama Piedmont.

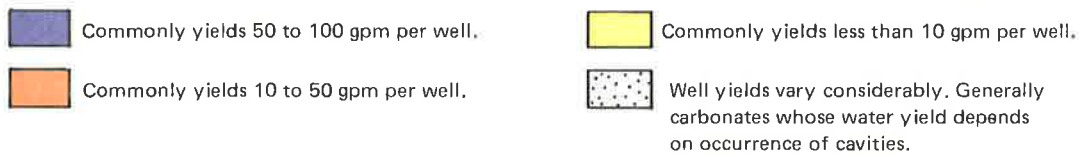
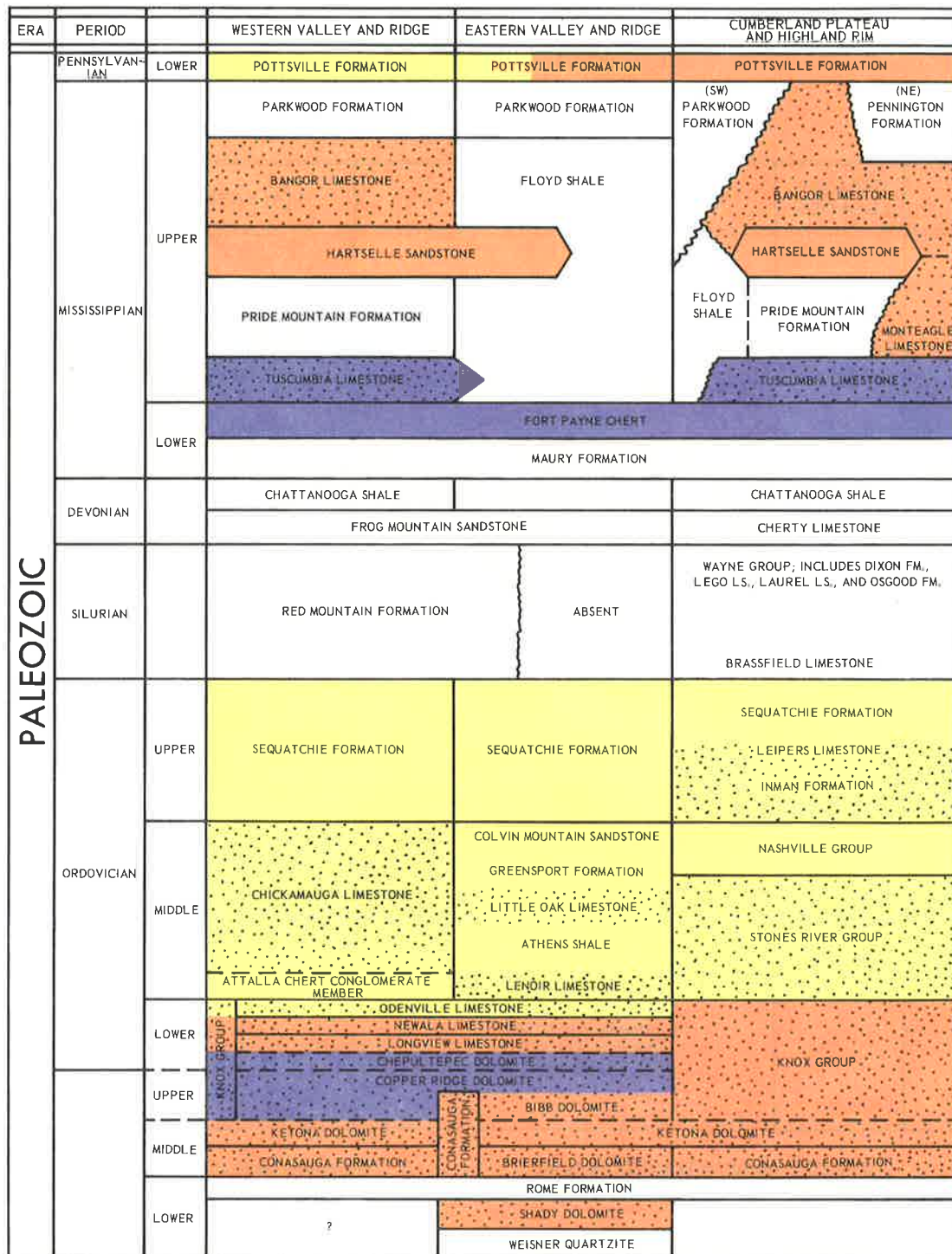


Figure 12.--General water-yielding capacities of Paleozoic aquifers.

commonly yield more than 50 gpm. Wells completed in rocks of the Pottsville Formation, which may have intergranular porosity and may also be fractured in part, commonly yield only about 10 gpm. The recharge area of individual aquifers in the folded and faulted Appalachian Valley and Ridge is usually small, owing to the narrow outcrop patterns produced by tilted strata; in the Cumberland Plateau and Highland Rim, the gently inclined carbonate rocks present broad outcrop and recharge areas. Figure 13 shows areas where the Pottsville Formation, Bangor Limestone, Fort Payne Chert, and Tusculumbia Limestone are usually at depths of less than 300 feet.

The Alabama Coastal Plain is underlain by thick wedges of unconsolidated sand, gravel, and clay and by poorly indurated beds of limestone and claystone. These deposits generally thicken and dip to the south and southwest in a radial pattern outward from the edge of the Coastal Plain overlap. They present broad, arcuate outcrop patterns, and recharge rates for the unconsolidated formations are high because of the permeability of the weathered surface materials and broad outcrop areas. Coastal Plain aquifers consistently provide the highest well yields in the State, as shown in figure 14. Several highly porous and permeable sand, gravel, and limestone beds of different formations may all be interconnected and form a single aquifer system. Clay or chalk beds are often present and may act as aquicludes or aquitards, separating aquifer systems. Areas where major coastal plain aquifers are tapped by wells are shown in figure 15. Coastal Plain aquifer systems tend to be areally extensive, often yielding large quantities of water to wells over an area of more than 200 square miles.

## OBSERVATION-WELL NETWORK

The Geological Survey of Alabama, in cooperation with the U.S. Geological Survey, maintains a network of monitoring wells to record ground-water levels throughout the State, so that significant data are available for the more important aquifers in the State (fig. 16). Data from each well measured has been published every year by the U.S. Geological Survey in its State Water Year Water Resources Data Report, and summary reports have been published by the Geological Survey of Alabama for Water Years 1981 and 1982 (Moore, 1981; Moore, 1982).

### OBSERVATION WELLS

Several types of observation wells are maintained. A few wells, usually those in the more important aquifers, are equipped with continuous recorders. These automatic gages collect data for the preparation of hydrographs, which graphically depict the rise and fall of the water level in the well for the period of years the gage has been in operation.

Other wells are measured only on a semiannual basis, in the fall and spring of each water year, since the high and low water levels are expected to occur during those seasons.

### OBSERVATION WELL NUMBERING SYSTEM

Wells are assigned a 15-digit number, with the first 13 digits corresponding to the latitude-longitude grid. For example, well number 314213083193801 would be located at 31°42'13" latitude, and 83°19'38" longitude, and would be the first well (01) positioned at that grid coordinate. Observation wells equipped with continuous recorders also are assigned numbers consisting of county name abbreviations followed by serial numbers; for example, Mtg-5 designates observation well number 5 in Montgomery County.



POTTSVILLE



BANGOR



TUSCUMBIA



FORT PAYNE

Figure 13.--Areas where Paleozoic aquifers are generally tapped by wells.

ERA	PERIOD	EPOCH	GROUP	WESTERN COASTAL PLAIN	CENTRAL AND EASTERN COASTAL PLAIN		
CENOZOIC	QUATERNARY	HOLOCENE AND PLEISTOCENE		ALLUVIAL AND TERRACE DEPOSITS			
		PLIOCENE		CITRONELLE FORMATION			
	MIOCENE			UNDIFFERENTIATED UPPER MIOCENE			
				CATAHOULA SANDSTONE	MIOCENE UNDIFFERENTIATED		
				PAYNES HAMMOCK SAND			
	OLIGOCENE	VICKSBURG		CHICKASAWHAY LIMESTONE			
				BYRAM FORMATION	BUCATUNNA CLAY MEMBER		
					MARL FACIES		
					GLENDON LIMESTONE MEMBER		
				MARIANNA LIMESTONE			
			FOREST HILL SAND		RED BLUFF CLAY	"BUMPNOSE LIMESTONE"	
	TERTIARY	EOCENE	JACKSON	YAZOO CLAY	SHUBUTA MEMBER	OCALA LIMESTONE OR CRYSTAL RIVER FORMATION	
					PACHUTA MARL MEMBER		
					COCOA SAND MEMBER		
					NORTH TWIST WOOD		
					CREEK CLAY MEMBER		
					MOODYS BRANCH FORMATION		
			CLAIBORNE		GOSPORT SAND		
					LISBON FORMATION		
					CLAYSTONE	TALLAHATTA FORMATION	SAND
WILCOX				HATCHETIGBEE FORMATION			
		BASHI MARL MEMBER					
		BELLS LANDING MARL MEMBER	TUSCAHOMA SAND				
		GREGGS LANDING MARL MEMBER					
		GRAMPJAN HILLS MEMBER					
PALEOCENE	MIDWAY		"OSTREA THIRSAE BEDS"				
			GRAVEL CREEK SAND MEMBER				
			NANAFALIA FORMATION				
			SALT MOUNTAIN LIMESTONE (CLARKE COUNTY)				
		NAHEOLA FORMATION	COAL BLUFF MARL MEMBER	ABSENT			
			OAK HILL MEMBER				
		MATTHEWS LANDING MARL MEMBER	ABSENT				
		PORTERS CREEK FORMATION					
		McBRYDE LIMESTONE MEMBER					
		PINE BARREN MEMBER					
			CLAYTON FORMATION				
ERA	PERIOD	GROUP	WESTERN COASTAL PLAIN	EASTERN COASTAL PLAIN			
MESOZOIC	CRETACEOUS	SELMA	PRAIRIE BLUFF CHALK				
			PROVIDENCE SAND				
			RIPLEY FORMATION				
			BLUFFPORT MARL MBR. DEMOPOLIS CHALK	CUSSETA SAND MEMBER			
		ARCOLA LIMESTONE MOOREVILLE CHALK	BLUFFTOWN FORMATION				
		EUTAW FORMATION					
		TUSCALOOSA	GORDO FORMATION	TUSCALOOSA GROUP			
COKER FORMATION							

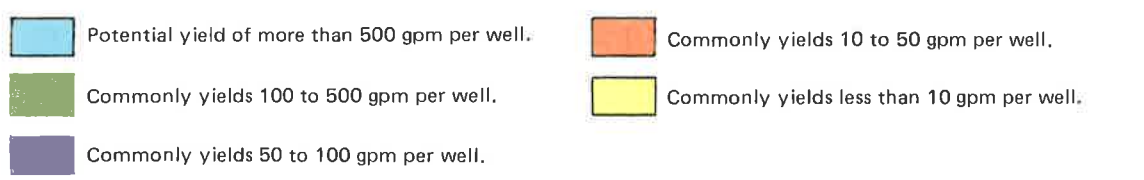


Figure 14.--General water-yielding capacities of Cenozoic and Mesozoic aquifers.

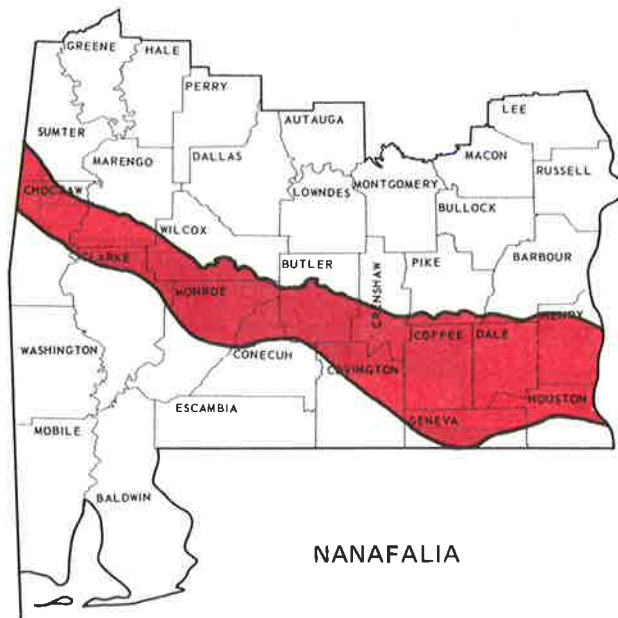
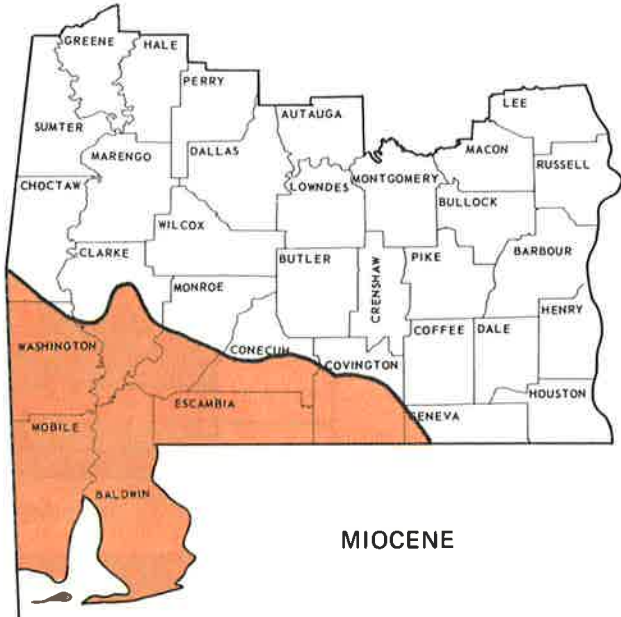
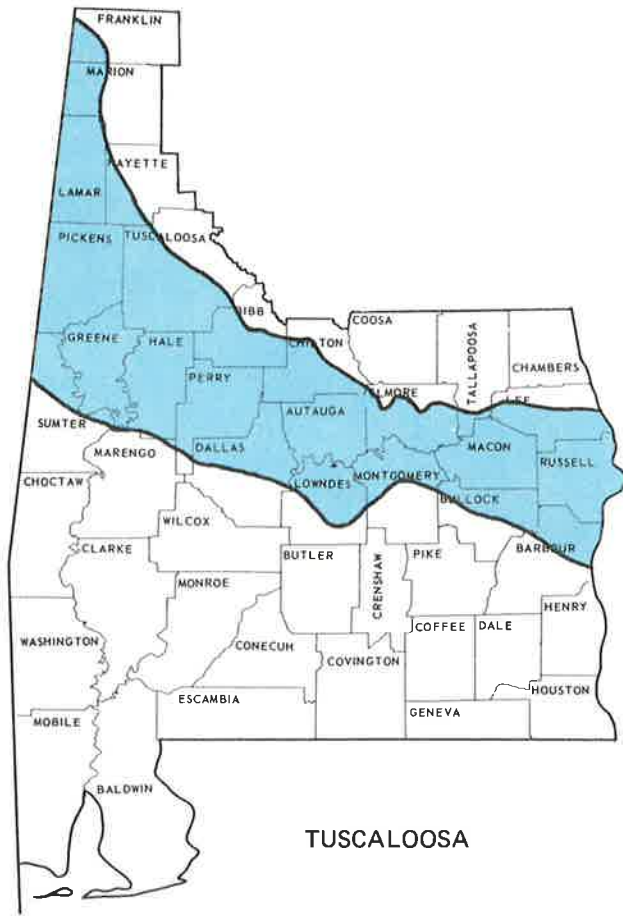
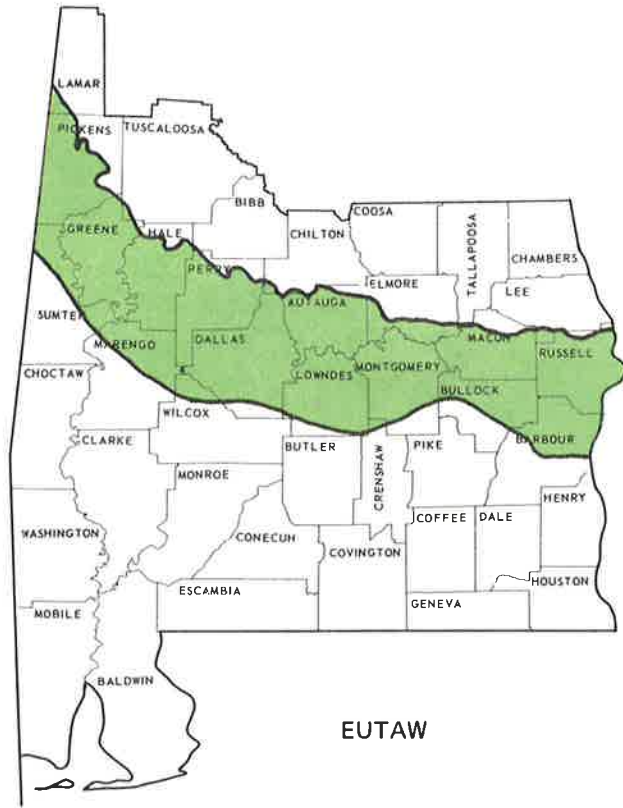


