GROUND-WATER AVAILABILITY IN JEFFERSON COUNTY, ALABAMA

GEOLOGICAL SURVEY OF ALABAMA

SPECIAL MAP 224

GEOLOGICAL SURVEY OF ALABAMA

Ernest A. Mancini
State Geologist

WATER RESOURCES DIVISION

GROUND-WATER AVAILABILITY IN JEFFERSON COUNTY, ALABAMA

To Accompany Special Map 224

By

Jonathan A. Hunter and Paul H. Moser

Tuscaloosa, Alabama
1990

GEOLOGICAL SURVEY OF ALABAMA

420 Hackberry Lane
P. O. Box O
Tuscaloosa, Alabama 35486 - 9780
(205) 349-2852

July 30, 1990

ERNEST A. MANCINI
State Geologist
and
Oil and Gas Supervisor

DIRECTORS
Executive Assistant, B. L. Bearden
Mineral Resources, W. E. Smith
Stratigraphy & Paleontology, C. W. Copeland, Jr.
Energy & Coastal Geology, R. M. Mink
Water Resources, J. D. Moore
Biological Resources, M. F. Mettee

Honorable Guy Hunt
Governor of Alabama
Montgomery, Alabama

Dear Governor Hunt:

I have the honor to transmit herewith Special Map 224, "Ground-Water Availability in Jefferson County, Alabama," by Jonathan A. Hunter and Paul H. Moser. This report presents information on the geology and the availability and quality of ground water in Jefferson County. The report also addresses current patterns of water use in the county. This information should be of use to people concerned with the development and management of the ground-water resources in Jefferson County.

Respectfully,

Ernest A. Mancini
State Geologist

CONTENTS

	Page
Abstract	1
Introduction	1
Purpose and scope	1
Previous investigations	1
Acknowledgments	2
Description of area	3
Physiography and topography	4
Drainage	4
Climate	5
Geology	6
General stratigraphy	6
Cambrian System	6
Rome Formation	6
Conasauga Formation	6
Ketona Dolomite	6
Cambrian and Ordovician Systems	6
Knox Group undifferentiated	6
Ordovician System	7
Little Oak and Lenoir Limestones undifferentiated	7
Chickamauga Limestone, Attalla Chert Conglomerate Member	7
Chickamauga Limestone	7
Sequatchie Formation	7
Silurian System	7
Red Mountain Formation	7
Devonian System	7
Frog Mountain Sandstone and Chattanooga Shale undifferentiated	7
Mississippian System	10
Maury Formation, Fort Payne Chert, and Tuscumbia Limestone undifferentiated	10
Pride Mountain Formation	10
Hartselle Sandstone	10
Bangor Limestone	10
Floyd Shale	10
Mississippian and Pennsylvanian Systems	10
Parkwood Formation	10
Pennsylvanian System	10
Pottsville Formation	10
Cretaceous System	11
Coker Formation	11
Quaternary System	11
Quaternary(?) gravels	11
Low terrace deposits and alluvium	11
Occurrence and availability of ground water	11
Conasauga Formation	12
Ketona Dolomite	12
Knox Group undifferentiated	13
Little Oak and Lenoir Limestones undifferentiated	13
Chickamauga Limestone	13
Fort Payne Chert and Tuscumbia Limestone undifferentiated	13
Hartselle Sandstone	13
Bangor Limestone	14

CONTENTS—CONTINUED

	Page
Pottsville Formation	14
Chemical quality of ground water	14
Cambrian and Ordovician limestones and dolomites	16
Fort Payne Chert and Tuscumbia Limestone undifferentiated	16
Hartselle Sandstone	16
Bangor Limestone	16
Pottsville Formation	16
Comparison of recent and historical ground-water quality data	18
Water utilization	19
Withdrawal use of water	20
Nonwithdrawal use of water	20
Summary	20
Selected references	21
Appendix A. Records of selected wells and springs in Jefferson County, Alabama	23
B. Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama	47
C. Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama	57

ILLUSTRATIONS

Figure 1.	Location of the study area	2
2.	Locations of coal degasification fields in the Warrior coal basin in Jefferson County, Alabama	3
3.	Physiographic divisions and features in Jefferson County, Alabama	5
4.	Generalized geologic map and structural cross section for Jefferson County, Alabama	8
5.	Hydrochemical classification system for natural waters using the trilinear diagram	17
6.	Trilinear diagram for water from 24 water wells and 1 spring in the Pottsville Formation in Jefferson County, Alabama	18
7.	Trilinear diagram for water from coal degasification wells in the Oak Grove coal degasification field in Jefferson County, Alabama	19

TABLES

Table 1.	Characteristics of the major water-bearing units in Jefferson County, Alabama	12
2.	Summary of chemical analyses of ground-water samples from 24 water wells and 1 spring in the Pottsville Formation in Jefferson County, Alabama	15
3.	Estimated daily water use in Jefferson County, Alabama, in 1985	20

GROUND-WATER AVAILABILITY IN JEFFERSON COUNTY, ALABAMA

By

Jonathan A. Hunter and Paul H. Moser

ABSTRACT

Jefferson County, in north-central Alabama, has an area of about 1,125 square miles and an estimated 1986 population of 676,400. The county lies within parts of the Appalachian Plateaus and Valley and Ridge physiographic provinces. Geologic units exposed in the county are of sedimentary origin and range in age from Cambrian to Holocene. The major aquifers in the southeastern half of the county are Cambrian to Mississippian-age carbonate units that, in some areas, contain extensive networks of solution-enlarged openings. In the northwestern half of the county, most wells and springs receive water from sandstone units in the Pottsville Formation of Pennsylvanian age. The chemical quality of ground water in most areas of the county is good. In some areas, however, the ground water has excessive concentrations of dissolved iron and high values of hardness. Water-use estimates for Jefferson County in 1985 indicate that about 160.07 million gallons of water were being withdrawn daily for use in the county. Approximately 91 percent of this total (145.65 million gallons) was obtained from surface-water sources, and 9 percent (14.42 million gallons) was ground water withdrawn from aquifers.

INTRODUCTION

This study of the ground-water resources in Jefferson County, Alabama, was conducted as part of a continuing program of the Geological Survey of Alabama for preparing and updating reports on the water resources in Alabama. The location of the study area is shown in figure 1.

PURPOSE AND SCOPE

The purpose of this report is to provide current information on the quantity and chemical quality of the ground-water resources in Jefferson County. These data should be useful to persons concerned with the development and management of ground water in the county. The report also establishes a water-quality database that may be used to detect any future changes in ground-water quality that may occur either naturally or as a result of man's activities.

The data-collection phase of the study included inventories of 240 water wells, 37 springs, and 50 coal degasification wells in the county. Ground-water samples were collected for chemical analysis from 36 water wells and 7 springs, and results of analyses of 49 samples from coal degasification wells were obtained from files in the Water Resources Division of the Geological Survey of Alabama. The well inventory and ground-water sampling programs were designed to provide a good areal distribution of data points across the county. During the data-collection process, emphasis was placed on obtaining data on ground-water quality for areas in and near the coal degasification fields in the Warrior coal basin in Jefferson County. The locations of these fields are shown in figure 2.

PREVIOUS INVESTIGATIONS

Johnston (1933) conducted a study on the ground waters in the Paleozoic rocks of northern Alabama, including Jefferson County. Peirce (1955) published a report on the surface-water resources and hydrology of east-central Alabama, which included part of Jefferson County. In a subsequent study, Peirce (1959) reported on the surface-water resources and hydrology of west-central Alabama, which included the remainder of the county. Newton and Hyde (1971) addressed problems with sinkhole development in an industrial subdivision in Birmingham. Sinkhole problems near Greenwood were discussed by Newton and others (1973). Knight (1976a) studied the relationship between urbanization and flooding in the Shades Creek drainage basin in Jefferson County. Knight (1976b) also produced a report on the water availability in the county. Scott (1977) reported on the drainage areas for

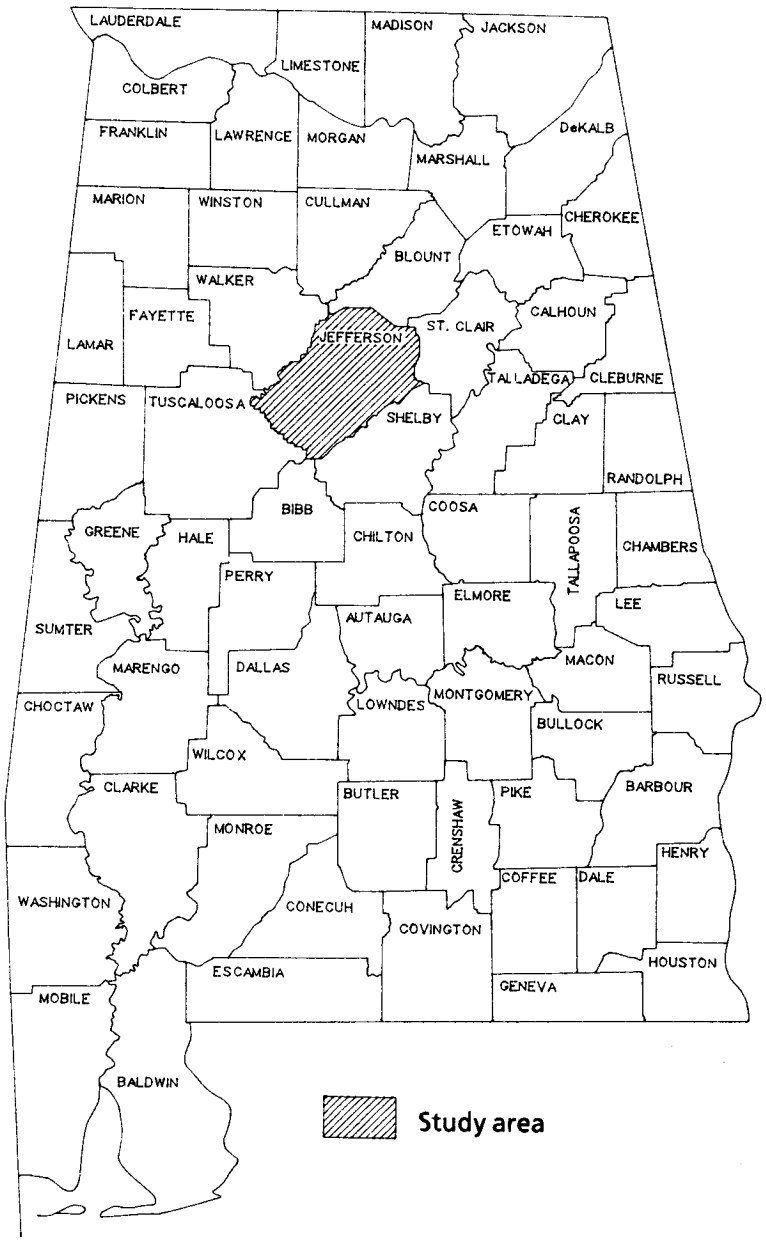

Figure 1.--Location of the study area.

Jefferson County. Moffett and Moser (1978) evaluated the ground-water resources in the Birmingham and Cahaba Valleys in the county. Data on streamflow in the county were summarized in a report by Bingham and Moore (1980).

In addition to the ground- and surface-water reports mentioned above, many studies have been conducted on the geology, mineral resources, and biota in Jefferson County. Some of these are listed in the Selected References section of this report.

ACKNOWLEDGMENTS

The authors wish to express their gratitude for the assistance and cooperation of the many citizens and city and county officials in Jefferson County during this study.

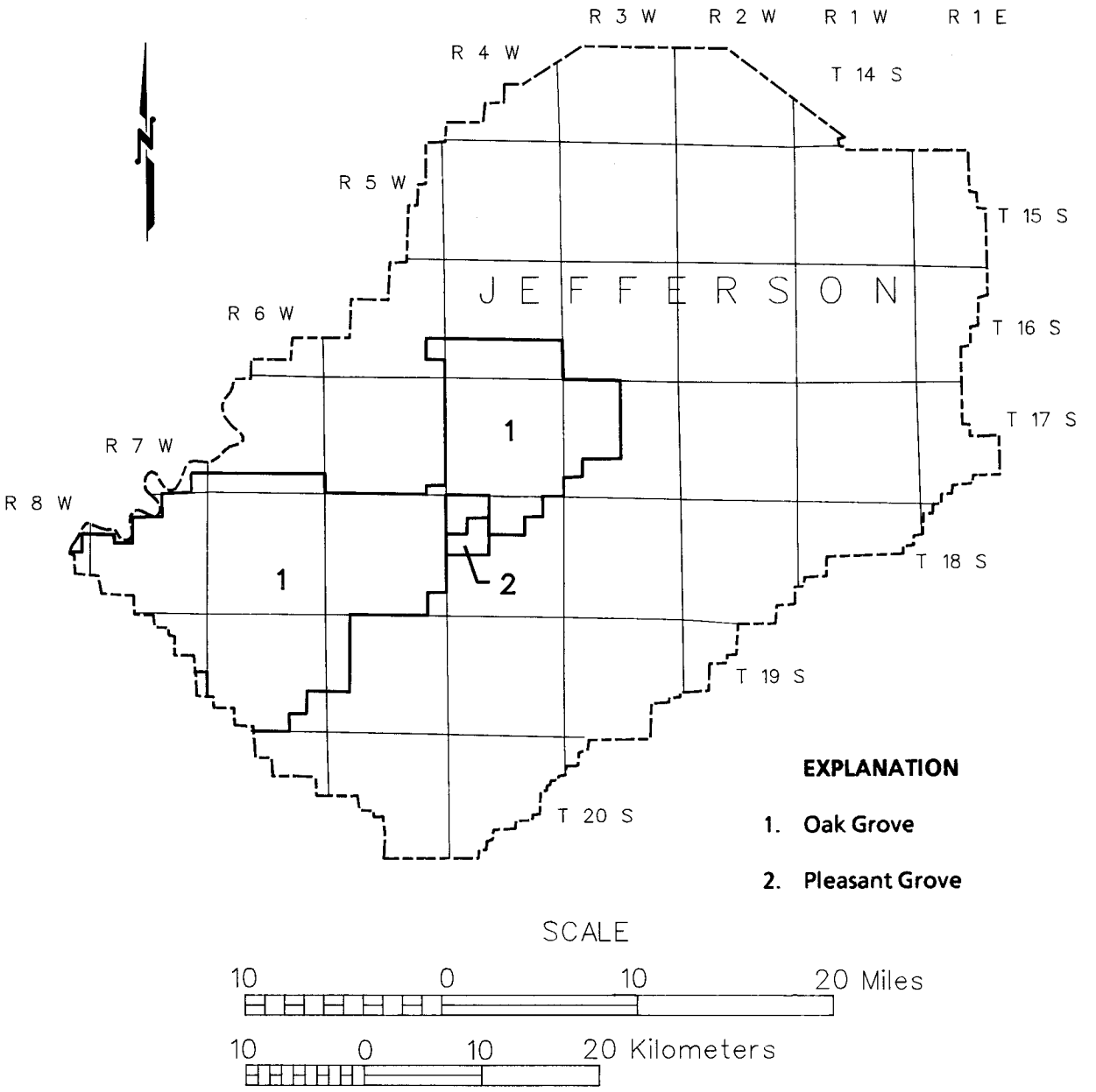

Figure 2.--Locations of coal degasification fields in the Warrior coal basin in Jefferson County, Alabama.

DESCRIPTION OF AREA

Jefferson County lies in the north-central part of Alabama. It is bounded on the north by Blount County, on the east by St. Clair County, on the south and southeast by Bibb and Shelby Counties, respectively, on the southwest by Tuscaloosa County, and on the northwest by Walker County. With an area of approximately 1,125 square miles, it is the sixth largest county in the state, and, with an estimated 1986 population of 676,400 (U.S. Department of Commerce, Bureau of Census, 1988), it is the most populated. Birmingham, the county seat, is the most populated city in the state with an estimated 277,510 inhabitants in 1986. The county has 82 miles of interstate highway and two state licensed airports and has access to an extensive river transportation system. Railroad systems serving the county include the

Burlington-Northern, CSX Transportation, Norfolk Southern, and Birmingham Southern Railroad systems.

The county has an industrial and agricultural economy. Major industries include producers of steel and cast iron products, carbonated beverages, fire extinguishers, and jellies and jams; poultry processors; wholesale and retail distributors; and producers of nonrenewable natural resource products such as coal and natural gas. Important agricultural products are eggs and timber.

PHYSIOGRAPHY AND TOPOGRAPHY

Jefferson County lies within parts of two physiographic provinces (fig. 3). The northwestern half of the county is in the Cumberland Plateau section of the Appalachian Highlands division of the Appalachian Plateaus province, and the southeastern half of the county is in the Alabama Valley and Ridge section of the Appalachian Highlands division of the Valley and Ridge province.

The major physiographic features in the Cumberland Plateau section in the county are Blount Mountain, Murphrees Valley, and the Warrior basin. Blount Mountain is a prominent, steep-sided, dissected plateau formed upon gently dipping beds of the Pottsville Formation. In Jefferson County, Blount Mountain is bounded on the southeast by Birmingham Valley and on the northwest by Murphrees Valley. Murphrees Valley is a faulted anticlinal valley containing inner valleys and ridges. It is bounded on the west by the Warrior basin physiographic district and merges with Birmingham Valley to the south. The Warrior basin is a broad, dissected upland of moderate relief formed upon gently dipping beds of the Pottsville Formation.

The Alabama Valley and Ridge section structurally consists of the Birmingham anticlinorium, Cahaba synclinorium, and the western edge of the Coosa synclinorium. This region is characterized by a series of northeast-southwest-trending valleys and ridges, including the Birmingham Valley, Cahaba Ridges, Cahaba Valley, and Coosa Ridges. Birmingham Valley extends from near the Jefferson-St. Clair County boundary in the northeast to near the Jefferson-Tuscaloosa-Bibb County boundaries to the southwest. The valley is approximately 45 miles long and ranges from 3 to 7 miles in width. The southwestern end of the valley is covered by Coastal Plain sediments south of Bucksville, and the northeastern end is bounded by Murphrees Valley and Blount Mountain, and merges with Big Canoe Valley in western St. Clair County. The central section of Birmingham Valley is divided into two smaller valleys by Flint Ridge. Opossum Valley lies adjacent to Flint Ridge on the west, and Jones Valley lies to the east. The southeastern side of the Birmingham Valley is bounded by escarpments formed by the relatively resistant beds in the Parkwood and Pottsville Formations. These escarpments locally are referred to as Shades and Little Shades Mountains. One of the most prominent topographic features in the county, Shades Mountain, rises to an elevation of about 1,150 feet above mean sea level.

Red Mountain is a narrow ridge along the eastern side of Birmingham Valley. Like Shades Mountain, it is a distinctive topographic feature, with a maximum elevation of about 950 feet. Immediately to the northwest of Red Mountain is Jones Valley, and to the southeast is Shades Valley.

The Cahaba Ridges are situated to the southeast of Birmingham Valley. They are a series of ridges and valleys formed on sandstone and shale units in the Parkwood and Pottsville Formations.

Cahaba Valley is located to the southeast of the Cahaba Ridges and northwest of the Coosa Ridges. It is approximately 10 miles long and 2 to 3 miles wide. The boundary between the Cahaba Valley and Cahaba Ridges is marked by the Helena thrust fault and a long, narrow valley underlain by shales of the Rome Formation.