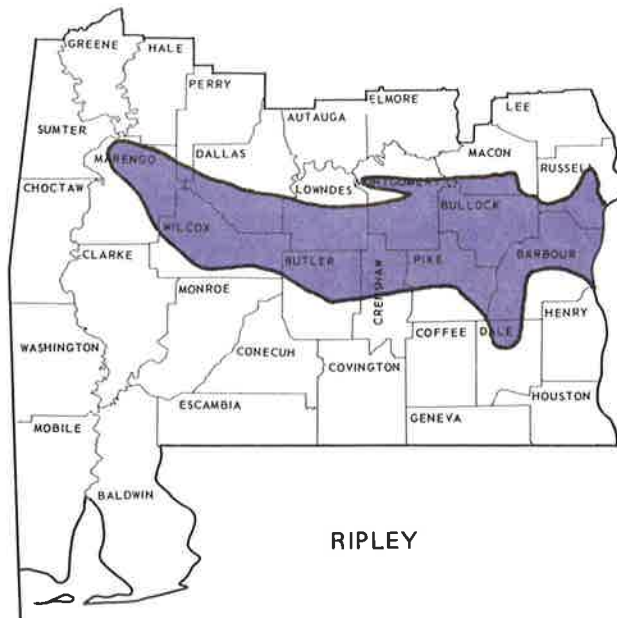
Figure 15.--Areas where major Coastal Plain aquifers in Alabama are generally tapped by wells.



TUSCALOOSA

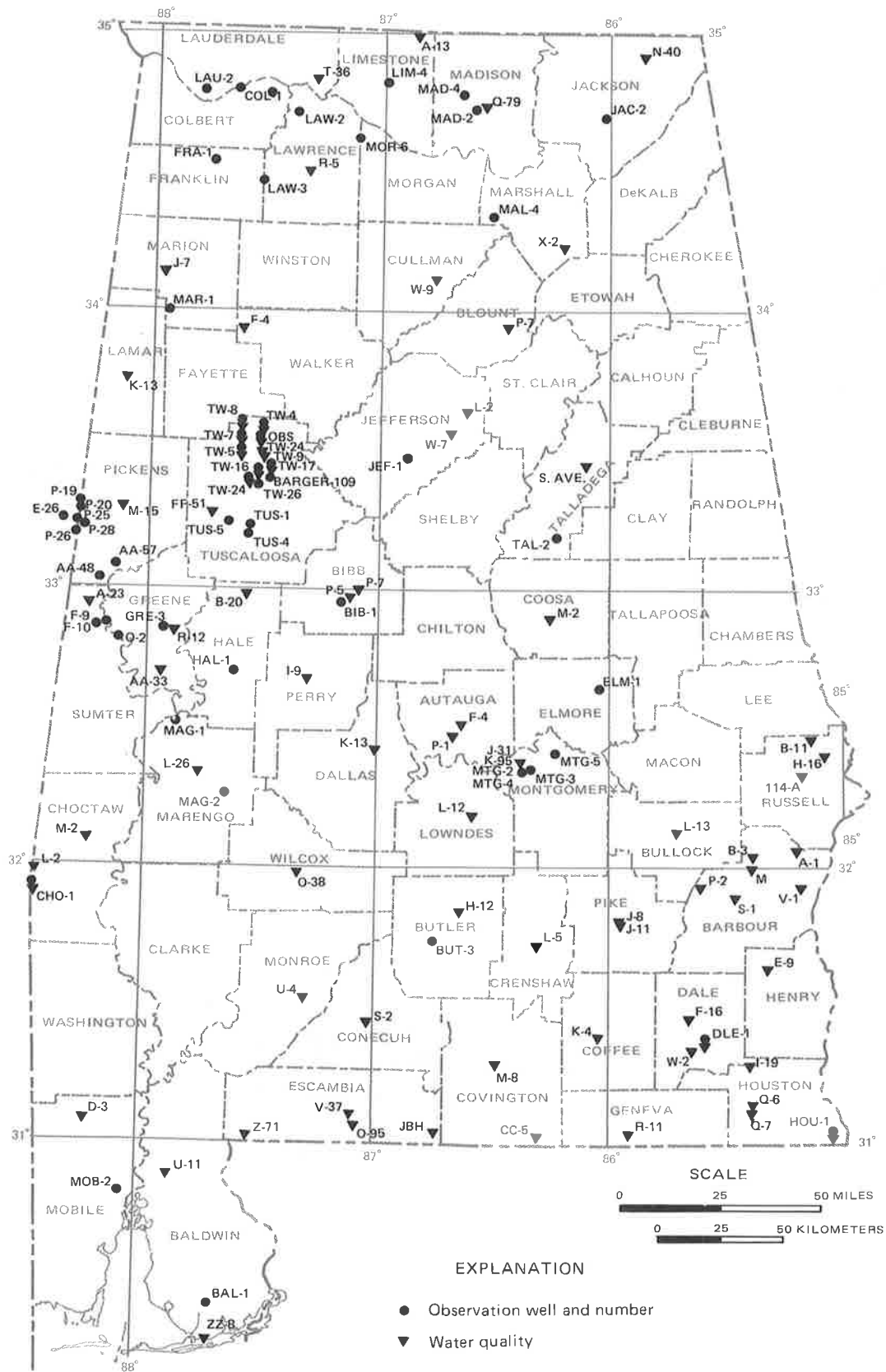


EUTAW



RIPLEY

Figure 15.--Areas where major Coastal Plain aquifers in Alabama are generally tapped by wells - Continued.



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

Figure 16.-Locations of observation wells, 1982 (from U.S. Geological Survey, 1984).

## METHODS OF MEASUREMENT

Water-level measurements are made either with electric tapes or steel tapes to as many significant figures as can be accurately read. Readings are usually most accurate for water levels close to ground level, as compared to readings of levels 200 or 300 feet below the measuring point of the well. The measuring point is any convenient point on the well head that can be read relative to a datum plane approximately at ground level at each well.

## GROUND-WATER AVAILABILITY TO WELLS

The availability of water to wells can be affected by a number of factors, including natural geologic and/or hydrologic conditions and drilling and development methods. Excessive pumping of nearby wells or drought may all lower the water level in an individual well. Improper construction or selection of the wrong completion method may also render a well unusable. Figure 17 shows some standard methods of well construction.

A permit to drill a water well is not required by the State of Alabama, but a Report of Drilled Well, Alabama Department of Environmental Management Form 60 1/83, must be filled out by the driller in quadruplicate and copies must be sent to the Public Water Supply section of the Alabama Department of Environmental Management and to the Geological Survey of Alabama where they are filed as part of the water information records of the State. A copy of this form is reproduced in the appendix.

## LEGAL ASPECTS OF GROUND WATER

Legal aspects of ground water are poorly defined in Alabama. The principal legal decisions concerning underground water in Alabama have arisen from mining controversies (Cohen, 1972).

The reasonable-use rule applies to ground water in Alabama. This rule recognizes the right of a landowner to a reasonable and beneficial use of the waters upon or underneath his land, provided the waters are not wasted or do not cause injury to others.

Cases involving misuse or overuse have become increasingly frequent in Alabama. For example, a case was presented in 1982 by several private landowners whose property surrounded land bought by a municipality to be used as a municipal supply well field. The landowners contended that the pumping of wells in the area at the rates needed to supply municipal needs would depress water levels in their nearby wells, thereby depriving them of the reasonable use of waters beneath their land.

Litigation involving dewatering of mines and quarries has also been initiated. Several suits have been filed to enjoin industrial or quarrying operations from pumping excess water from mines or pits because the pumpage lowered surrounding water levels and triggered ground collapse mechanisms.

Because these newer cases are evincing a concern with effects of the hydrologic cycle that was absent in earlier cases, more care must be taken by the large users to reduce effects of their pumpage on the water system. Therefore, users of large volumes of ground water should be prepared to compensate nearby landowners for damages.

## SURFACE WATER

Surface water is abundant and well distributed in Alabama and has been developed extensively for many uses. Streams and reservoirs provide water for domestic consumption, industrial uses,

CASED LARGE WELL WITH SCREEN AND RISER PIPE      CASED WELL WITH OPEN-HOLE COMPLETION      CASED WELL WITH SCREEN AND GRAVEL PACK      "SAND POINT" DRIVEN WELL

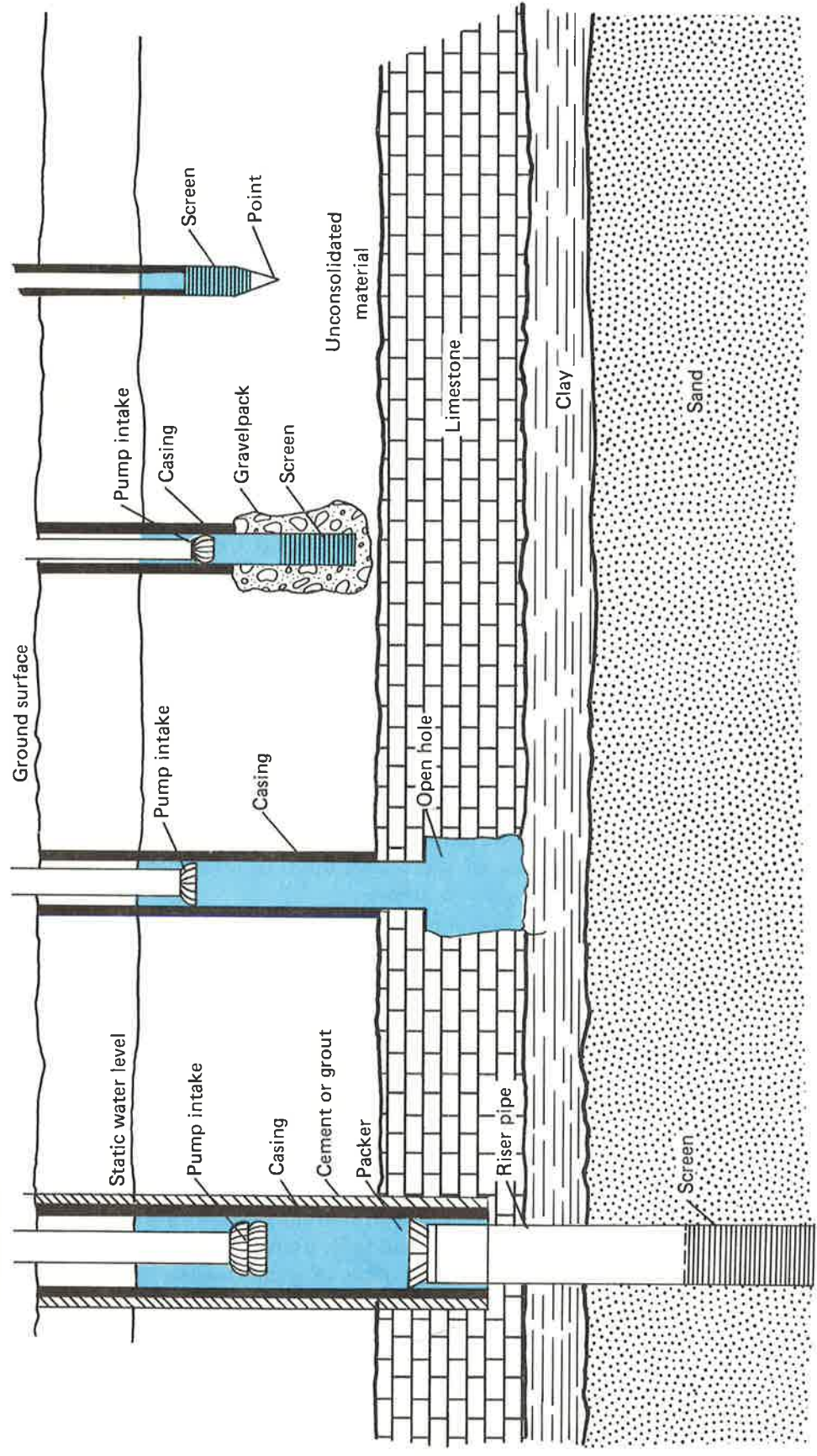


Figure 17.--Common types of well construction.

electric power generation, waste dilution, and recreation. In order to use and develop surface-water resources effectively and to plan for land use and construction in areas affected by watercourses, several types of surface-water data are required. Among the most important of these are streamflow duration data, average annual discharge, low-flow measurements, seasonal distribution of flow, and maximum stream stage. To make these and various other types of streamflow measurements, the Geological Survey of Alabama, in cooperation with the U.S. Geological Survey, maintains a network of stream-gaging stations on streams throughout Alabama (fig. 18). Stream-discharge measurements are also made for research projects at various sites by personnel from both agencies.

## HYDROLOGIC REGIONS

Surface-water data are collected and organized by hydrologic units, corresponding to river drainage basins and aggregates of basins. Hydrologic **regions** may contain several major river basins; **subregions** correspond to the drainage area of a major river; and **accounting units** correspond to the basins of major tributaries (fig. 19). Cataloging units (not shown) correspond to the drainage basins of smaller tributaries. Each unit is assigned a two-digit number. These numbers are combined in a sequence from larger to smaller basins, enabling an eight-digit number to delineate the position of a tributary basin within a major river basin and a multi-river basin. This numbering system is used by several agencies, including the U.S. Geological Survey, U.S. Department of Agriculture, Soil Conservation Service, and Alabama Department of Environmental Management.

Within accounting units, gaging stations are assigned arbitrary numbers in downstream order along the main stream. No distinction in numbering is made between partial-record stations, where limited streamflow data are collected periodically, and continuous gaging stations, where systematic observations of gage height and/or discharge are measured continuously.

Table 1 shows an example of summarized streamflow data for the main stream of the Black Warrior River. Values for the period of record are the highest and lowest values measured for the entire period the station has been in operation, including the current water year. Values for the current year are the highest and lowest measured only during that year. The U.S. Geological Survey maintains computer files of streamflow data and publishes daily values for gaging stations in its annual Water Data Reports for the State. This data is also summarized in annual water reports of the Geological Survey of Alabama.

Several types of information may be provided for each station. Gage height (stage) is a direct measurement, in feet, of the height of the water surface above a given datum plane, usually the National Geodetic Vertical Datum (NGVD). Other data, such as discharge, can be computed using this measurement.

## STREAMFLOW MEASUREMENTS

Stream-gaging stations may vary from complex installations containing continuous recorders, flow-through sampling chambers, climatological instruments, and small automatic laboratories, to simple gage-height scales marked on spillway walls or other structures (fig. 20). The most common stations are continuous recorders in houses mounted on galvanized pipes on stream banks or attached to bridges. These stations commonly measure stage and discharge of streams. Automated recorders may give either a continuous graph of stage measurements or a tape punched at timed intervals; non-recording gages are read directly.

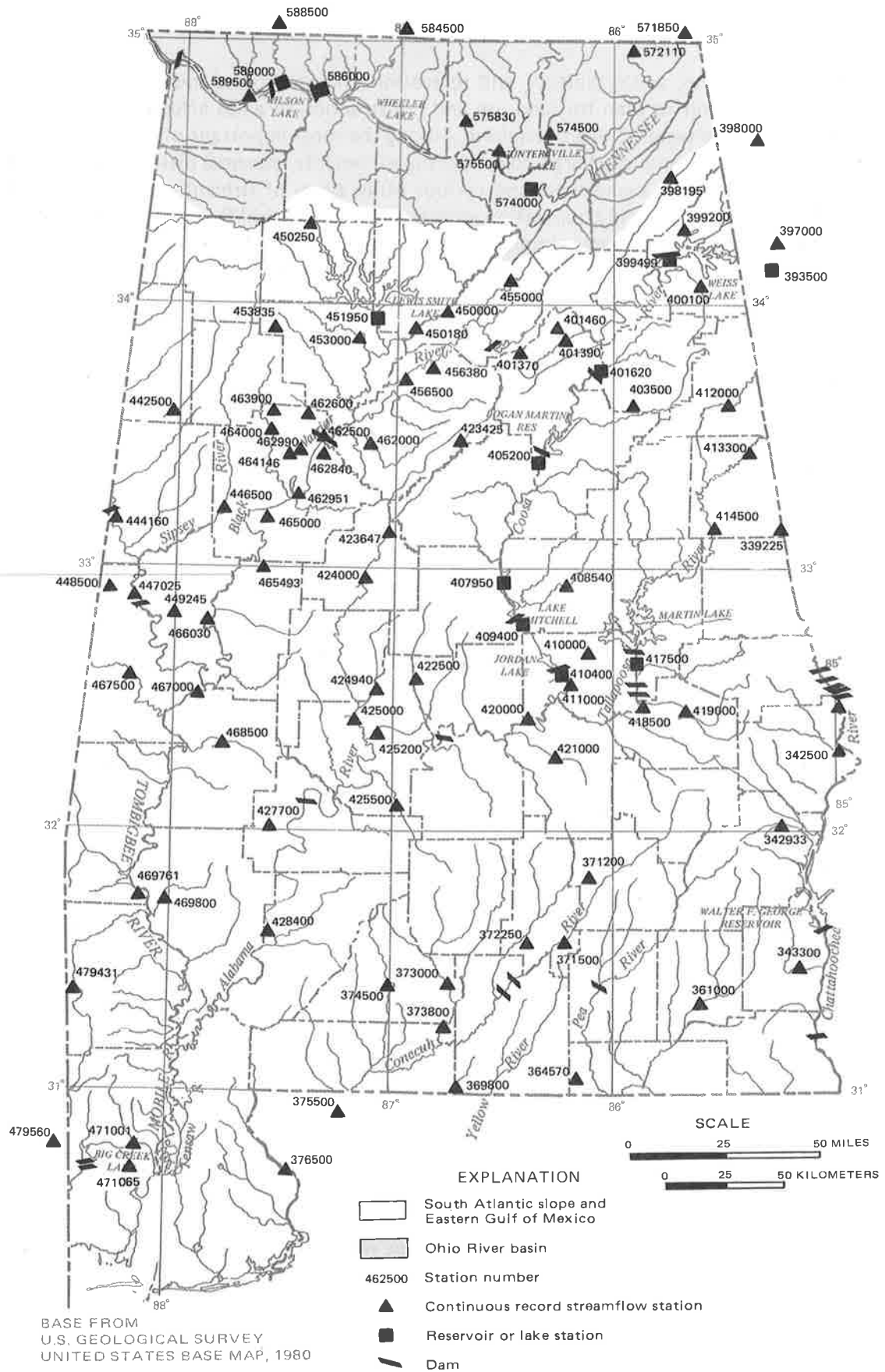


Figure 18.--Locations of stream-gaging stations.

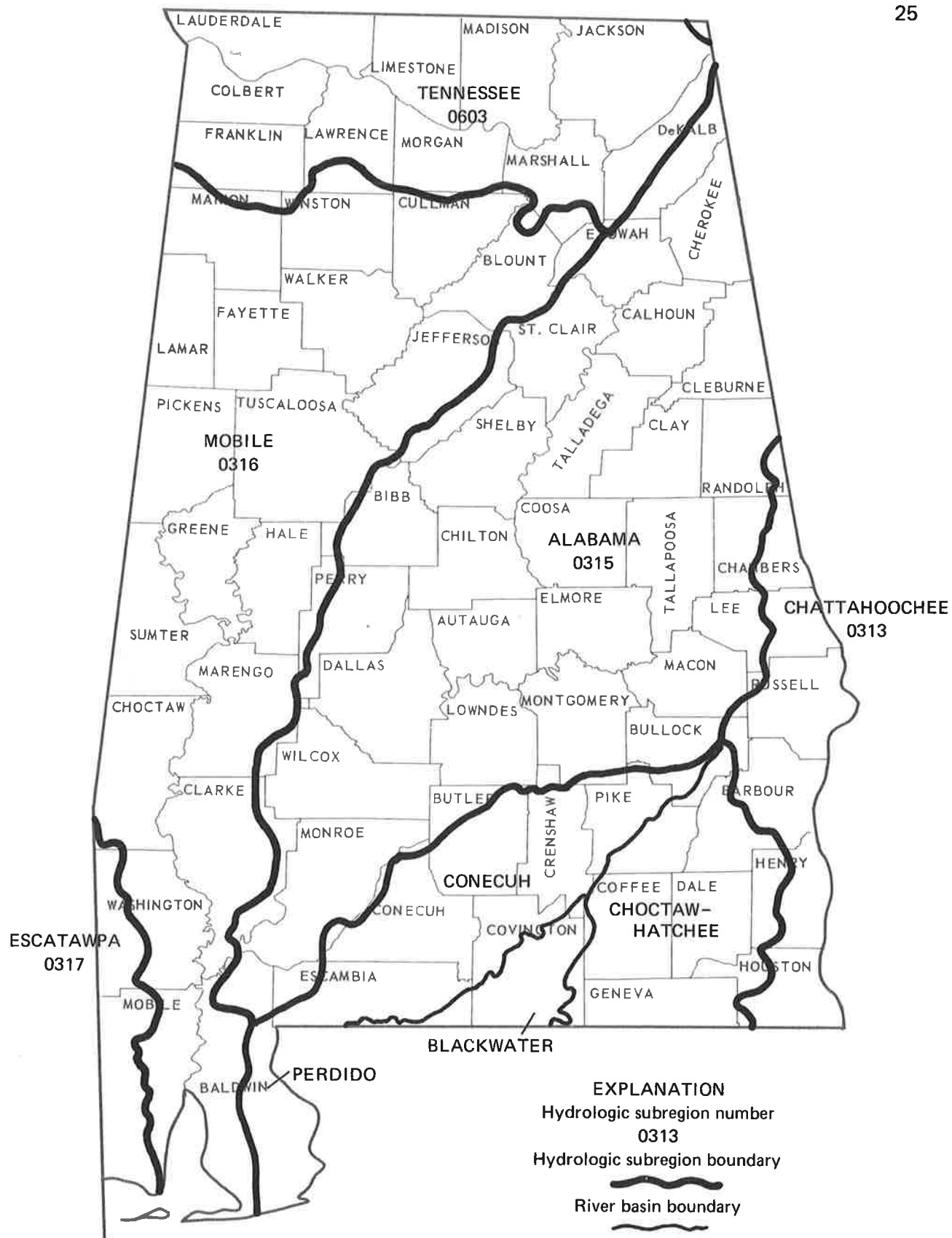


Figure 19.--Hydrologic regions of Alabama.

Table 1.--Average annual discharge compared to 1982 mean discharge, Black Warrior River

<u>Station number</u>	<u>Location of station</u>	<u>Years of record</u>	<u>Average annual discharge (ft<sup>3</sup>/s)</u>	<u>1982 mean discharge (ft<sup>3</sup>/s)</u>
02450180	Mulberry Fork near Arkadelphia	6	907	874
02450250	Sipsey Fork near Grayson	16	169	128
02456500	Locust Fork at Sayre	44	1,462	1,558
02462500	Black Warrior River at Bankhead Lock and Dam	6	7,174	6,385
02462951	Black Warrior River at Holt Lock and Dam	6	7,512	6,708
02465000	Black Warrior River at Northport	62	7,970	7,930
02466030	Black Warrior River at Warrior Lock and Dam, near Eutaw	6	10,220	8,219

### LOW-FLOW MEASUREMENTS

In order for bridges, dams, causeways, and similar structures to be properly constructed, it is necessary to know the maximum discharge of the stream involved and the maximum height of water that may be attained in the stream. Natural low-flow values of streams are necessary in planning for water-supply availability, disposal of waste effluents into streams, hydroelectric power generation, and wildlife management. The most commonly used values are the annual 7-day low flows of 2-year and 10-year recurrence intervals, called the 7-day  $Q_2$  and 7-day  $Q_{10}$ . The 7-day  $Q_2$  and  $Q_{10}$  values available in 1982 for selected streams in Alabama are given in table 2. The reliability of low-flow values is dependent upon the period of record, the number of years for which discharge records are available. Usually, the longer the period of record, the more reliable the low-flow values. Most simply, the 7-day  $Q_2$  represents the median low flow, or the lowest flow to which the stream will decline on an average of once every 2 years of normal flow. This value also provides an estimate of the amount of flow generally available without the need for storage. The 7-day  $Q_{10}$  is the lowest flow for 7 consecutive days that may be expected to occur in 1 out of 10 years. This value is useful for determining the lowest flows during drought years.



Figure 20.--Types of gaging stations.

adversely affect the lands of other owners. For example, a landowner may construct an impoundment on his land, but he may not cause the stream to cease flowing through downstream property, nor cause another owner's land upstream to be inundated by the impounded water.

The title to land bounded by a non-navigable watercourse includes the bed of the stream to the center of the main channel, unless the landowner's instrument of title limits the boundary to the bank or to another designated point.

Several State agencies have responsibility for enforcement of different sets of regulations involving water. The Alabama Department of Environmental Management is responsible for the quality of public drinking water supplies and water-pollution control. The Alabama Surface Mine Reclamation Commission is responsible for the quality of waters that may be affected by mining, and the State Oil and Gas Board is responsible for the quality of waters that may be affected by oil and gas exploration and production. The State Department of Conservation is responsible for enforcement of water-safety traffic laws on state waterways and impoundments, and for the quality of water in wildlife refuges and game management areas.

## WATER QUALITY

The quality or chemical character of water is one of the most important factors affecting its use. Any water supply must meet, or be capable of treatment to meet, certain sets of standards for each type of use.

In areas where natural conditions have not been extensively affected, water quality is controlled by three circumstances: the presence of gases or particulate matter in the atmosphere through which precipitation falls; the type of earth materials with which the water comes in contact; and the amount of time the water remains in contact with soils and rocks.

Rainwater or snow is relatively pure, but it usually has trapped enough soluble gases or chemically active particles from the atmosphere through which it travels to react with the materials with which it comes in contact. For example, carbon dioxide, dissolved in pure water, produces weak carbonic acid, which is capable of dissolving limestone and leaching several other minerals from rocks over a period of time.

Several of the common mineral constituents of rocks, such as oxides and sulfides, calcium carbonate, and sodium chloride, readily dissolve in water. Iron and calcium carbonate contribute to "hardness" of water and, though objectionable in excess, do not make water unusable for most purposes. Excessive sodium chloride or acidity may render the water unfit for some uses. The most common natural water-quality problems are related to hardness, dissolved solids, excess iron, and low pH (high acidity).

Ground water is more likely to have a higher mineral content than surface water because it moves much more slowly and has more time to react with minerals present in the rocks through which it moves. It is more likely to come in contact with earth materials whose minerals have not been leached by weathering. Ground-water quality is likely to be much less variable than that of surface water.