To the southeast of Cahaba Valley are the Coosa Ridges. This set of ridges and valleys is formed by sandstones and shales of the Parkwood and Pottsville Formations. Oak Mountain forms the northwestern boundary of the Coosa Ridges in Jefferson County.

DRAINAGE

Most of Jefferson County lies within the Black Warrior River basin. Areas of the county southeast of Red Mountain, however, are in the Cahaba River basin. The northwestern half of the county is drained primarily by Locust Fork and Valley, Five Mile, Turkey, Gurley, Village, Mud, and Rock Creeks. These streams primarily exhibit a dendritic drainage pattern as they flow

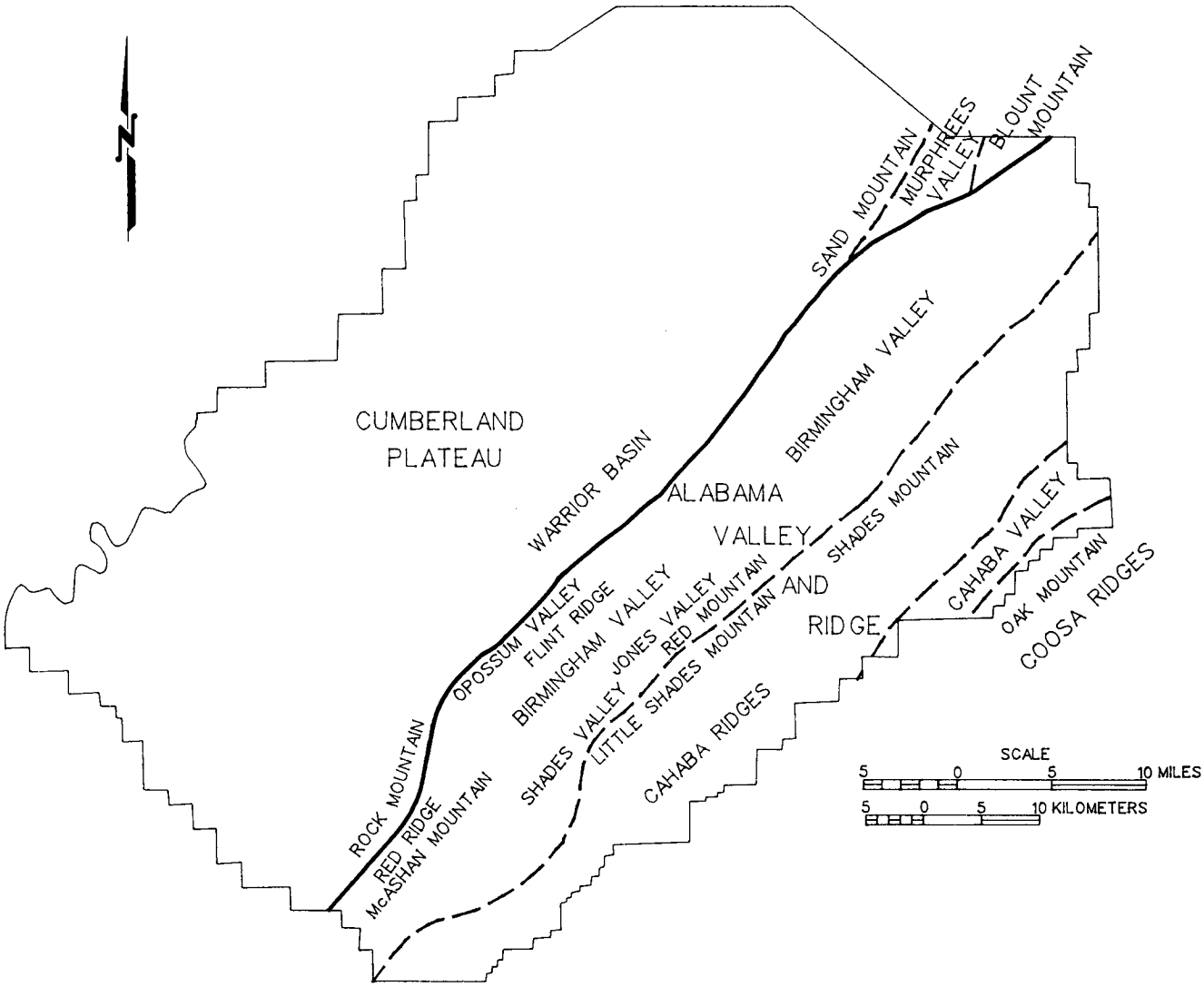

Figure 3.--Physiographic divisions and features in Jefferson County, Alabama (modified from Sapp and Emplaincourt, 1975).

across gently dipping rocks in the Warrior basin. Streams draining the southeastern half of the county include the Cahaba and Little Cahaba Rivers and Shades, Little Cahaba, Patton, and Mill Creeks. A trellised drainage pattern is common in this part of the county, reflecting the presence of steeply dipping beds of varying lithology in the Valley and Ridge.

CLIMATE

Jefferson County lies in the Appalachian Mountain climatological division of Alabama. Its climate is characterized as humid subtropical, with hot summers, mild winters, and precipitation during all months of the year. Precipitation, almost all of which occurs as rainfall, averages about 54 inches annually. Temperatures range from an average of about 43°F (degrees Fahrenheit) in January to about

80°F in July. The average annual temperature is approximately 62°F. The base period 1951 to 1980 was used in calculating these climatic data.

GEOLOGY

GENERAL STRATIGRAPHY

Jefferson County is underlain by more than 10,000 feet of sedimentary rocks that range in age from Cambrian to Holocene. Rocks in the northwestern half of the county have very gentle dips while those in the southeastern half of the county commonly are steeply dipping and even overturned in many places as a result of folding and faulting. The gently dipping rocks in the Warrior basin are separated from the disturbed units in the Valley and Ridge by the Appalachian structural front, a tectonic zone situated along the northwestern edge of Birmingham Valley.

Alternating carbonate and clastic units of Cambrian age are exposed along the axes of eroded anticlines and adjacent to the major thrust faults. Cambrian- to Mississippian-age carbonate and clastic rocks are exposed along the flanks of the anticlines. Resistant sandstones and shales of Pennsylvanian age are exposed in the Warrior basin and along the crests of some of the higher ridges in the county. Overlying the bedrock in most areas of the county are varying thicknesses of unconsolidated material commonly referred to as regolith. These deposits consist of fragmented rock material derived from the intense weathering of the bedrock. Late Cretaceous units of sand, gravel, and clay exist as outliers on hilltops near the Tuscaloosa and Bibb County boundaries. Thin accumulations of unconsolidated alluvial sediments of Holocene age occur along many of the larger streams and rivers in the county. Similar deposits of sand, gravel, and clay are present at higher elevations above some of the streams. Known as terrace deposits, these sediments are ancient remnants of the floodplains that existed when the streams were at higher elevations than they are today.

The outcrops and the subsurface relationship of the geologic units in Jefferson County are shown in figure 4. The following lithologic descriptions and thickness values were modified from Moffett and Moser (1978), Kidd and Richter (1979), and Szabo and others (1988).

CAMBRIAN SYSTEM

ROME FORMATION

The Rome Formation consists of variegated thinly interbedded mudstone, shale, siltstone, and sandstone, with local occurrences of limestone and dolomite. Quartzose sandstone is common near the top of the formation. The Rome has a thickness of at least 500 feet. The only exposure of the Rome in Jefferson County is found in a thin belt adjacent to the Helena thrust fault in the Cahaba Valley.

CONASAUGA FORMATION

The Conasauga Formation is composed of medium-bluish-gray fine-grained, thin-bedded, argillaceous limestone with varying proportions of interbedded dark-gray shale. The Conasauga is estimated to be between 1,100 and 1,900 feet thick. The formation occurs throughout Jones and Opossum Valleys, but is absent in Cahaba Valley (Butts, 1910). The regolith covering the Conasauga bedrock has an average thickness of about 35 feet (Barksdale and Moore, 1976).

KETONA DOLOMITE

The Ketona is composed of light- to medium-gray thick-bedded coarsely crystalline dolomite. The formation is present throughout Cahaba and Opossum Valleys and in Jones Valley north of McCalla. In these areas, the formation attains a maximum thickness of about 600 feet. The Ketona is absent south of the McCalla area.

CAMBRIAN AND ORDOVICIAN SYSTEMS

KNOX GROUP UNDIFFERENTIATED

The Knox Group includes, in ascending order, the Copper Ridge Dolomite, Chepultepec Dolomite, Longview Limestone, and Newala Limestone. In the Birmingham anticlinorium, the Knox is represented by the Copper Ridge and Chepultepec and is mapped either as the Copper Ridge (Єcr) or as the Copper Ridge-Chepultepec undifferentiated (OЄccr). In Cahaba Valley, however, the entire section of Knox is present and is mapped as the Knox Group undifferentiated (OЄk) or the Copper Ridge-Chepultepec undifferentiated (OЄccr), Longview Limestone (Olv), and Newala Limestone (On).

The Knox consists of light-gray to light-brown locally sandy dolomite, dolomitic limestone, and limestone. Light-colored chert is abundant. The thickness of the Knox ranges from about 1,500 feet in the southwestern part of the county to at least 3,000 feet in Cahaba and Murphrees Valleys. The regolith developed upon the bedrock of the Knox Group consists primarily of clay and fragments of chert. The regolith of the Copper Ridge and Chepultepec Dolomites usually contains more chert than that of the Longview and Newala Limestones. The average thickness of the regolith overlying the Cambrian and Ordovician carbonate rocks as discussed by Barksdale and Moore (1976) is about 75 feet.

ORDOVICIAN SYSTEM

LITTLE OAK AND LENOIR LIMESTONES UNDIFFERENTIATED

The Little Oak and Lenoir Limestones are exposed in Cahaba Valley. These units are composed of dark-gray argillaceous, fossiliferous medium- to thick-bedded limestone. Rare chert is present locally in the upper part and fenestral mudstone in the lower part (Mosheim Limestone Member of the Lenoir Limestone). These units total approximately 1,000 feet in thickness.

CHICKAMAUGA LIMESTONE, ATTALLA CHERT CONGLOMERATE MEMBER

The Attalla Chert Conglomerate Member of the Chickamauga Limestone is present in Birmingham Valley. The conglomerate is composed of pebbles, cobbles, and boulders of chert and rare dolomite and quartzite in a sand-sized chert and quartz matrix. Thin beds of gray-green or dusky-red shale are common at the base. The unit has an average thickness of about 20 feet and a maximum thickness of about 50 feet.

CHICKAMAUGA LIMESTONE

The Chickamauga Limestone is exposed in Birmingham-Big Canoe Valley. The formation consists of medium- to dark-gray thick- to thin-bedded partly argillaceous, locally fossiliferous limestone and is between 200 and 500 feet thick.

SEQUATCHIE FORMATION

The Sequatchie Formation is composed of light-olive-gray and dusky-red calcareous shale interbedded with light- to dark-gray fine- to coarse-grained partly bioclastic, argillaceous, locally glauconitic limestone. The formation is present in Birmingham and Murphrees Valleys where it attains a maximum thickness of about 3 feet.

SILURIAN SYSTEM

RED MOUNTAIN FORMATION

The Red Mountain Formation consists of dark-reddish-brown to olive-gray partly fossiliferous, mostly fine-grained sandstone interbedded with siltstone and shale. Minor amounts of bioclastic limestone and conglomeratic sandstone are present in the formation. The formation also includes hematite beds and beds of ferruginous sandstone. The Red Mountain is exposed in the Birmingham Valley and in a fault block along the southeastern boundary of the Cahaba Ridges adjacent to the Helena fault. Thickness of the formation ranges from 200 to 500 feet in Birmingham Valley and in the subsurface of the Warrior basin. It is 350 feet thick or less in the subsurface of the Cahaba Ridges. Individual hematite beds range from 5 to 30 feet thick.

DEVONIAN SYSTEM

FROG MOUNTAIN SANDSTONE AND CHATTANOOGA SHALE UNDIFFERENTIATED

The Frog Mountain Sandstone is composed of light- to dark-gray sandstone with thin dark-gray shale interbeds. Light-gray to black dolomudstone, glauconitic limestone, and fossiliferous chert occur locally in the lower part of the formation. The Frog Mountain is present in Cahaba Valley and ranges from 0 to 36 feet thick.

The Chattanooga Shale consists of brownish-black to black organic shale containing light- to dark-gray sandstone interbeds near the base. The unit occurs in Birmingham Valley at a maximum thickness of about 20 feet.

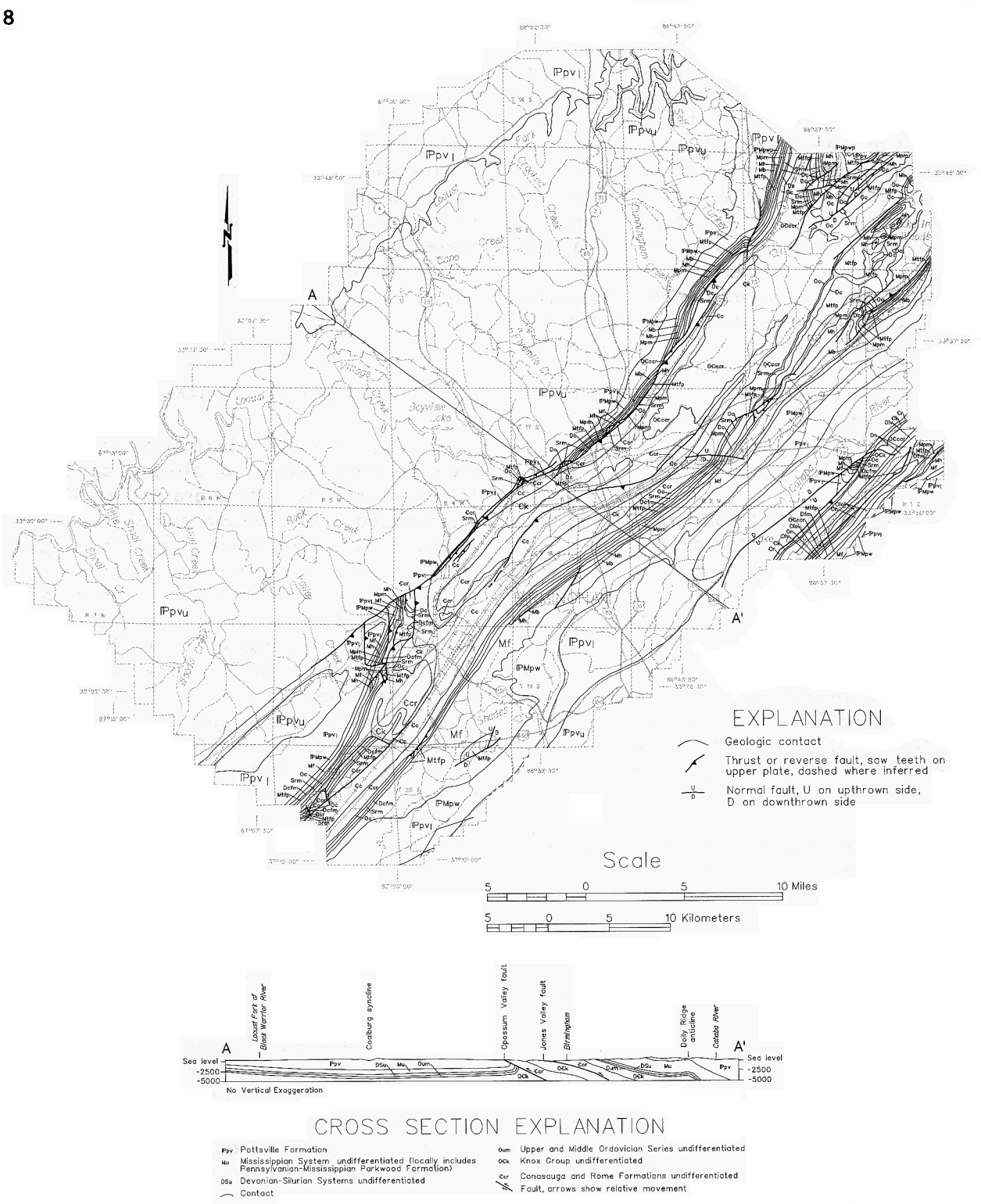

Figure 4.--Generalized geologic map and structural cross section for Jefferson County, Alabama (modified from Osborne and others, 1988, and Szabo, Osborne and Copeland, 1988).

EXPLANATION

System	Map Symbol	Description
Cretaceous	Kck	**Coker Formation** Light-colored micaceous very fine to medium sand, cross-bedded sand, varicolored micaceous clay, and a few thin gravel beds containing quartz and chert pebbles. Beds of thinly laminated finely glauconitic very fine to fine sand, silt and dark-gray carbonaceous clay (Eoline Member) occur locally in the lower part.
Pennsylvanian	IPpv	**Pottsville Formation** Light-gray thin- to thick-bedded quartzose sandstone and conglomerate containing interbedded dark-gray shale, siltstone, and coal.
	IPpv$_l$	**Pottsville Formation (lower part)** Light-gray thick-bedded to massive pebbly quartzose sandstone, containing varying amounts of interbedded dark-gray shale, siltstone, and thin discontinuous coal.
	IPpv$_u$	**Pottsville Formation (upper part)** Interbedded dark-gray shale, siltstone, medium-gray sandstone, and coal in cyclic sequences.
Mississippian	IPMpw	**Parkwood Formation** Interbedded medium- to dark-gray shale and light- to medium-gray sandstone; locally contains dusky-red and grayish-green mudstone, argillaceous limestone, and clayey coal.
	IPMpwp	**Parkwood and Pennington Formations undifferentiated** Interbedded medium- to dark-gray shale and light- to medium-gray sandstone; locally contains lithic conglomerate, dusky-red and grayish-green mudstone, argillaceous limestone, chert and clayey coal.
	Mb	**Bangor Limestone** Medium-gray bioclastic and oolitic limestone, containing interbeds of dusky-red and olive-green mudstone in upper part.
	Mf	**Floyd Shale** Dark-gray shale, sideritic in part; thin beds of sandstone, limestone, and chert are locally present.
	Mh	**Hartselle Sandstone** Light-colored thick-bedded to massive quartzose sandstone, containing interbeds of dark-gray shale.
	Mpm	**Pride Mountain Formation** Medium- to dark-gray shale, containing one to three units of a variable combination of sandstone and limestone in the lower part; locally contains rare interbeds of dusky-red and greenish-gray mudstone.
	Mtfp	**Tuscumbia Limestone and Fort Payne Chert undifferentiated** Light- to dark-gray, fossiliferous and oolitic partly argillaceous and cherty limestone, with abundant irregular light-gray chert nodules and beds. Basal beds are greenish-gray to grayish-red phosphatic shale (Maury Formation).
Devonian	Dc	**Chattanooga Shale** Brownish-black to black organic shale containing light- to dark-gray sandstone and rare limestone interbeds near the base.
	Dcfm	**Chattanooga Shale and Frog Mountain Sandstone undifferentiated** (In areas mapped as Dcfm one or both units may be locally absent; see individual descriptions.)
	Dfm	**Frog Mountain Sandstone** Light- to dark-gray sandstone with thin dark-gray shale interbeds; light-gray to black dolomudstone, glauconitic limestone, and fossiliferous chert.
Silurian	Srm	**Red Mountain Formation** Greenish-gray to dark-gray slightly calcareous, partly sandy shale; greenish-gray to light-brownish-gray cherty, argillaceous, dolomitic, siliceous, sandy and glauconitic limestone and medium-gray calcareous sandstone.
Ordovician	Os	**Sequatchie Formation** Grayish-red, grayish-green, and yellowish-gray thin-bedded calcareous shale and calcareous mudstone containing interbedded fossiliferous limestone, and medium-gray to moderate-red partly sandy and glauconitic, medium- to coarse-grained bioclastic limestone.
	Oc	**Chickamauga Limestone** Medium- to dark-gray thick- to thin-bedded partly argillaceous, locally fossiliferous limestone. Occasionally includes a thin interval of the Attalla Chert Conglomerate Member at base.
	Olol	**Little Oak and Lenoir Limestones undifferentiated** Dark-gray argillaceous, fossiliferous medium- to thick-bedded limestone; locally contains rare chert in the upper part and an interval of fenestral mudstone in the lower part (Mosheim Limestone Member of the Lenoir Limestone).
	On	**Newala Limestone** Light- to dark-gray thick-bedded micritic and peloidal limestone and minor dolomite.
	Olv	**Longview Limestone** Light- to medium-gray thick-bedded cherty limestone and dolomite, locally sandy.
Cambrian	O€k	**Knox Group undifferentiated in part** Light-gray to light-brown locally sandy dolomite, dolomitic limestone, and limestone; characterized by abundant light-colored chert.
	O€ccr	**Chepultepec and Copper Ridge Dolomites undifferentiated** Light-gray to dark-bluish-gray thick-bedded dolomite and interbedded light-gray limestone; includes abundant chert.
	€cr	**Copper Ridge Dolomite** Light-gray finely to coarsely crystalline, thick-bedded siliceous dolomite; characterized by abundant stromatolitic chert.
	€k	**Ketona Dolomite** Light- to medium-gray thick-bedded coarsely crystalline dolomite.
	€c	**Conasauga Formation** Medium-bluish-gray fine-grained, thin-bedded argillaceous limestone and interbedded dark-gray shale in varying proportions.
	€r	**Rome Formation** Variegated thinly interbedded mudstone, shale, siltstone, and sandstone; limestone and dolomite occur locally. Quartzose sandstone commonly present near top of formation.