Surface water is highly variable in quality throughout the year, partly because of variations in flow due to climatic conditions, impounding, or diversion of water. It is also more accessible to pollutants of all types, especially those generated by man. Streambeds are less likely to contain concentrations of highly reactive natural minerals because alluvial processes tend to remove these minerals quickly and leave only the more inert in the streambed.

## WATER-QUALITY STANDARDS

Water-quality standards are set and enforced for various water uses by Federal, State, and local government regulations. The most important of these regulations are those dealing with drinking water standards for public supply.

A public water system is one which provides or sells water to the public for human consumption, having at least 15 service connections or regularly serving an average of 25 individuals at least 60 days out of the year. All public water supplies must meet the standards for contaminant limits established by the Safe Drinking Water Act, Primary Drinking Water Regulations, Title 40, Part 141 of the Federal Code. These standards, shown in table 3, are specified by both the Environmental Protection Agency and the State of Alabama. Samples must be collected and sent to the Public Water Supply Section, Water Division, of the Alabama Department of Environmental Management at intervals specified by the State for analysis. The sampling interval for ground water supplied systems is once per month; surface-water treatment facilities must take at least one sample and analyze it every day. Most public water supply systems maintain their own sampling and analysis program also, at more frequent intervals than required by the State. Table 4 shows sampling frequencies and locations required for different contaminants and for other factors, such as color, odor, and turbidity.

Organic pollutants from disposed waste and pesticide runoff have been detected in some water sources. As additional allowable limits for these are set, the Environmental Protection Agency issues updates of the drinking water standards.

The Geological Survey of Alabama and U.S. Geological Survey maintain water-quality stations on streams and rivers throughout the State (fig. 21). Water-quality samples are analyzed in the Geological Survey of Alabama Water-Quality Laboratory. Selected water samples and project-related samples may also be collected and analyzed in the laboratory.

Water-quality stations are commonly established in areas where pollution may be expected to become a problem, such as on streams draining strip-mined areas or downstream from wastewater outfalls. Water samples are analyzed and the analytical data are entered into a computer by the U.S. Geological Survey. If any of the tested parameters exceeds standards, the computer prints an "alert," which is distributed on a regular basis to cooperating agencies.

If concentrations in excess of allowed standards are detected from spot-sampling or samples taken for specific research projects, the location of the sample and a copy of the analysis is sent to the agency charged with enforcing water-quality standards for that particular area. For example, pollution from strip-mined areas is controlled by the Alabama Surface Mine Reclamation Commission; pollution of water from other sources, such as leachate from landfills or runoff of pesticides from farmland, is controlled by the Alabama Department of Environmental Management; and pollution in wetland environments or wildlife sanctuaries is controlled by the U.S. Fish and Wildlife Service or the Alabama Department of Conservation. Pollution from oil and gas exploration and development is monitored and controlled by the State Oil and Gas Board.

## POLLUTION SOURCES

Certain sites are monitored carefully for pollution of ground water. The Alabama Department of Environmental Management has established procedures for installing equipment to monitor the quality of water in wells tapping ground water at various depths around sewage lagoons, landfills, and waste disposal sites to check for movement of leachate or sewage into the ground-water system.

Table 3.--Water quality limits for public water supplies (from U.S. Environmental Protection Agency, 1979)

## INORGANIC CHEMICALS

Alkalinity	--
Ammonia	0.5 milligrams/liter (mg/l)
Arsenic (total)	0.05 mg/l
Barium	1 mg/l
Cadmium	0.010 mg/l or 10 micrograms/liter ( $\mu$ g/l)
Chromium	0.05 mg/l or 50 $\mu$ g/l
Chloride	250 mg/l
Copper	1 mg/l
Cyanide	0.2 mg/l
Fluoride	(see chart below)
Hardness	(see chart below)
Iron	0.3 mg/l or 300 $\mu$ g/l
Lead	0.05 mg/l or 50 $\mu$ g/l
Manganese	0.05 mg/l or 50 $\mu$ g/l
Mercury	0.002 mg/l or 2 $\mu$ g/l
Nitrate as Nitrogen	10 mg/l
Nitrite as Nitrogen	1.0 mg/l
Phosphate	--
Selenium	0.01 mg/l or 10 $\mu$ g/l
Silver	0.05 mg/l or 50 $\mu$ g/l
Sodium	270 mg/l
Sulfate	250 mg/l
Zinc	5 mg/l

## FLUORIDE

Average maximum daily air temperature ( $^{\circ}$ F)	mg/l
50.0-53.7	1.8
53.8-58.3	1.7
58.4-63.8	1.5
63.9-70.6	1.4
70.7-79.2	1.2
79.3-90.5	1.1

## TOTAL HARDNESS

Mg/l CaCO <sub>3</sub>	Class
0- 60	soft
61-120	moderately hard
121-180	hard
more than 180	very hard

## ORGANIC CHEMICALS

Endrin	0.0002 mg/l
Lindane	0.004 mg/l
Methoxychlor	0.1 mg/l
Toxaphene	0.005 mg/l
2, 4 D	0.01 mg/l
2, 4, 5 - TP Silvex	0.01 mg/l
Trihalomethane (total)	0.01 $\mu$ g/l
Color	15 color units
Coliform bacteria	< 1/100 ml (mean)
pH	6.5-8.5
Total dissolved solids	500 mg/l
Turbidity	1-5 turbidity units

## RADIOLOGICAL

Radium 226,228	5 picoCuries/liter (pCi/l)
Gross beta	4 millirem/year (50 pCi/l)
Gross alpha	(15 pCi/l)

Table 4.--Sampling frequencies and locations for community and non-community water supplies (from Alabama Department of Environmental Management, 1982).

<u>Community water system</u>	<u>Non-community water system</u>
<u>Inorganic Contaminants</u>	
Surface water: 1-year intervals Ground water: 3-year intervals	Surface and ground water: nitrates— intervals specified by Alabama Department of Environmental Man- agement (ADEM)
<u>Organic Contaminants</u>	
Surface water: 3-year intervals un- less otherwise specified by ADEM Ground water: none, unless specified by ADEM	Surface and ground water: at inter- vals specified by ADEM for each system
<u>Microbiological Contaminants</u>	
Surface and ground water: required number of samples per month set by ADEM for each system, based on population served; samples taken at points representative of dis- tribution system	Surface and ground water: minimum of 2 samples per month during each month the system provides water; taken at points representative of distribution system
<u>Turbidity Levels</u>	
Surface and ground water: minimum 1 per day, at a representative entry point to the distribution system	Surface and ground water: minimum 1 per day, at a representative entry point to the distribution system; sampling frequency may be reduced at discretion of ADEM
<u>Radioactivity Levels</u>	
Surface and ground water: natural and man-made radionuclides—4 con- secutive quarterly samples or the average of 4 quarterly samples— other sampling intervals at dis- cretion of ADEM	Surface and ground water: natural and man-made radionuclides—4 con- secutive quarterly samples or the average of 4 quarterly samples— other sampling intervals at dis- cretion of ADEM

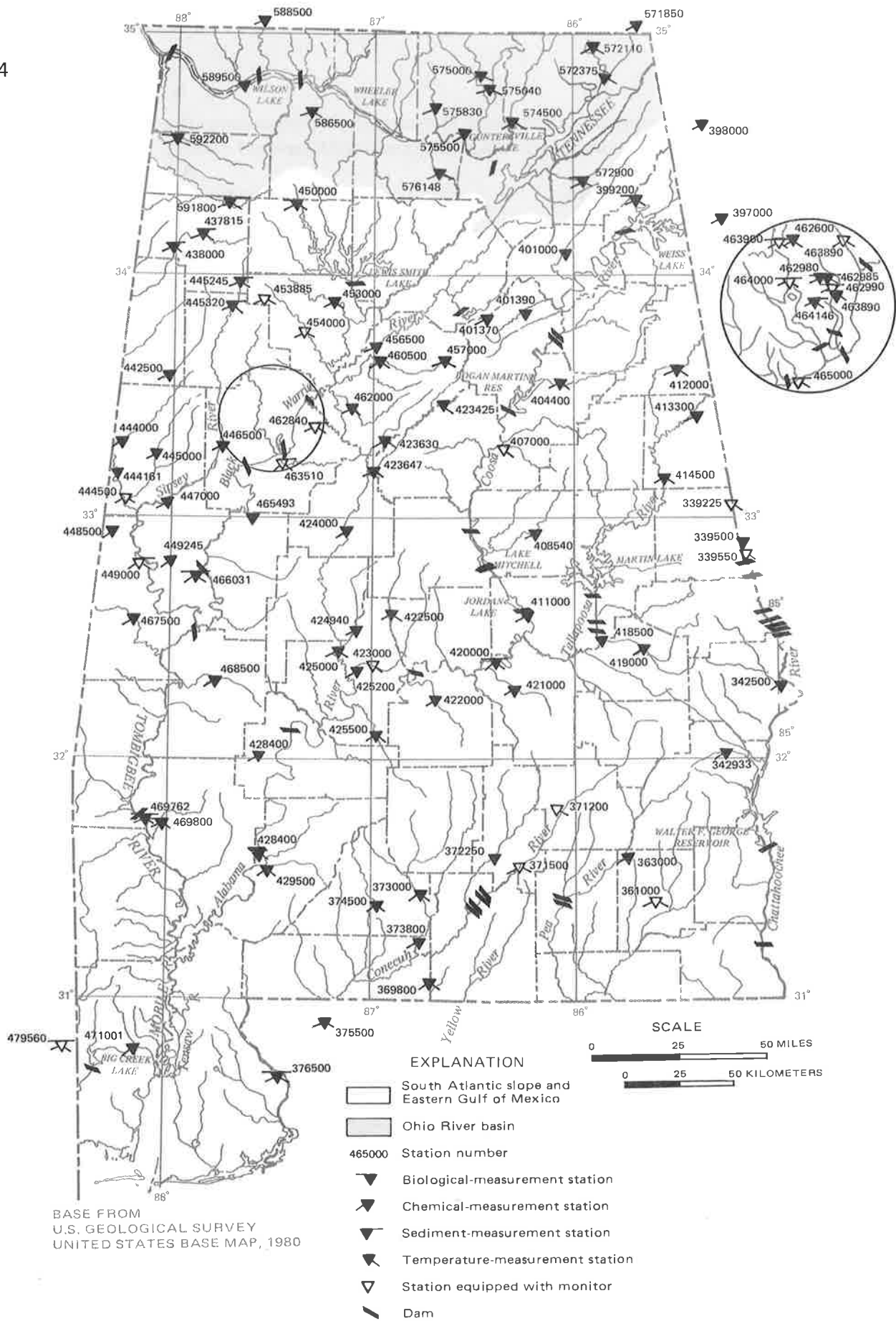


Figure 21.--Locations of water-quality stations, 1982.

Ground-water quality is also monitored through special programs designed to check for specific conditions, such as salt-water encroachment into coastal aquifers or industrial or agricultural pollutants that may reach the ground-water system.

The names and addresses of Federal and State agencies that monitor water quality and are charged with enforcing water-quality standards are listed in the appendix.

## WATER USE

In 1982, approximately 3,162 billion gallons of water were withdrawn from surface- and ground-water sources for use in Alabama. This figure represents approximately 2,200 gpd for every person in the State. This is 500 gpd less than the estimated per capita use in 1980 (Baker, 1983). Several factors, including reduction in use at a large thermonuclear plant, shut-down of large industrial users, and decreased agricultural and domestic needs in a wetter than average year contributed to this decline.

Water use is divided into two main categories: withdrawal or off-stream use, where water is withdrawn from its natural setting in streams, lakes, or aquifers prior to being used; and nonwithdrawal or in-stream use, where water is used without being withdrawn from its natural setting. Data were collected for 10 categories of use in Alabama, 6 of which were withdrawal uses and 4 nonwithdrawal. Figure 22 shows total amounts of withdrawal and nonwithdrawal use for 1982, compared to 1980 total withdrawal and nonwithdrawal use.

## WITHDRAWAL USE

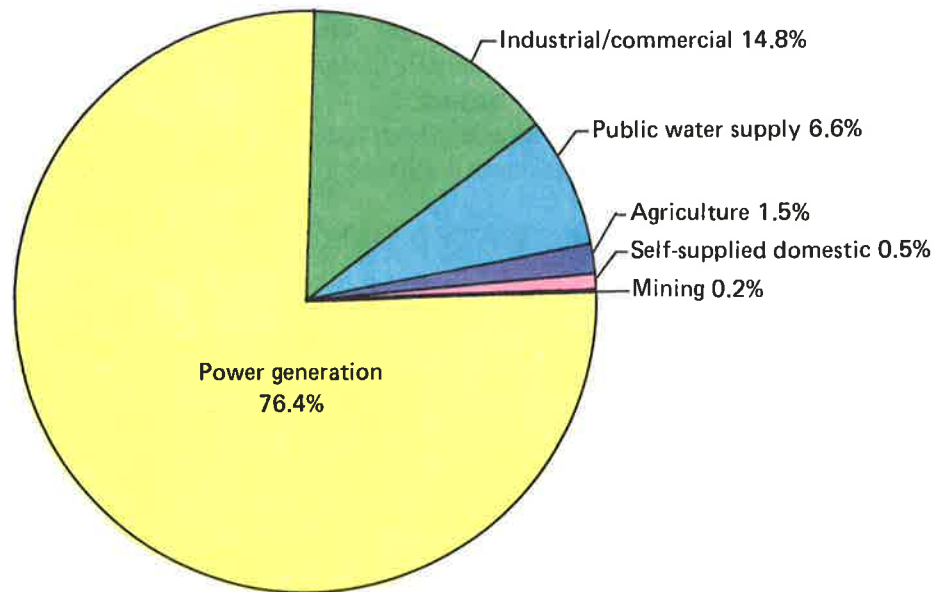
The six withdrawal use categories inventoried were public water systems, self-supplied industry or commerce, agriculture, self-supplied domestic, mining, and thermonuclear power generation. Figure 23 shows comparative amounts of withdrawal use in million gallons per day (mgd) for 1980, 1981, and 1982.