MISSISSIPPIAN SYSTEM

MAURY FORMATION, FORT PAYNE CHERT, AND TUSCUMBIA LIMESTONE UNDIFFERENTIATED

The Maury consists of greenish-gray to grayish-red phosphatic shale and is approximately 1 to 3 feet thick. The formation is exposed intermittently in the Birmingham area, and because of its limited thickness, is mapped with the overlying Fort Payne Chert and Tuscumbia Limestone.

The Fort Payne Chert is composed of light- to dark-gray limestone with abundant irregular light-gray chert nodules and beds. The formation ranges from about 90 to 200 feet thick.

The Tuscumbia Limestone consists of light- to dark-gray fossiliferous and oolitic partly argillaceous and cherty limestone. The Tuscumbia is not present in Cahaba Valley and is only rarely exposed in the Birmingham area. Reported thicknesses of the formation range from 70 to 110 feet.

PRIDE MOUNTAIN FORMATION

The Pride Mountain Formation is composed of medium- to dark-gray shale with one to three units of a variable combination of sandstone and limestone in the lower part. Locally, the formation contains interbeds of dusky-red and greenish-gray mudstone. The Pride Mountain is exposed in Birmingham and Cahaba Valleys. The formation is between 120 and 420 feet thick.

HARTSELLE SANDSTONE

The Hartselle Sandstone consists of light-colored thick-bedded to massive quartzose sandstone, containing interbeds of dark-gray shale. Present in Birmingham and Cahaba Valleys, the Hartselle reaches a thickness of about 120 feet.

BANGOR LIMESTONE

The Bangor Limestone is composed of medium-gray bioclastic and oolitic limestone with interbeds of dusky-red and olive-green mudstone in the upper part. Approaching a maximum thickness of about 500 feet in the subsurface of the northeastern part of the county, the Bangor thins toward the south and is absent in the southern part of the county.

FLOYD SHALE

The Floyd Shale consists of dark-gray shale, sideritic in part, with local occurrences of thin beds of sandstone, limestone, and chert. The formation is between 0 and 600 feet thick in Birmingham Valley and in the subsurface of the Warrior basin. The unit is 300 to 1,000 feet thick in Cahaba Valley and in the subsurface of the Cahaba Ridges.

MISSISSIPPIAN AND PENNSYLVANIAN SYSTEMS

PARKWOOD FORMATION

The Parkwood Formation is composed of interbedded medium- to dark-gray shale and light- to medium-gray sandstone. Locally present are dusky-red and grayish-green mudstone, argillaceous limestone, and clayey coal. The Pennington Formation of Mississippian age is mapped with the Parkwood in Murphrees Valley and on Blount Mountain. However, since the Pennington occupies only a small area in the northeastern part of the county, it is not addressed separately in this report. The thickness of the Parkwood ranges from about 1,400 feet in the Trussville area to about 2,500 feet in the area south of Greenwood.

PENNSYLVANIAN SYSTEM

POTTSVILLE FORMATION

The Pottsville Formation is exposed in the Warrior basin, Cahaba Ridges, Cahaba Valley, and Blount Mountain in Jefferson County. Lithologies in the Pottsville differ between the Alabama Valley and Ridge and Cumberland Plateau physiographic sections, as well as stratigraphically within each of these sections. The formation, therefore, is divided into upper and lower parts within these sections. However, in this report, the Pottsville is addressed as a single hydrologic unit.

The Pottsville consists of light- to medium-gray thin-bedded to massive pebbly quartzose sandstone with interbedded dark-gray shale, siltstone, and coal. The upper part of the formation contains most of the economically

important coal seams. The thickness of the Pottsville ranges from about 100 feet along Shades Mountain to about 2,000 feet in the western part of the county.

CRETACEOUS SYSTEM

COKER FORMATION

The Coker Formation is composed of unconsolidated deposits of sand, clay, and gravel. The sand is light-colored, micaceous, very fine to medium grained. The clays are light gray to pale purple to moderate pink. Very pale-orange to grayish-orange quartz and chert gravel usually is present near the base of the formation. Since the Coker exists only as isolated outliers on some hilltops in the southwestern corner of the county, it is not shown on the geologic map. The unit has a maximum thickness of about 60 feet.

QUATERNARY SYSTEM

QUATERNARY(?) GRAVELS

Unconsolidated to semiconsolidated deposits of sand and gravel possibly of Quaternary age are present at several places in Cahaba Valley and at one place near Chalkville. The deposits are composed of quartzite pebbles and cobbles with some chert cobbles in a matrix of chert fragments and/or fine- to very coarse-grained quartz and chert sand. In one exposure near Leeds, these deposits are approximately 50 feet thick. Like the Coker Formation, outcrops of the Quaternary gravels are very isolated and therefore are not shown on the geologic map.

LOW TERRACE DEPOSITS AND ALLUVIUM

Adjacent to some of the larger streams in the county are unconsolidated deposits of gravel, sand, and silt. These sediments have been eroded from rocks across which the streams flow and subsequently were transported and redeposited downstream. The clasts within the matrix are primarily chert and quartz fragments. Thickness of these deposits is usually less than 30 feet. Because they are very thin and only intermittently present, the terrace and alluvial deposits are not shown on the geologic map.

OCCURRENCE AND AVAILABILITY OF GROUND WATER

Ground water occurs in open spaces between grains of a rock or sediment, as well as in fractures, crevices, or along bedding planes in the rock. In order for a rock or sediment to be of value as an aquifer, it must be porous and permeable to a certain degree. Porosity is defined as the ratio of the volume of void space in a rock or sediment to the total volume of the rock or sediment. Permeability is the ability of a rock or sediment to transmit fluids. Porosities of sandstone usually are between 3 and 30 percent, while those of carbonate rocks such as limestone and dolomite normally range from less than 1 to 30 percent (Fetter, 1980).

The availability of ground water in an area depends upon several factors, including precipitation amounts, topography, and the physical characteristics of the rocks or sediments in the area. In areas underlain by sandstone, limestone, or dolomite, as is most of Jefferson County, ground-water availability can be highly variable from place to place. This is largely due to wide variations in the porosities and permeabilities of the rocks. The zones of highest porosity in sandstone and carbonate rocks are found along fractures, joints, and bedding planes. Particularly in carbonate rocks, ground water circulating through these openings can dissolve the rock, thereby greatly increasing the porosity. Permeability is increased as these solution channel systems become more extensive and interconnected. The porosity of carbonate rocks commonly is greater in valleys because ground- and surface-water drainage toward the low-lying areas results in increased dissolution of the rocks. Sandstone porosities are generally more uniform than those in carbonates. Sandstones are much more resistant to chemical weathering than carbonates, however, and therefore do not commonly contain zones of extremely high porosity as do cavernous limestones. In both carbonate and clastic rocks, porosities and permeabilities usually decrease with depth since the deeper rocks are less weathered and are under pressure from the weight of overlying rocks. For these reasons, the chances of obtaining significant amounts of water at depths greater than about 300 feet are small.

The water-bearing characteristics of the aquifers in Jefferson County are discussed in the

following sections. The geologic units that are not considered to be significant aquifers in the county are omitted from the discussion. Table 1 summarizes the lithologic and water-bearing characteristics of the aquifers in the county.

CONASAUGA FORMATION

The Conasauga is a source of large quantities of water for wells and springs in Jefferson County. Because the zones of increased porosity and permeability are concentrated along solution channels, however, the availability of water from the formation is not uniformly distributed. The wells with the highest yields are those that penetrate the solution-enlarged openings in the rock. Test drilling is often required to locate these cavities. Reported well yields as high as 300 gpm (gallons per minute) and estimated spring discharges of up to 3,400 gpm from the Conasauga have been documented in previous studies (Johnston, 1933; Robinson and others, 1953; Moffett and Moser, 1978). The porosity of the formation is estimated to be about 1.5 percent (Barksdale and Moore, 1976). This estimate does not include interstitial porosity in the formation, since water in these pore spaces could not be developed by conventional methods. As in most consolidated aquifers, the porosity and permeability in the Conasauga generally decrease with depth. Most of the ground water is contained within the upper 300 feet of the formation.

The regolith covering the Conasauga bedrock would likely provide small quantities of water to very shallow wells in some areas. Often capable of storing large amounts of water, the regolith releases the water very slowly to the underlying bedrock.

KETONA DOLOMITE

The Ketona is a major producer of water in Jefferson County. Moffett and Moser (1978) reported well yields as high as 390 gpm and estimated spring flows of 2,000 gpm from the Ketona. Extensive solution channels in the

Table 1.--Characteristics of the major water-bearing units in Jefferson County, Alabama

Geologic unit	Range in thickness (ft)	Water-bearing characteristics
Pottsville Formation	100 - 2,000	Water is concentrated in fractures, joints, and along bedding planes. Usually yields less than 10 gpm per well.
Bangor Limestone	0 - 500	Water contained in solution-enlarged cavities, joints, and fractures. Capable of supplying 500 + gpm in some areas.
Hartselle Sandstone	0 - 120	Water found in fractures, joints, and interstitial pores. Generally yields small quantities of water to wells and springs, although large quantities have been documented from some areas.
Fort Payne Chert and Tuscumbia Limestone undifferentiated	160 - 310	Water occurs in solution-enlarged openings. Reported to provide 800 + gpm per well in some parts of the county.
Chickamauga Limestone	200 - 500	Water found in solution cavities, joints, fractures, and along bedding planes. Yields of 700 gpm from the formation have been reported in Jefferson County.
Little Oak and Lenoir Limestones undifferentiated	Up to 1,000	Water occurs in solution cavities. Probably capable of providing large quantities of water to wells where solution cavity development is extensive.
Knox Group undifferentiated	1,500 - 3,000	Large quantities of water occur in solution cavities. Reported well yields of 820 gpm and measured spring discharges as high as 3,900 gpm have been documented from the Knox Group.
Ketona Dolomite	400 - 600	Water occurs in solution cavities. Reported well yields as high as 390 gpm and estimated spring discharges of 2,000 gpm from the Ketona have been documented.
Conasauga Formation	1,100 - 1,900	Water found in solution cavities. Reported well yields as high as 300 gpm and estimated spring discharges of 3,400 gpm from the Conasauga have been documented.

formation are the sources for the largest quantities of water. Barksdale and Moore (1976) estimated the porosity of the Cambrian and Ordovician carbonate rocks, including the Ketona, in the Valley and Ridge province to be about 1.5 percent.

The formation of sinkholes in the Ketona has been a serious problem in some areas. In all probability, the pumping of large quantities of ground water from the Ketona contributes to land subsidence near the zones of pumping. As heavy pumping lowers the water table in an area, solution cavities that are normally filled with water are emptied to a degree and thus the fluid pressure adding support to the cavity walls is decreased or removed altogether. In addition, subsurface erosion may proceed at increased rates as the water table fluctuates. These conditions can eventually result in the collapse of surficial materials into the underlying void spaces, thereby forming sinkholes.

KNOX GROUP UNDIFFERENTIATED

Large quantities of water are contained within solution channels in the Knox Group. Wells with reported yields of 145, 230, and 750 gpm were inventoried by Knight (1976b). In the same report, Knight documented the presence of a well that was pumped at a reported 820 gpm for 21 hours. Springs with measured discharges as high as 3,900 gpm have been inventoried in previous studies (Moffett and Moser, 1978).

Because it contains an abundance of chert fragments, the regolith of the Copper Ridge and Chepultepec Dolomites generally is more permeable than that of the Longview and Newala Limestones. Dug wells may obtain small quantities of water from the regolith.

LITTLE OAK AND LENOIR LIMESTONES UNDIFFERENTIATED

The Little Oak and Lenoir Limestones contain water in solution cavities. Due to paucity of information, statements of water yields from specific wells or springs in these units cannot be made. It is likely, however, that large quantities of water are available where solution cavity development is extensive in these rocks.

According to Barksdale and Moore (1976), the regolith of the Little Oak will usually yield quantities of water adequate for domestic use, while that of the Lenoir may not because of low permeability.

CHICKAMAUGA LIMESTONE

The solution cavity systems in the Chickamauga Limestone probably are not as well developed as those in some of the other carbonate rock aquifers in the county. Nevertheless, large quantities of ground water have been obtained from the formation in some areas. One industrial-supply well inventoried by Moffett and Moser (1978) had a reported yield of 700 gpm. This well was located in a complexly faulted part of the Chickamauga. Zones where high yields are obtainable from the Chickamauga may be more difficult to delineate than for some of the other carbonate aquifers. In general, fault zones would be the most likely areas for potentially large quantities of water in the formation.

The regolith overlying the Chickamauga Limestone has a low permeability and, therefore, often yields inadequate supplies of water to shallow wells.

FORT PAYNE CHERT AND TUSCUMBIA LIMESTONE UNDIFFERENTIATED

The Fort Payne Chert-Tuscumbia Limestone may be the best aquifer in Jefferson County. This aquifer apparently has a more extensive network of interconnected fractures and solution cavities than some of the other aquifers in the area. Previous studies have indicated that this unit provides water to a large number of high-yield wells. Moffett and Moser (1978) collected data on 18 municipal and industrial supply wells completed in the Fort Payne-Tuscumbia aquifer in Jefferson County. About 80 percent of these wells had reported yields of 230 gpm or more, and 20 percent yielded 800 gpm or more.

The regolith overlying the bedrock of the Fort Payne Chert-Tuscumbia Limestone has an average thickness of about 50 feet and a porosity of 30 to 35 percent (Barksdale and Moore, 1976). Shallow wells may yield relatively small quantities of water from the regolith.

HARTSELLE SANDSTONE

The Hartselle Sandstone is a reliable aquifer in Jefferson County. Ground water in the

Hartselle is primarily found in fractures, joints, and interstitial pores in poorly cemented sandstones. Barksdale and Moore (1976) reported that the formation has an effective porosity of about 6 percent in the Valley and Ridge province.

High-capacity wells inventoried during previous studies were reported to yield 50 to 1,350 gpm from the Hartselle (Spigner, 1975; Knight, 1976b; and Moffett and Moser, 1978). However, several of these wells may have been receiving some water contributions from the Bangor Limestone. Additionally, without pumping-test data it was not known if the highest capacity wells could sustain their large yields for production purposes.

BANGOR LIMESTONE

The Bangor Limestone supplies large quantities of water to wells in the county. It is believed that much of the water is located in vertical or near-vertical joints and fractures. Moffett and Moser (1978) collected information on seven industrial or public supply wells completed in the Bangor. Reported yields from these wells ranged from 50 to 630 gpm.

The regolith of the Bangor Limestone has an average thickness of about 50 feet. Small quantities of water may be available to shallow wells completed in the regolith.

POTTSVILLE FORMATION

The Pottsville Formation usually yields less than 10 gpm of water to wells and springs in the northwestern half of the county. Concentrations of water occur in fractures, joints, along bedding planes, and in porous beds of sandstone. The formation has an overall porosity of about 10 percent (Barksdale and Moore, 1976).

CHEMICAL QUALITY OF GROUND WATER

The chemical character of natural ground water is acquired and continually altered through reactions with soluble minerals and gases in the soils and rocks through which the water travels. In general, the longer the water remains in contact with the rocks, the more mineralized it becomes. For this reason, ground water in deeper parts of an aquifer usually has a poorer chemical quality than the water in shallower zones. This is clearly evident when the results of chemical analyses of water samples collected from water wells and springs in the Pottsville Formation (appendix B) are compared to analyses of water from coal degasification wells completed in deeper zones (appendix C). The minimum, median, and maximum values of all chemical constituents were determined for samples collected from water wells and springs in the Pottsville Formation in the county (table 2).

Two of the most common water-quality problems are excessive concentrations of iron and water hardness. Iron concentrations higher than 0.3 mg/L (milligrams per liter) can result in stained clothing, plumbing fixtures, and cooking utensils. Water hardness is caused by the presence of divalent metallic cations such as calcium and magnesium. These cations react with soap to form a precipitate, thereby increasing soap usage and reducing its cleansing action. Hardness is expressed as a concentration of $CaCO_3$ and is classified as follows: soft, 0 to 60 mg/L; moderately hard, 61 to 120 mg/L; hard, 121 to 180 mg/L; and very hard, 181 mg/L or more. Excessive hardness values are most common in water obtained from carbonate rocks.

Water chemistry can be expressed in terms of the relative percentages of the major cations (Ca, Mg, Na + K) and anions (SO_4, Cl, $CO_3 + HCO_3$) in a water sample and depicted graphically on a trilinear diagram of the type developed by Hill (1940) and Piper (1944). The diagram consists of two triangular fields separated by a diamond-shaped field. Each apex of a triangle represents a 100 percent concentration of one of the constituents. The relative percentages of the three major cations (Na and K are combined) are plotted on the left-hand triangular field, and the relative percentages of the three major anions (CO_3 and HCO_3 are combined) are plotted on the right-hand triangular field. The diamond-shaped field is used to represent the composition of the water with respect to both cations and anions. The cation point is projected parallel to the magnesium axis onto the center field, and the anion point is projected parallel to the sulfate axis. The intersection of these points within the center field is then plotted. It is this point that is used to define the "hydrochemical facies" of the water. Hydrochemical facies are distinct zones that have cation and anion concentrations

Table 2.--Summary of chemical analyses of ground-water samples from 24 water wells and 1 spring in the Pottsville Formation in Jefferson County, Alabama

Abbreviations: µmhos/cm, micromhos per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; ND, not detected.