## PUBLIC WATER SYSTEMS

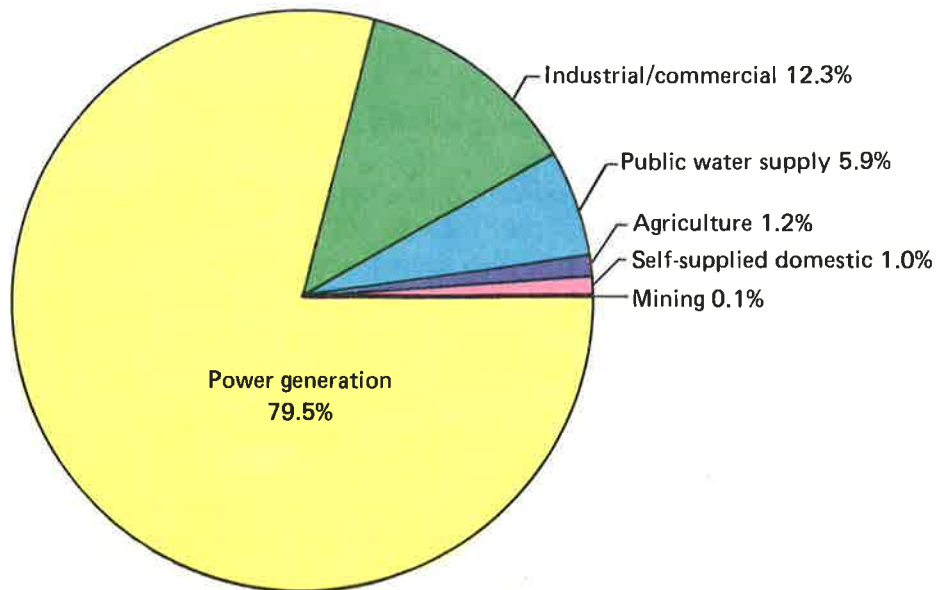
Public water systems served 84 percent of the people of Alabama in 1982. Although water use by public supply systems declined in 1982, due to less use by large industry/commercial customers and decreased domestic use in a wetter than average year, several factors led to inflated per capita use figures. Withdrawal figures for public supply systems are usually accurate because withdrawals are measured; however, use figures, especially in smaller systems, are estimated. Because these smaller systems are not metered, there is no way to measure actual use or conveyance loss, the leakage from water lines within the system. The per capita use figures were calculated using actual withdrawals, if possible, and do not allow for conveyance losses. Prior to 1982, use estimates were made using the amount of 110 gpd as the average per capita domestic use; in 1982, this was revised to 75 gpd, a figure that more accurately reflects actual use in Alabama. Because 1982 had greater than average precipitation, and 1980 and 1981 were dry years, domestic use for watering lawns, filling swimming pools, or for water-cooled air conditioning systems was also less.

## INDUSTRIAL/COMMERCIAL USE

Information for self-supplied industrial/commercial use was not updated for 1982; therefore, use figures for this category are the same as for 1980.



1982  
Withdrawal Use



1980  
Withdrawal Use

Figure 22.--Total water use, in percent, 1980 and 1982.

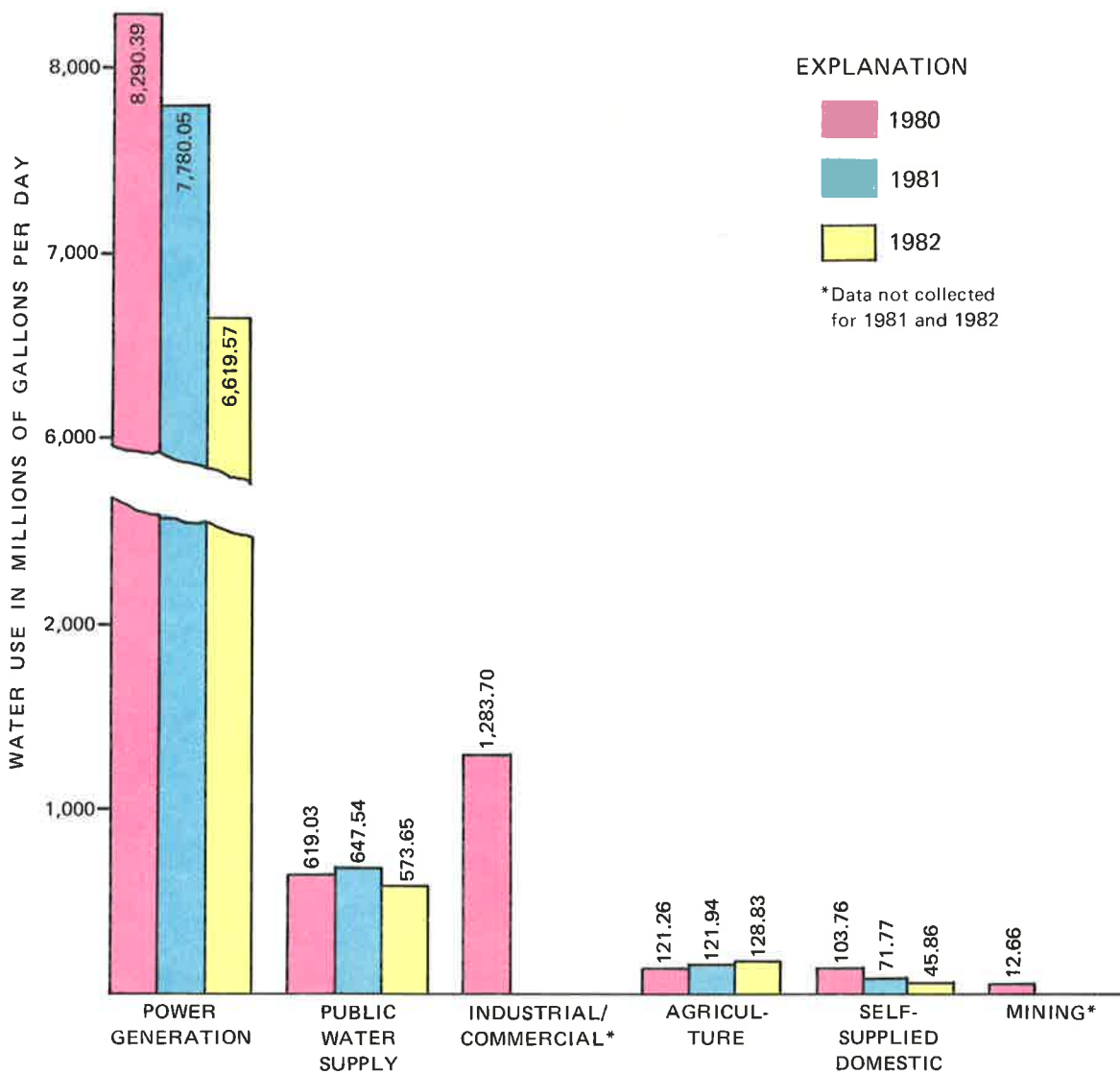


Figure 23.--Comparative withdrawal use 1980, 1981, 1982, in mgd.

### AGRICULTURAL USE

Agricultural uses are divided into irrigation and nonirrigation uses; nonirrigation use includes water for livestock operations and for catfish farming. The figures for 1981 were used for comparison with 1980 figures, since no new data were collected for 1982. Irrigation increased 340 percent from 1970 to 1982, indicating that farmers are beginning to use irrigation as a method of crop insurance, particularly during dry periods. Counties in south Alabama were the most intensively irrigated. Water-use figures for irrigation were estimated for 1982 and are averages for the entire year.

### SELF-SUPPLIED DOMESTIC USE

Water use values for this category must be estimated. The number of people served by public water systems was subtracted from the total population (1980 Census figures) to determine the self-supplied domestic population. Water-use figures were estimated using an average use of 75 gpd per person, which is considered a more realistic figure than the 110 gpd used prior to 1982. (Adjustment for this difference should be made when comparing 1982 water use to that in previous years.)

### POWER GENERATION

Water use by thermonuclear and coal-fired power generating plants in Alabama accounted for 6,619 mgd, or more than 76 percent of the entire withdrawal water use. This figure declined from 1980 to 1982, primarily due to a reduction in water use at Bellefonte Nuclear Plant.

### MINING

The amount of water withdrawn for mining was not sufficient to constitute a major usage, at only 13 mgd (1980 estimate). Most of this water was used for washing coal, sand, and gravel. This water is usually recycled.

### NONWITHDRAWAL USE OF WATER

Nonwithdrawal or in-stream uses of water comprised 4 of the 10 categories inventoried. These are hydroelectric power generation, sewage treatment, navigation, and recreation/preservation. Water for these uses is not removed from its natural setting and is often used many times over as it moves downstream.

### HYDROELECTRIC POWER GENERATION

The 20 hydroelectric power generating facilities operating in Alabama in 1982 used an estimated 184,610 mgd of water to produce 10.7 million megawatt hours of electricity (Baker, 1983). There is virtually no consumptive use of water by hydroelectric generating plants; water used at one plant is often used in similar or other ways downstream.

### SEWAGE TREATMENT

The total estimated discharge by sewage treatment facilities in Alabama was approximately 356 mgd (1980 estimates). Discharge data from the Alabama Department of Environmental Management records, supplemented by discharge records from operators of sewage treatment facilities, were used to estimate this figure. Sewage treatment discharge data by county and hydrologic subregion are published by the Geological Survey of Alabama (Baker, 1983).

### NAVIGATION

In 1982, there were 14 locks operating on four lock-and-dam navigation systems in Alabama. These locks have inside dimensions ranging from 84 X 100 feet to 110 X 600 feet. Water requirements for a single lockage range from a low of 9 million gallons (mg) at Oliver Lock on the Black

Warrior River to 50 mg at Wilson Lock on the Tennessee River. The combined volume of all locks in Alabama is approximately 297 mg. Lockage is also a sequential use of water, in that the same water is used downstream.

### RECREATION/PRESERVATION

Although recreation/preservation is not considered a major water-use category, it is important to the State's economy. Alabama has no natural large lakes, but abundant impoundments, developed for navigation and hydroelectric power generation, provide habitats for fish and wildlife as well as recreational areas. They support a significant part of the State's economy by providing a basis for the tourist industry, sales of recreational equipment, and habitats and spawning areas for commercial game and fish.

Recreation/preservation use is usually estimated by the number of annual visits per facility. In 1980, the Tennessee Valley Authority estimated recreational use at its Guntersville, Wheeler, Wilson, and Pickwick Lakes and associated property at 16 million visits. Attendance at other State-operated parks and recreational areas was estimated at 7 million visits.

### WATER PROBLEMS

#### FLOODING

Flooding is a major water-related problem. In many cases it cannot be controlled in any way other than by construction of dams and flood-control impoundments or levees and dikes. However, in many cases, permanent construction in the path of a flood can be avoided. Very few people have an adequate idea of the area that floodwaters can cover in a short period of time. Flat, open flood plains appear to be attractive, easily developed sites for building, but these areas are particularly susceptible to flooding. Figure 24 shows two images taken from space by the LANDSAT multi-spectral scanner. In the October image, the Alabama and Tombigbee Rivers, converging on the borders of Clarke County to form the Mobile River, appear as thin, black lines. The swampy, water-saturated ground of the upper Mobile River delta is a smudgy gray. This image was taken during a period of normal water conditions. In the December image, taken during high water but not flood stage, note the increased size of the river and the vast increase of inundated land near it, shown as a smudgy, very dark gray. The two small rivers to the west and east of the Mobile River, not visible on the October image, show as highly visible areas of inundation.

The U.S. Geological Survey has published flood prone area maps for most areas in Alabama (fig. 25). Comparison of building site maps and flood prone area maps, delineating areas of danger from floods, should be a prerequisite to any construction near rivers.

#### WATER SHORTAGES

Water shortages may occur naturally or as a result of over use or improper development of ground- or surface-water resources. Wherever they occur, the effects may be long term and costly to water users and detrimental to the environment.

Droughts are the most common naturally occurring water shortage. In the Southeast, droughts are caused by deficiency in precipitation, mainly rainfall. The severity of drought effects depends on the length of time a rainfall deficiency lasts, the areal extent of the deficiency, and the season at which it occurs.



Figure 24.--LANDSAT images showing Alabama and Tombigbee Rivers.

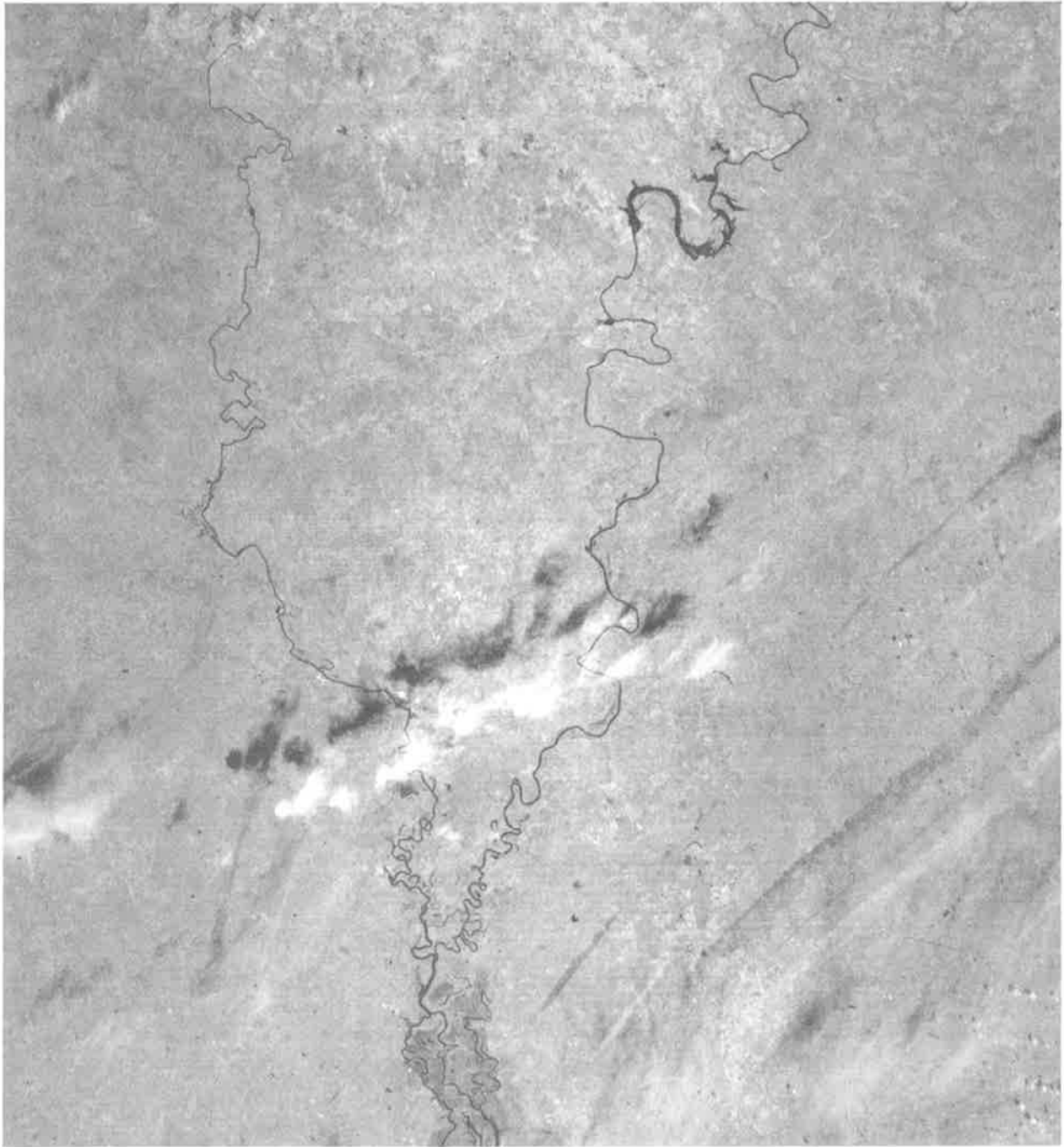


Figure 24.--LANDSAT images showing Alabama and Tombigbee Rivers - Continued.