Water analysis parameter (units)	Limits for public water supplies[1]	Low value	High value	Median value
Specific conductance (µmhos/cm)	--	40	1,225	211
Bicarbonate (mg/L)	--	7	550	100
Carbonate (mg/L)	--	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	--	6	450	82
pH	--	5.6	8.2	6.8
Silica (mg/L)	--	8.9	40	18
Calcium (mg/L)	--	0.3	55	14
Magnesium (mg/L)	--	0.2	24	5.6
Sodium (mg/L)	--	1.2	280	17
Potassium (mg/L)	--	0.4	1.9	1.1
Sulfate (mg/L)	250	ND	150	8.2
Chloride (mg/L)	250	1.9	32	4.6
Fluoride (mg/L)	4	ND	0.82	<0.05
Nitrate as N (mg/L)	10	ND	5.67	0.02
Ammonia as N (mg/L)	--	ND	0.51	0.04
Orthophosphate as P (mg/L)	--	ND	0.29	ND
Arsenic (µg/L)	50	ND	4	<0.5
Barium (µg/L)	1,000	<5	450	110
Cadmium (µg/L)	10	ND	12	<0.5
Chromium (µg/L)	50	ND	1	<0.5
Iron (µg/L)	300	10	11,800	110
Lead (µg/L)	20	ND	2	ND
Manganese (µg/L)	50	<5	450	70
Mercury (µg/L)	2	ND	0.2	0.1
Selenium (µg/L)	10	ND	3	1
Silver (µg/L)	50	ND	1	ND
Strontium (µg/L)	--	10	360	80
Zinc (µg/L)	5,000	10	2,600	50
Total dissolved solids (mg/L)	500	52	665	132
Hardness as $CaCO_3$ (mg/L)	--	2	240	60

[1]Water-quality limits as established by the Alabama Department of Environmental Management (1989).

describable within defined composition categories (Freeze and Cherry, 1979). These categories comprise the hydrochemical classification system for natural waters as shown in figure 5. Changes in hydrochemical facies within an aquifer occur with depth and distance from aquifer recharge areas. Comparisons of trilinear diagrams for groups of samples collected from different zones of an aquifer can clearly illustrate the chemical evolution of ground water as it moves along its flow path.

In this report, two trilinear diagrams were created for water samples collected from the Pottsville Formation. One of these is for samples collected from water wells and springs in the relatively shallow parts of the formation, and the other represents samples from coal degasification wells completed in deeper parts of the Pottsville. These diagrams are discussed in the section addressing the quality of water in the Pottsville Formation.

CAMBRIAN AND ORDOVICIAN LIMESTONES AND DOLOMITES

Because of similarities in water quality, these rocks are grouped in this section. Included in this group are the Conasauga Formation, Ketona Dolomite, Knox Group undifferentiated, Little Oak and Lenoir Limestones undifferentiated, and the Chickamauga Limestone. During this study, 10 ground-water samples were collected from wells and springs in these units. Results of analyses of these samples in addition to other available data indicate that the water quality in these aquifers generally is good. Iron concentrations in the samples ranged from "ND" (not detected) to 20 µg/L (micrograms per liter) and hardness values ranged from 100 mg/L to 280 mg/L.

FORT PAYNE CHERT AND TUSCUMBIA LIMESTONE UNDIFFERENTIATED

Two ground-water samples were collected from wells and springs in the Fort Payne-Tuscumbia aquifer during this study. The iron concentrations in these samples were 10 µg/L and 20 µg/L, and hardness values were 49 and 85 mg/L. The complete analyses of the samples along with other available data indicate that the ground water in this aquifer has a good chemical quality.

HARTSELLE SANDSTONE

One ground-water sample was collected from the Hartselle during this study. This sample had an iron concentration of 10 µg/L and a hardness of 155 mg/L. Based on results of analyses of samples collected during previous studies, the chemical quality of ground water in the Hartselle is good.

BANGOR LIMESTONE

One sample was obtained from a well in the Bangor Limestone during this study. The results of chemical analysis of this sample in addition to water-quality data collected during previous studies indicate that the ground water in most parts of the Bangor generally is of good chemical quality. The iron concentration in the sample was 10 µg/L and the hardness was 140 mg/L. Previous studies (Spigner, 1975; Moffett and Moser, 1978) have noted that the Bangor has a history of problems associated with turbidity, subsidence, contamination, and severe drilling difficulties. It was suggested that these problems may be partly due to the highly weathered nature of the upper part of the formation as well as the shallow depths to ground water.

POTTSVILLE FORMATION

Ground-water samples were collected from 24 water wells and 1 spring in the Pottsville during this study. These samples had iron concentrations ranging from 10 µg/L to 11,800 µg/L, and hardness values from 2 mg/L to 240 mg/L. Analyses conducted during this and other studies indicate that the quality of ground water in the relatively shallow Pottsville (less than about 300 feet deep) in Jefferson County generally is good. The trilinear diagram created for water samples collected from water wells and springs in this relatively shallow zone is shown in figure 6. This diagram indicates that water in the upper part of the Pottsville in Jefferson County primarily is of the calcium-bicarbonate type.

Water in deeper parts of the Pottsville generally is of a much poorer chemical quality than that in shallower zones. The trilinear diagram in figure 7 was created using analyses of water from coal degasification wells in the Oak Grove coal degasification field in Jefferson

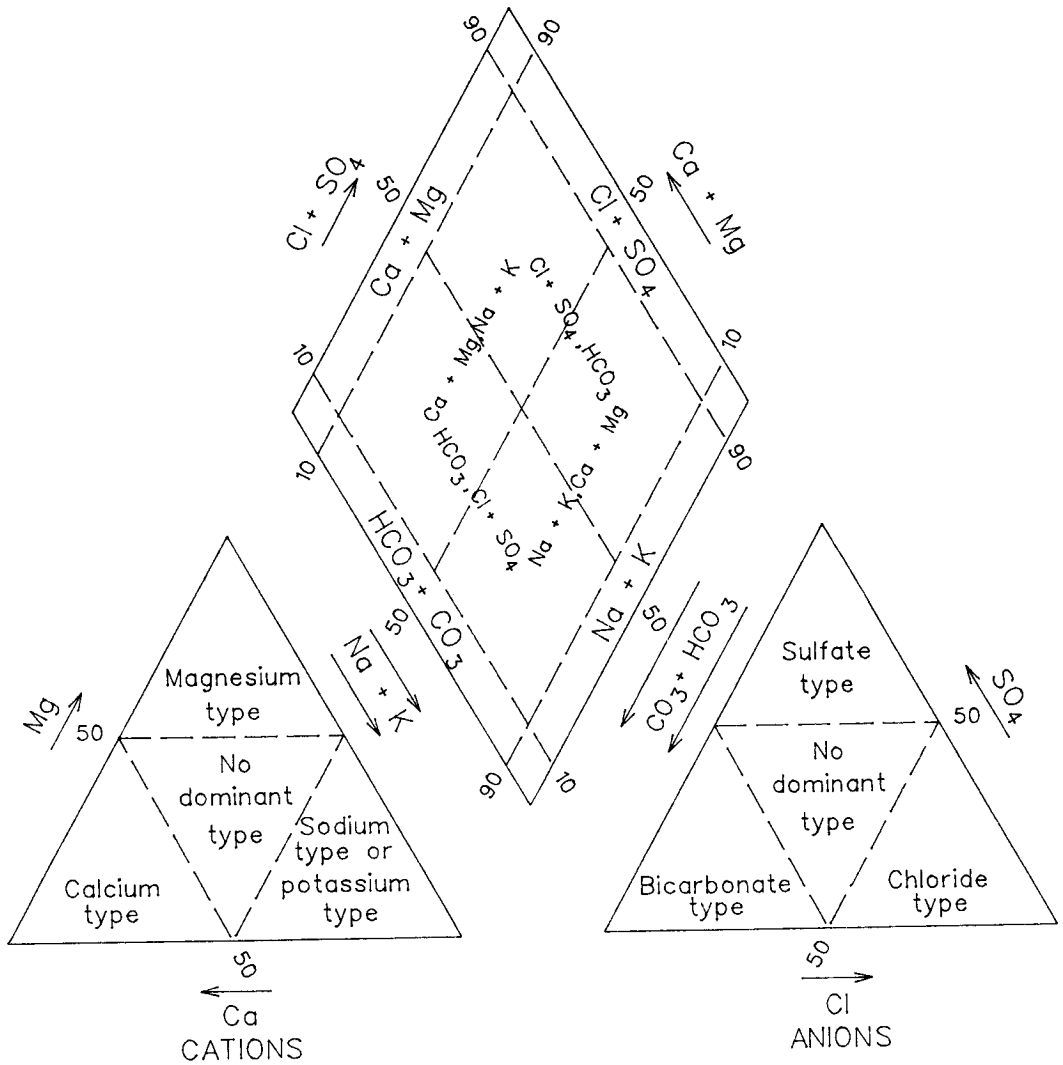

Figure 5.--Hydrochemical classification system for natural waters using the trilinear diagram.

County. Most of the degasification wells in this field have depths between 1,000 and 1,500 feet. Figure 7 shows that the water in the deeper zones of the Pottsville is of the sodium-chloride type. Water from some of the degasification wells located near an underground coal mine in the Oak Grove field is of the sodium-bicarbonate type and is unusually low in total dissolved solids. It is believed that dewatering of the mine locally has lowered the hydrostatic pressure in the Pottsville, allowing this relatively fresh water to infiltrate from shallower parts of the formation (Epsman and others, 1988).