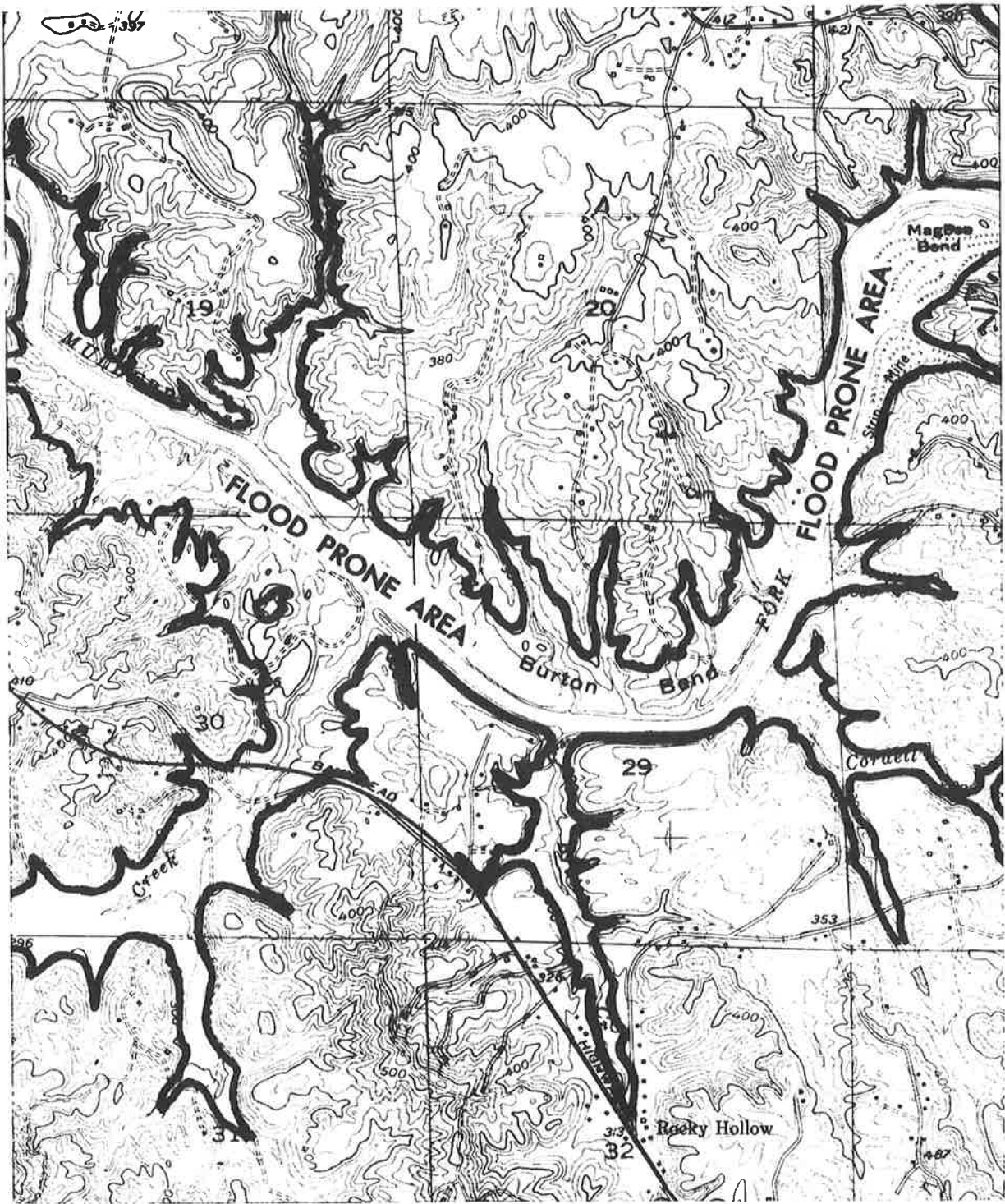


Figure 25.--Flood-prone area map, part of Sipsey quadrangle, Alabama (from U.S. Geological Survey, 1968).

In recent years, Alabama has experienced three major droughts of record: in 1954, 1968, and 1980-81. The 1954 drought affected the entire state; rainfall averaged more than 20 inches below normal, and streamflows reached 30-year lows. The 1968 and 1980-81 droughts had less rainfall deficit, but several factors caused severe local effects in some areas. The 1968 drought was concentrated mainly in the southeastern counties of the State, where rainfall was 15 to 20 inches below normal. This drought lasted longer in the affected area than the drought of 1954. The drought of 1980-81 differed in several respects from the 1954 and 1968 droughts. Rainfall in the southern part of the State was only 8 to 14 inches below normal; however, 1980 was preceded by drier than normal weather, and about 50 percent of the rainfall deficit occurred in June or July of 1981, a period of high irrigation withdrawal. Irrigated acreage in the affected area was much greater than in 1954, as was population. The decline in rainfall was so gradual during 1980 that many water managers did not decrease withdrawals until the drought was fairly well advanced, thereby further affecting ground- and surface-water supplies.

Water shortages induced or enhanced by man's activities are, in contrast, usually only locally severe. The most common is the decline in ground-water levels caused by overpumping. Several cities in Alabama, especially in the southern part of the State, derive their water supplies from wells. Increased pumpage to keep pace with demand from an increasing population has caused water-level declines in several of the aquifers in the immediate vicinity of these cities.

## OVERDEVELOPMENT

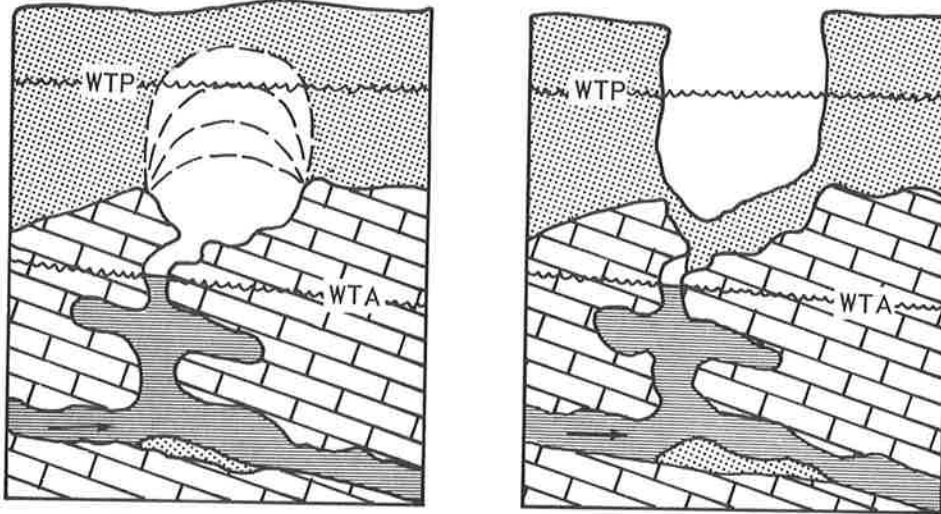
The balance between precipitation, runoff, and surface- and ground-water supplies is often delicate. Excessive urban construction, removal of forested areas, and replacement of bare ground by paving can all contribute to water-supply problems. Removal of large areas of trees and plants and subsequent paving leads to excessive storm runoff, which prevents water recharge to underlying aquifers and may contribute to erosion around foundations and footings from high-velocity storm drainage. If ground-water levels are allowed to decline or are depressed by active pumpage, sinkholes may develop in carbonate rock terranes. Figure 26 illustrates the formation and collapse of a sinkhole in residuum overlying carbonate bedrock. Careful planning for water management in areas prone to sinkhole development can help minimize damage from incipient collapse.

## WATER QUALITY

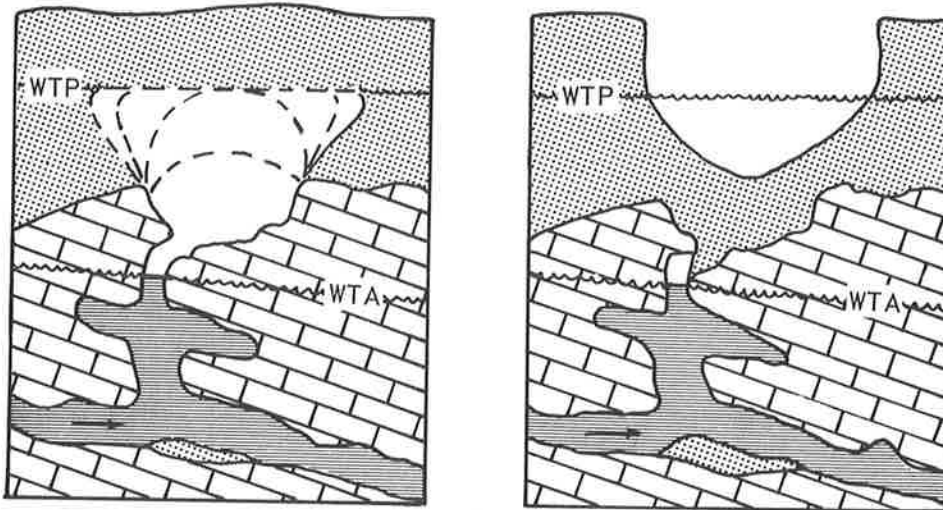
The quality of water controls its potential for use. Both naturally occurring substances and those introduced by man may seriously affect the utility of water supplies.

Naturally occurring conditions such as excessive chloride, iron, and hardness most commonly affect ground-water supplies. High chloride content makes water unfit for most uses. Excessive hardness inhibits the action of cleaning agents, causes scum in bathtubs, scale in hot water tanks and lines, and problems in processing of food, beverages, and rubber. Excessive iron in water causes staining of plumbing fixtures and laundry, objectionable taste, and may form scale or sludge in pipes, pumps, and water heaters. Some aquifers produce water with a sulfurous odor ("rotten egg" odor) and taste. Rare occurrences of trace metals such as arsenic and cadmium have been noted in water in Alabama.

Pollutants introduced by man may include pesticides, herbicides, bacteriological contaminants, heavy metals, and organic chemicals from manufacturing and industrial processes and agricultural activities.



A. Vertical enlargement and resulting collapse.



B. Vertical and lateral enlargement and resulting collapse.

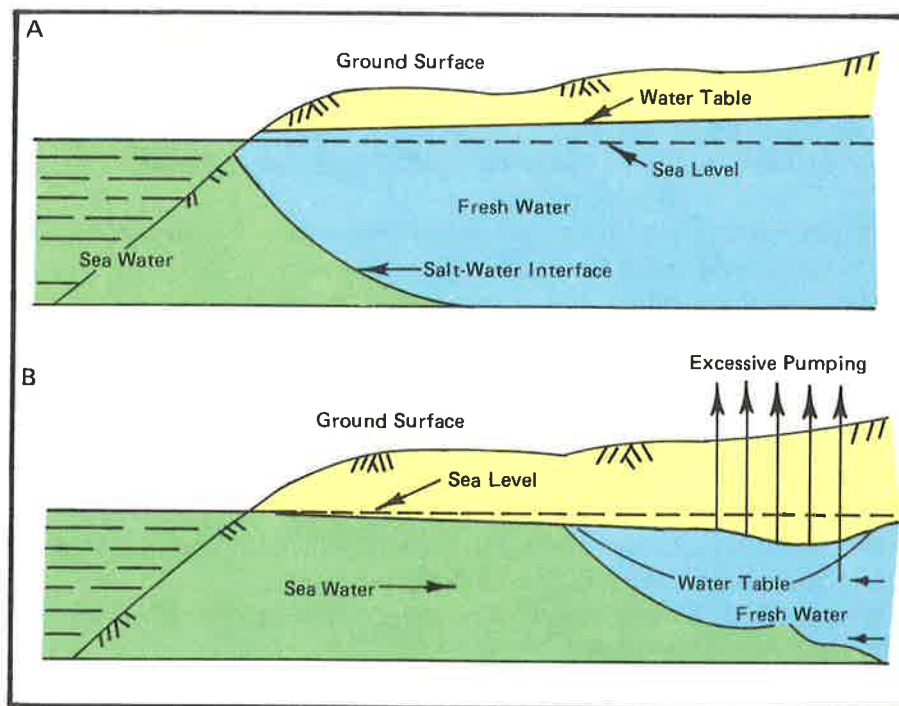
**EXPLANATION**

<p>--- Boundary designating cavity growth</p> <p>WTP-Water table prior to decline</p> <p>WTA-Water table after decline</p>	<p>▨ - Unconsolidated deposits</p> <p>▨ - Water-filled opening in limestone</p> <p>→ - Direction of water movement</p> <p>▨ - Limestone</p>
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Figure 26.--Sinkhole formation in limestone terrane (after Newton, 1976).

## SALT-WATER ENCROACHMENT

Excessive pumpage of ground water in coastal areas, where the salt-water/fresh-water interface is very close to the surface, may draw salt water into fresh-water aquifers, effectively destroying them for many years (fig. 27). When the fresh-water aquifer becomes totally flushed with salt water, surface-water supplies may have to be used.



### EXPLANATION

- A. Not subject to salt-water intrusion.
- B. Subject to salt-water intrusion.

Figure 27.--Salt-water encroachment into a shallow aquifer (modified from Chandler and Moore, 1983).

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## GLOSSARY

- ACRE-FOOT - A unit of measurement of water volume which represents the quantity of water required to cover 1 acre to a depth of 1 foot.
- AQUICLUDE - Relatively impermeable rock which acts as the upper or lower boundary of an aquifer. It can slowly absorb water but does not readily transmit water to wells or springs.
- AQUIFER - A formation, part of a formation, or a group of formations that is saturated and will yield water to wells and springs.
- ARTESIAN WATER - Ground water that is in an aquifer confined by an impermeable bed or beds and under sufficient pressure to cause the water levels in wells to rise above the base of the overlying confining bed.
- ARTESIAN WELL - Well deriving water from an artesian or confined water body.
- AVERAGE DISCHARGE - The average of the mean annual discharges for the period of record.
- BASE FLOW - The sustained flow of a stream during fair weather conditions. Generally the base flow is composed of effluent ground water.
- BASIC HYDROLOGIC DATA - Data collected during inventories of water and related land features, and records on water-related processes. The data include records of precipitation, streamflow, ground-water levels, water, and water quality.
- CONDENSATION - The process by which a substance changes from the vapor state into the liquid or solid state.
- CONE OF DEPRESSION - The depression in the water level or potentiometric surface of ground water caused by pumping a well or pit. The greatest amount of depression occurs near the discharge well or pit. The cone defines the area of influence of pumpage.
- CONFINED WATER - Ground water occurring under pressure greater than atmospheric pressure. The boundary of the upper surface of the water is an impermeable bed or a bed with a permeability significantly less than the permeability of the bed in which the water occurs.
- CONFINING BED - A relatively impermeable bed adjacent to and confining water in an aquifer.
- DAILY DISCHARGE - The volume of water flowing past a point within a 24-hour period. Daily discharge is normally reported as the mean discharge for 24 hours.
- DAILY GAGE HEIGHT - Gage height is the mean gage height for 24 hours or the value that occurs at a specified time during the day.
- DEPLETION - The removal of ground water from an aquifer at a rate greater than that of recharge.
- DISCHARGE - The volume of water passing a specified point within a specified period of time. Discharge is commonly reported in cubic feet per second (ft<sup>3</sup>/s).
- DRAINAGE BASIN - The area around a surface-water drainage system which contributes runoff from precipitation to the system.
- DRAINAGE DIVIDE - The boundary or rim separating two drainage basins.
- DRAWDOWN - The amount of decline in the water level or the reduction in pressure in a well caused by ground-water discharge.
- EVAPORATION - The process by which a substance passes from a liquid or solid state to a vapor state.
- EVAPOTRANSPIRATION - The combined processes by which water is lost from the land area by evaporation from water surfaces and moist soil and by transpiration of plants.
- ft<sup>3</sup>/s (cubic feet per second) - The volume of water flowing at a velocity of 1 foot per second through a cross section with an area of 1 square foot.
- FRESH WATER - Water with a low salinity or with a low dissolved solids content.
- GAGE HEIGHT OR STAGE - The height of a water surface above an arbitrarily established datum plane. Gage height and stage are synonymous terms.

**GROUND WATER** - The part of subsurface water that is in the zone of saturation. However, the term is used by some to refer to all water beneath the surface.

**GROUND-WATER DISCHARGE** - The removal of water by any means from the zone of saturation.

**GROUND-WATER RECHARGE** - The process by which water is added to the zone of saturation.

**HARDNESS** - The property of water that prevents lathering of soaps and causes the formation of insoluble residues when soap is used. It causes scale to form in vessels in which water has evaporated. It is due to presence of some cations, primarily calcium and magnesium.

**HEAD** - The pressure of a fluid on an area at a given point caused by the height of the fluid surface above that point.

**HYDROGRAPH** - A graph which shows the change in ground-water level or other characteristics of water with time.

**HYDROLOGIC BUDGET** - An accounting of the inflow to, outflow from, and storage in a hydrologic unit such as an aquifer, drainage basin, or reservoir.

**HYDROLOGIC CYCLE** - A term to denote the sequence of events in the circulation of water from the sea, through the atmosphere, to the land, and back to the sea.

**HYDROLOGY** - The science that deals with the properties, circulation, and distribution of water on and under the earth's surface and in the atmosphere.

**HYDROSTATIC HEAD** - The height of a vertical column of water with a unit cross-sectional area having a weight equal to the hydrostatic pressure at a point.

**HYDROSTATIC LEVEL** - The level to which water will rise in a well under a full pressure head. This level defines the potentiometric surface. Same as **STATIC LEVEL**.

**HYDROSTATIC PRESSURE** - The pressure caused by the weight of the ground water at higher levels in the zone of saturation.

**INFILTRATION** - The movement of water into soils or into interstices or cracks in rocks.

**INFILTRATION RATE** - The rate at which soils or interstices in rocks under specified conditions can absorb water. It is expressed as depth of water per unit of time.

**IMPERMEABLE** - A term used in describing a substance that does not allow the transmittal of fluids under pressure.

**MAXIMUM DISCHARGE** - The instantaneous maximum streamflow. These values are commonly determined from records of surface-water elevation (stage, gage height) and the use of stream-flow rating charts.

**MAXIMUM GAGE HEIGHT** - The maximum instantaneous gage height (stage).

**MOISTURE** - Water that is diffused in the atmosphere or in the ground.

**PERCHED AQUIFER** - An aquifer containing perched ground water.

**PERCHED GROUND WATER** - Ground water that is separated from an underlying main body of ground water by an unsaturated zone.

**PERCHED WATER TABLE** - The water table of a body of perched ground water. See **PERCHED GROUND WATER**.

**PERCOLATION** - The movement of water, generally downward, by the force of gravity or under hydrostatic pressure, through the interstices of rocks or soils, but not through large openings such as caves.

**PERMEABILITY** - The ability of a porous rock or soil to transmit fluids without impairment of the structure of the rock or soil.

**POROSITY** - The property of a rock or soil of containing interstices. It is expressed as the ratio (as a percentage) of the volume of the interstices to the total volume of the rocks.

**POTABLE WATER** - Water that is safe and palatable for human consumption.

**POTENTIOMETRIC MAP** - A map showing the elevation of the potentiometric surface of an aquifer. Same as **PIEZOMETRIC MAP**.

- POTENTIOMETRIC SURFACE** - The imaginary surface representing the static head of ground water in an aquifer. It is defined by the level to which water will rise in wells. Same as **PIEZOMETRIC SURFACE**.
- RECHARGE** - The process by which water is added to the zone of saturation.
- RECHARGE AREA** - The area where water enters the soil and moves downward to the zone of saturation.
- SALINITY** - The quantity of dissolved salts in water measured by weight in parts per thousand with the qualifications that all carbonate has been converted to oxide, all bromide and iodide have been converted to chloride, and all organic matter has been oxidized.
- SALT-WATER ENCROACHMENT** - The displacement of fresh water in an aquifer by salt water because of the greater density of salt water. The encroachment occurs when the total head of the salt water exceeds that of the fresh water.
- 7-day  $Q_2$**  - The lowest average rate of flow for 7 consecutive days to or below which the flow of a stream will decline in half the years of a sampling period. It has a recurrence interval of 2 years.
- 7-day  $Q_{10}$**  - The lowest average rate of flow for 7 consecutive days to or below which streamflow can be expected to decline in 1 year out of 10, on the average.
- SOIL MOISTURE** - Water in the upper part of the zone of aeration which is just beneath the land surface.
- SPECIFIC CAPACITY** - The rate of discharge of water from a well per unit of drawdown. It is generally expressed in gallons per minute per foot of drawdown.
- SPECIFIC DISCHARGE** - The rate of discharge of ground water through a unit cross-sectional area of the aquifer measured perpendicular to the direction of flow.
- SPECIFIC YIELD** - The ratio of the volume of water that a saturated soil or rock will yield by gravity to the volume of the rock or soil.
- SPRING** - A place where ground water flows naturally from a soil or rock onto the land surface or into a surface-water body.
- STAGE** - See **GAGE HEIGHT**.
- STATIC HEAD** - The height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point. It is the sum of the elevation head and the pressure head.
- STATIC LEVEL** - See **HYDROSTATIC LEVEL**. Also, static level refers to the water level in a well that is not affected by ground-water withdrawal.
- SUBSURFACE WATER** - All water occurring below the surface of the earth and within bodies of surface waters.
- TRANSPIRATION** - The process by which water is absorbed by roots of plants and then evaporated into the atmosphere at the surfaces of the plants.
- UNCONFINED WATER** - Ground water that is not confined under pressure by relatively impermeable rocks. It has a free-water surface.
- UNSATURATED ZONE** - The zone between the land surface and the water table. The water is under pressure less than atmospheric pressure.
- WATER TABLE** - The surface of a ground-water body which has a pressure equal to atmospheric pressure. It is the surface that separates the zone of saturation and the zone of aeration. It is defined by the level that water will stand in a well completed in an unconfined aquifer.
- WELL** - A pit, hole, or tunnel constructed in the ground for the purpose of obtaining water from soils or rocks.



**APPENDIX 1**

**FEDERAL AND STATE AGENCIES RESPONSIBLE  
FOR WATER REGULATION IN ALABAMA**



## FEDERAL

U.S. Environmental Protection Agency  
345 Courtland Street, N.E.  
Atlanta, Georgia 30365

## STATE

Alabama Department of Conservation and Natural Resources  
64 North Union Street  
Montgomery, Alabama 36104

Alabama Department of Environmental Management  
1751 Federal Drive  
Montgomery, Alabama 36130

Alabama Surface Mine Reclamation Commission  
P.O. Box 1027  
Jasper, Alabama 35501

State Oil and Gas Board  
P. O. Box 0, University Station  
420 Hackberry Lane  
Tuscaloosa, Alabama 35486



**APPENDIX 2**

**STATE OF ALABAMA  
LICENSED WATER WELL DRILLERS**

**AS OF FEBRUARY 23, 1983**

Pursuant to the provisions of Act No. 1516 (1971 Regular Session, Legislature of Alabama), the following have been granted a license to drill water wells within the State of Alabama by the Alabama Department of Environmental Management.



Abernathy Well Drilling  
P.O. Box 1199  
Rome, GA 30161  
Floyd County (GA)  
404/291-2065

Acme Drilling Co.  
P.O. Box 88  
River Falls, AL 36476  
Covington County  
205/222-7452

Marvin Adams  
Rt. 9, Box 325  
Athens, AL 35611  
Limestone County  
205/232-2855

Adams-Massey Co.  
309 N. Park St.  
Carrollton, GA 30117  
Carroll County (GA)  
404/832-3132

Allsup Drilling, Inc.  
Rt. 3, Box 863  
Macon, MS 39341  
Noxubee County (MS)  
601/726-4330

Alms Pump Service, Inc.  
201 E. Michigan Rd.  
Foley, AL 36535  
Baldwin County  
205/943-1249

Alpha Drilling Co.  
1805 S. Hwy. 100  
Bowdon, GA 30108  
Carroll County (GA)  
404/258-7749

Alsay-Pippin Corp.  
P.O. Box 6650  
Lake Worth, FL 33461  
305/967-6620

American Drilling Co.  
P.O. Box 907  
Alabaster, AL 35007  
Shelby County  
205/663-0139

G. H. Anderson  
1113 N. Main Ave.  
Sylacauga, AL 35150  
Talladega County  
205/245-4186

Anderson Drilling Co.  
113 Broad St.  
Grove Hill, AL 36451  
Clarke County  
205/275-8276

Delma Baird  
Rt. 2, Box 73  
Arley, AL 35541  
Winston County  
205/384-4923

Ballard Well Drilling  
Hwy. 22 E.  
Alexander City, AL 35010  
Tallapoosa County  
205/234-6850

Barbaree Well Drilling  
6001 Crystal Dr.  
Columbus, GA 31907  
Muscookee County (GA)  
404/568-0192

Bay Hardware  
P.O. Box 357  
Grand Bay, AL 36541  
Mobile County  
205/865-6711

James E. Bearden  
5312 Hwy. 280 S.  
Birmingham, AL 35243  
Shelby County  
205/967-2399

Mack H. Beasley Water  
Well Service  
Rt. 3, Box 981  
Jay, FL 32565  
Santa Rosa County (FL)  
904/675-6577

Black Belt Drilling Co.  
Rt. 1, Box 311  
Forkland, AL 36740  
Greene County  
205/289-0399

Wayne M. Blair  
103 Salter St.  
Evergreen, AL 36401  
Conecuh County  
205/578-2352

Bland Drilling Co.  
Rt. 1, Box 754  
Empire, AL 35063  
Walker County  
205/648-5292

Herbert Boring  
Route 3  
Blountsville, AL 35031  
Blount County  
205/466-7218

W. J. Bozeman & Son  
Route 1  
Sardis, AL 36775  
Lowndes County  
205/872-3906

Brady Well & Pump Works  
Rt. 3, Box 99  
Selma, AL 36701  
Dallas County  
205/874-6801

Branton Bros. Well Drilling  
Rt. 8, Box 200  
Dothan, AL 36301  
Houston County  
205/677-5489

Brown Well Co., Inc.  
P.O. Box 309  
Chipley, FL 32428  
Washington County (FL)  
904/638-7221

Loyd Lee Busha  
Route 3  
Boaz, AL 35957  
Etowah County  
205/593-8576

C & C Drilling Co.  
Rt. 5, Box 417  
Jasper, AL 35501  
Walker County  
205/387-7006

Campbell Well Drilling  
111 W. Pine St.  
Scottsboro, AL 35768  
Jackson County  
205/547-2352 or 547-2189

Carlross Well Supply Co.  
P.O. Box 2079  
111 N. Pkwy.  
Memphis, TN 38103  
Shelby County (TN)  
901/526-1141

Carr's Well Service  
Rt. 1, Box 150  
Buckatunna, MS 39322  
Washington County  
601/648-2537

Champion Well Drilling  
635 Tyson St.  
Thomasville, AL 36784  
Clarke County  
205/636-2374 or 636-4605

Champion Well & Pump Service  
Rt. 2, Box 52  
Lanett, AL 36863  
Chambers County  
205/644-2424

W. B. Clardy & Son  
223 Hartley Dr.  
Columbus, MS 39701  
601/328-3168

Clark Water Well Drilling  
Rt. 2, Box 106  
Laurel, MS 39440  
Jones County (MS)  
601/428-1435

Coast Water Well Service  
3000 Ridgdell Rd.  
Gautier, MS 39553  
Jackson County (MS)  
601/497-1828

Coffey Well Service  
Rt. 3, Box 458  
Jay, FL 32565  
Santa Rosa County (FL)  
904/675-6676

Joel A. Coley  
Rt. 1, Box 50  
Forkland, AL 36740  
Greene County  
205/289-1868

D L Drilling Co.  
Rt. 1, Box 300  
Eufaula, AL 36027  
Barbour County  
205/687-5634

C. B. Dalrymple Drilling  
Rt. 3, Box 94  
Crossville, AL 35962  
DeKalb County  
205/659-2666

John H. Davis  
Rt. 1, Box 365  
Loxley, AL 36551  
Baldwin County  
205/947-7505 or 947-5090

H. R. Porter Dawes Well  
Service  
Rt. 2, Box 279  
Mobile, AL 36609  
Mobile County  
205/666-3733

Philip M. Dease  
Rt. 1, Box 101  
Midland City, AL 36350  
Dale County  
205/792-6285 or 983-5372

Hershell Densmore  
P.O. Box 90  
Arley, AL 35541  
Winston County  
205/387-1655

Densmore Drilling Co.  
3029 Nixon Rd.  
Bessemer, AL 35020  
Jefferson County  
205/428-7241

Dependable Drilling Corp.  
744 Dates Circle  
Bessemer, AL 35023  
Jefferson County  
205/491-9627

Dixie Drilling Corp.  
Rt. 1, Box 576  
Sumiton, AL 35148  
Walker County  
205/648-6027

Dixie Well Boring Co.  
Rt. 2, Whitesville Rd.  
LaGrange, GA 30240  
Troup County (GA)  
404/884-5756

Hawley Dodson & Son  
P.O. Box 585  
Fayetteville, TN 37334  
Lincoln County (TN)  
615/433-4201

Thomas Clayton Duncan  
Rt. 3, Box 482  
Jasper, AL 35501  
Walker County  
205/387-2318

English Well Drilling  
P.O. Box 367  
1750 Hickman Rd.  
Elba, AL 36323  
Coffee County  
205/897-2428 or 897-6311

Doc Faison  
P.O. Box 597  
Bonifay, FL 32425  
Holmes County (FL)  
904/547-3639

Fairpark Equipment Co.  
Rt. 4, Box 14  
Talladega, AL 35160  
Talladega County  
205/362-7019

Billy Feltman  
Rt. 1, Box 232  
Carbon Hill, AL 35549  
Walker County  
205/622-3563

Finch's Well Co.  
Box 230, Ave. D  
Mobile, AL 36608  
Mobile County  
205/342-0422

Flo Drilling Co.  
Rt. 5, Box 90  
Brewton, AL 36426  
Escambia County  
205/867-4976

French Well Drilling Co.  
Rt. 1, Box 380  
Attalla, AL 35954  
Etowah County  
205/547-8375

Fryfogle Water Well Service  
Rt. 8, Box 3  
Lucedale, MS 39452  
601/947-3262 or 947-3759

J. R. Goodwin  
P.O. Box 98  
Munford, AL 36268  
Talladega County  
205/358-4085

Gothard & Son Contractors  
Rt. 2, Box 400-A  
Montgomery, AL 36108  
Montgomery County  
205/263-9949

Graves Well Drilling  
P.O. Box 225  
Sylacauga, AL 35150  
Talladega County  
205/249-4371

I. D. Griffin Water Well  
607 S. Commerce St.  
Geneva, AL 36340  
Geneva County  
205/684-2475

Griffin Well Co.  
Rt. 1, Box 148-A  
Wilmer, AL 36587  
Mobile County  
205/649-2888

Tom Griffith Water Well  
& Conductor Service  
320 Mayson St.  
Columbia, MS 39429  
Marion County (MS)  
601/736-2646

Griner Drilling Service  
P.O. Drawer 825  
Columbia, MS 39429  
Marion County (MS)  
601/736-6347

Hacoda Drilling Co.  
Rt. 2, Box 10  
Floral, AL 36442  
Covington County  
205/858-6294

Howard Hale Well Boring  
& Drilling  
P.O. Box 935  
LaGrange, GA 30241  
Troup County (GA)  
404/882-1510

Charles Halebrooks  
Rt. 1, Box 108  
Hartselle, AL 35640  
Morgan County  
205/773-7055

W. O. Hall  
Rt. 2, Box 193  
Vina, AL 35593  
Franklin County  
205/356-2210

Hammett Drilling Co.  
Route 2  
Andalusia, AL 36420  
Covington County  
205/222-3562

Hancock & Chestnutt Drilling  
Rt. 6, Box 317  
Ft. Payne, AL 35967  
DeKalb County  
205/523-3386

Hanners & Davis Well Drilling  
Rt. 2, Box 227  
Lineville, AL 36266  
Clay County  
205/396-5382

D & H Havens Well Co.  
Rt. 1, Box 209  
Semmes, AL 36575  
Mobile County  
205/649-6912

Pat Hearst  
Rt. 3, Box 95-A  
Lineville, AL 36266  
Clay County  
205/488-5547

Heart of Dixie Well  
Drilling  
Rt. 2, Box 52-A  
Alpine, AL 35014  
Talladega County  
205/268-9791

Helms Brothers Well  
Boring  
Rt. 2, Box 535  
Villa Rica, GA 30180  
Paulding County (GA)  
404/459-3807

Ray Hendon  
Rt. 9, Box 239  
Jasper, AL 35501  
Walker County  
205/387-1377

Herndon Well & Supply  
P.O. Box 47  
Shannon, MS 38868  
Lee County (MS)  
601/767-9777

Walter C. Hicks  
Rt. 1, Box 238  
Mount Hope, AL 35651  
Lawrence County  
205/974-6283

J. E. Hodges  
Route 1  
Clopton, AL 36317  
Henry County  
205/585-2714

Ed Holland Co.  
6615 Gant St.  
Houston, TX 77066  
713/444-6960

Holland Well Co.  
P.O. Box 7363  
Mobile, AL 36607  
Mobile County  
205/473-5752

Horn Drilling Co.  
Rt. 1, Box 421-B  
Tallasse, AL 36078  
Elmore County  
205/283-5725

John J. Hudson Well  
Drilling  
Rt. 3, Box 274-B  
Enterprise, AL 36330  
Dale County  
205/393-4619

A. D. & Hayward Hughes  
Well Drilling  
Rt. 1, Box 320  
Chancellor, AL 36316  
Coffee County  
205/347-2989 or 347-8762

J. D. Hughes  
Route 1  
Enterprise, AL 36330  
Coffee County  
205/347-0513

J. R. Hughes  
Rt. 2, Box 36  
New Brockton, AL 36351  
Coffee County  
205/347-7303 or 894-2380

Hughes Water Well Co.  
3205 Cromwell Dr.  
Dothan, AL 36301  
205/794-3764

Hughes Water Well Drilling  
Rt. 1, Box 310  
Geneva, AL 36340  
Geneva County  
205/684-9814

Hughes Well Drilling  
Rt. 1, Box 331  
Chancellor, AL 36316  
Coffee County  
205/347-9758 or 347-1147

William O. Humphrey  
Rt. 3, Box 263  
Boaz, AL 35957  
Etowah County  
205/593-8801

Jackson Drilling Co.  
Rt. 2, Box 238  
Haleyville, AL 35565  
Marion County  
205/486-5452

Charles G. Kitchens Well  
Drilling  
Rt. 1, Box 349  
Parrish, AL 35580  
Walker County  
205/686-7811

Knox Drilling Co.  
P.O. Box 83  
Haleyville, AL 35565  
Marion County  
205/486-3128

Laton Well Drilling  
Rt. 1, Box 480  
Chatom, AL 36518  
Washington County  
601/848-7679

Layne Central Co.  
3720 N. Palafox St.  
Pensacola, FL 32505  
Escambia County (FL)  
904/432-5101

James D. Lemley  
Route 1  
Woodville, AL 35776  
Marshall County  
205/728-2526

Lineberry Drilling Co.  
Rt. 2, Box 41  
Clifton, TN 38425  
Wayne County  
615/676-3464

Little Drilling Co.  
Route 1  
Hillsboro, AL 35643  
Lawrence County  
205/974-8996

Lockhart Well Drilling  
Rt. 3, Box 354  
Floral, AL 36442  
Covington County  
205/858-6927

McCormack Drilling Co.  
Rt. 2, Box 103-A  
Leighton, AL 35646  
Colbert County  
205/446-5625

McDonald & Hill, Inc.  
P.O. Box 1510  
1020 Grand Ave.  
Meridian, MS 39301  
Lauderdale County (MS)  
601/693-3401

McLendon Well Drilling  
Rt. 1, Box 360  
Clio, AL 36017  
Barbour County  
205/397-2553

Michael Drilling Co.  
Rt. 4, Box 220  
Rogersville, AL 35652  
Lauderdale County  
205/247-5531

Mid-South Drilling Co.  
Rt. 1, Box 36-F  
Carrollton, AL 35447  
Pickens County  
205/367-8496

Miller Drilling Co.  
P.O. Box 706  
Lawrenceburg, TN 38464  
Lawrence County (TN)  
615/762-7548

Milstead Drilling Service  
P.O. Box 528  
Semmes, AL 36575  
Mobile County  
205/649-6376

Mizell Drilling Service  
Rt. 2, Box 759  
Trinity, AL 35673  
Lawrence County  
205/355-0684

Myhand Drilling Co.  
Rt. 5, Box 266  
Jasper, AL 35501  
Walker County  
205/384-3697

R. H. Morgan Drilling  
Rt. 2, Box 457  
Somerville, AL 35670  
Morgan County  
205/498-2472

Odom Well Drilling  
Rt. 4, Box 81  
Jacksonville, AL 36265  
Calhoun County  
205/820-2590

Owens Drilling Co.  
Route 2  
Fort Payne, AL 35967  
205/657-3395

Jim V. Peel  
Rt. 1, Box 69-A  
Maylene, AL 35114  
Shelby County  
205/426-3606

Ponder Drilling Co.  
Rt. 10, Box 337-A  
Cullman, AL 35055  
Cullman County  
205/747-2511

Abner Pope & Sons  
Rt. 1, Box 354-A  
Ocilla, GA 31774  
912/468-7368

Pope Testing Lab, Inc.  
2463 Eslavia Creek Pkwy.  
Mobile, AL 36606  
Mobile County  
205/471-3458

Porter Drilling & Supply  
Rt. 1, Box 106  
Waynesboro, MS 39367  
Wayne County (MS)  
601/735-2241

Powell Drilling Co.  
P.O. Box 155  
Rutledge, AL 35071  
Crenshaw County  
205/335-5365

Vertice Allen Powell  
P.O. Box 87  
Uriah, AL 36480  
Monroe County  
205/862-2500

J. M. Presley  
Rt. 4, Box 165  
Enterprise, AL 36330  
Coffee County  
205/347-2829

W. Presnall, Inc.  
Rt. 1, Box 325  
Grove Hill, AL 36451  
Clarke County  
205/246-4055

Cecil Radford & Son  
Rt. 2, Box 87  
Selma, AL 36701  
Dallas County  
205/872-1651

Rafter 5 Service Co.  
P.O. Box 114  
Aliceville, AL 35442  
Pickens County  
205/373-8428

Red Drilling Co.  
P.O. Box 252  
Theodore, AL 36590  
Mobile County  
205/653-9130

W. H. Richey  
Route 7  
Russellville, AL 35653  
Colbert County  
205/332-0688

Marvin S. Ridgeway  
Rt. 2, Box 342  
Millport, AL 35576  
Lamar County  
205/662-4278

J. D. Roberts Drilling  
Rt. 2, Box 179  
Hope Hull, AL 36043  
Lowndes County  
205/288-5613

Thomas Rossi  
Rt. 1, Box 331-A  
Sulligent, AL 35586  
Lamar County  
205/698-8757

Rowe Drilling Co.  
P.O. Box 1363  
Tallahassee, FL  
Leon County  
904/576-1271

Rutherford Well Boring  
P.O. Box 903  
Clanton, AL 35045  
Chilton County  
205/755-2525

Sand Mountain Drilling  
Rt. 2, Box 156-A  
Crossville, AL 35962  
DeKalb County  
205/659-4893

Johnny M. Sanford  
Rt. 2, Box 168-E  
Heflin, AL 36264  
Cleburne County  
No phone

Shumock Well Co.  
Rt. 1, Box 79  
Wilmer, AL 36587  
Mobile County  
205/649-4559

Simmons Well Drilling  
Rt. 3, Box 105  
Boaz, AL 35957  
Etowah County  
205/593-3435

Smith Artesian Well, Inc.  
Rt. 3, Box 420  
Phenix City, AL 36867  
Russell County  
205/297-1884

Donald Smith Co.  
Rt. 3, Box 1  
Headland, AL 36345  
Henry County  
205/693-2969

H. E. Smith Well Co.  
Rt. 1, Box 137-A  
Dothan, AL 36301  
Houston County  
205/792-2827

Smith Drilling Co.  
Star Route, Box 33  
Epes, AL 35460  
Sumter County  
205/652-7178

William E. Smitherman  
Rt. 2, Box 167  
Maplesville, AL 36750  
Chilton County  
205/366-2637

H. T. Sparks  
Rt. 2, Box 23  
Hollypond, AL 35083  
Cullman County  
205/796-5182

Steele Brothers  
345 Church St.  
Greenville, AL 36037  
Butler County  
205/382-2283

Stone Drilling Co.  
146 Green Rd.  
New Market, AL 35961  
Madison County  
205/379-2346

Terry Drilling Co., Inc.  
Rt. 8, Box 28  
Meridian, MS 39301  
Lauderdale County (MS)  
601/482-6412 or 482-0361

Thomason Well Drilling,  
Inc.  
713 Edge St.  
Ft. Walton Beach, FL 32548  
Okaloosa County (FL)  
904/862-4613

Tri State Drilling Service  
504 Dusy St.  
Dothan, AL 36301  
Houston County  
205/792-3605

Uriah Drilling Co.  
P.O. Box 116  
Uriah, AL 36480  
Monroe County  
205/862-2258

Virginia Supply & Well Co.  
P.O. Box 14145  
Atlanta, GA 30376  
Fulton County (GA)  
404/875-0441

Weldon Drilling Co.  
Rt. 1, Box 330  
Tallassee, AL 36078  
Elmore County  
205/541-3615

E. C. White  
Rt. 1, Box 15  
Perdido, AL 36562  
Baldwin County  
205/937-9384

White Well Co.  
4607 Dauphin Island Pkwy.  
Mobile, AL 36605  
Mobile County  
205/479-8718

Windham Pump & Supply  
5800 Muldoon Rd.  
Pensacola, FL 32506  
Escambia County (FL)  
904/455-2281

**APPENDIX 3**

**WELL FORMS**





**NOTIFICATION OF INTENT TO DRILL A WATER WELL**

DRILLING CONTRACTOR	License Number	Address	Zip Code	Date	
PROPERTY OWNER	Address (mailing)			Zip Code	
WELL LOCATION	County	Section	¼ Section	Township	Range ---or:

Distance and direction from nearest town, community, road junction or other reference point

WELL WILL BE USED FOR:

<input type="checkbox"/> Private supply	<input type="checkbox"/> Public supply	<input type="checkbox"/> Industrial supply	<input type="checkbox"/> Test well
<input type="checkbox"/> Irrigation	Other: _____		

Estimated starting date	Drilling method: (check)	Cable tool Rotary Jetted Bored	Diameter of well	Estimated depth
		Other: _____		

ADEM Form 60 1/83

\_\_\_\_\_  
SIGNATURE of Drilling Contractor

(Tear here for mailing.)

FIRST  
CLASS  
POSTAGE

**SANITARIAN**

\_\_\_\_\_ County Health Department  
\_\_\_\_\_, Alabama