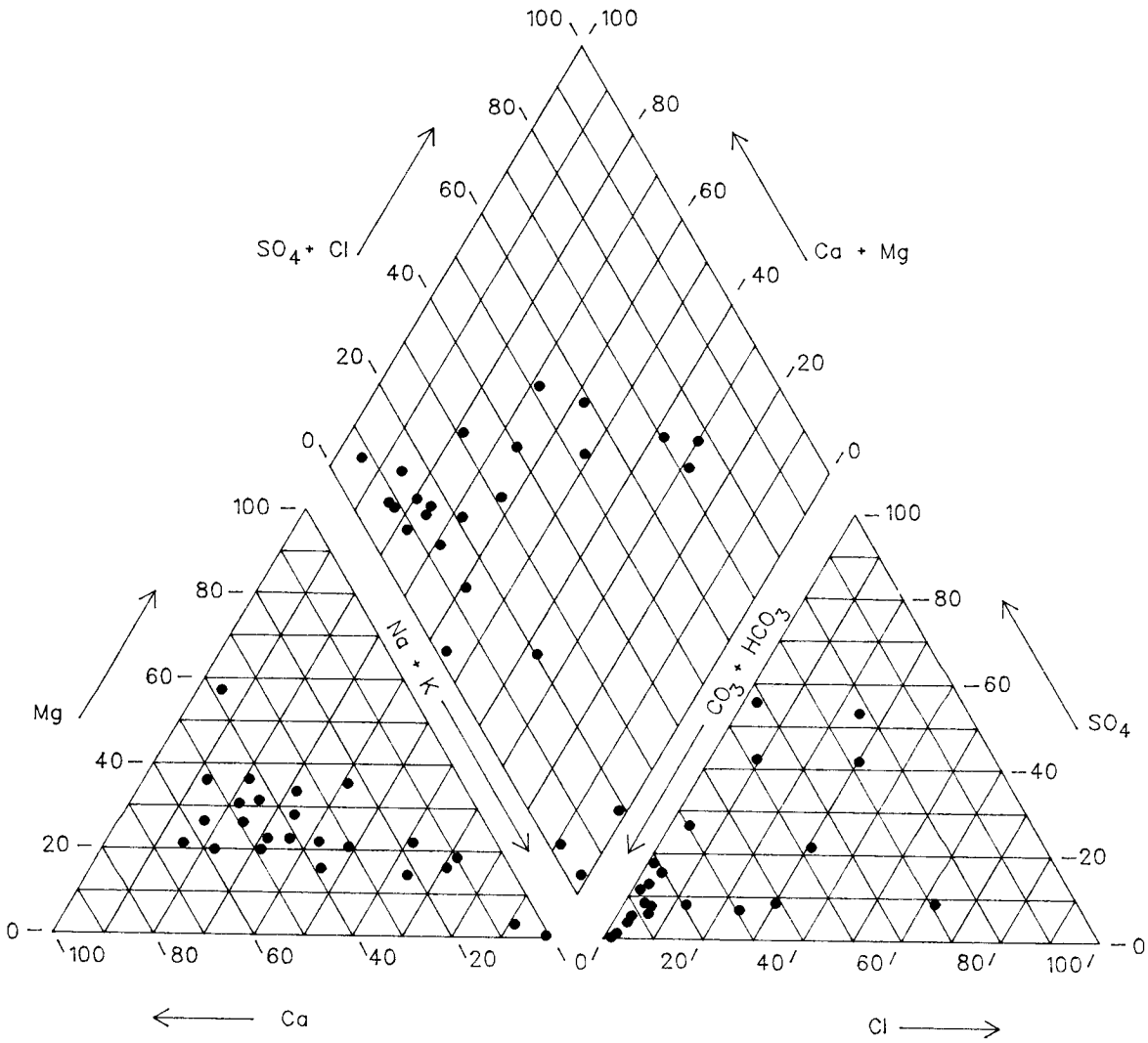

Figure 6.--Trilinear (Piper) diagram for water from 24 water wells and 1 spring in the Pottsville Formation in Jefferson County, Alabama.

COMPARISON OF RECENT AND HISTORICAL GROUND-WATER QUALITY DATA

During this study, ground-water samples were obtained from five springs and one water well that had been sampled during previous studies by Knight (1976b) and/or Moffett and Moser (1978). These sites are M-5, M-10, W-26, BB-1, DD-4, and LL-12 (pl. 1). All of these are in carbonate rocks in either Birmingham or Cahaba Valley. A comparison of the results of all

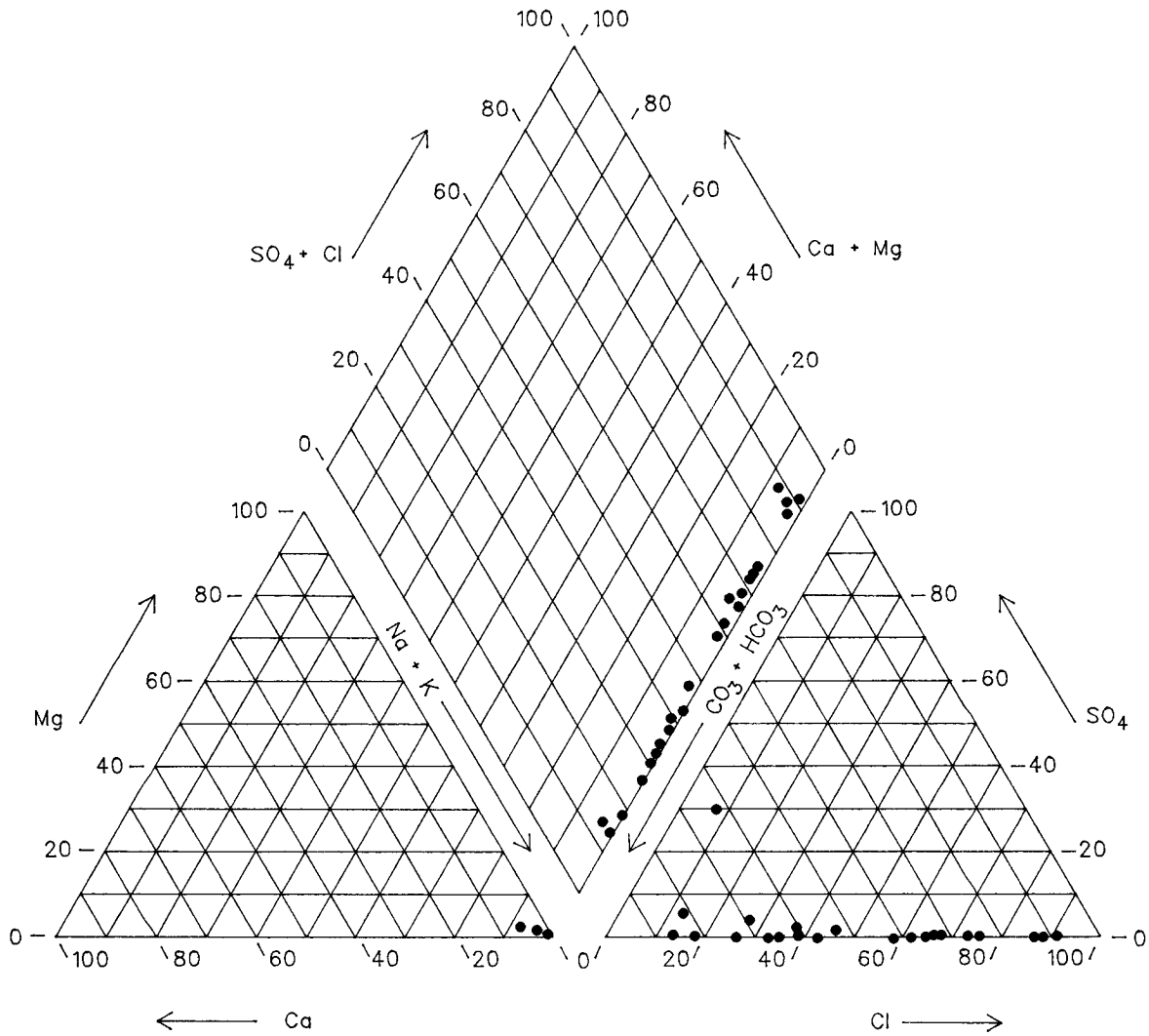

Figure 7.--Trilinear (Piper) diagram for water from coal degasification wells in the Oak Grove coal degasification field in Jefferson County, Alabama.

available chemical analyses of water from these sites indicated that no significant changes in water quality have occurred at the sites.

WATER UTILIZATION

Water utilization can be divided into two major categories: withdrawal uses and nonwithdrawal uses. Withdrawal uses are those for which the water must be withdrawn from its natural setting in streams, lakes, or aquifers in

order to be used. Nonwithdrawal or "instream" uses are those for which the water may be used while remaining in its natural setting.

WITHDRAWAL USE OF WATER

In 1985, an estimated 160.07 mgd (million gallons per day) of water was being withdrawn for use in Jefferson County (Baker and Mooty, 1987). Approximately 145.65 mgd of this total was derived from surface-water sources, and the remaining 14.42 mgd was from ground-water sources. The largest quantities of water were withdrawn for distribution by public water supply systems in the county. These systems, which include the Birmingham, Leeds, Trussville, Irondale, Warrior, and Warrior River water systems, withdrew about 105.99 mgd of surface water and 6.26 mgd of ground water. Several other public water systems in the county purchased water from these systems in 1985. Surface water sources utilized by the city of Birmingham include Inland Lake, Lake Purdy, and Lewis Smith Lake. Self-supplied domestic water users, such as those that receive water from domestic water wells and springs, withdrew about 0.24 mgd, all of which was ground water. Self-supplied domestic water users accounted for less than 1 percent of the population in Jefferson County in 1985. Table 3 provides 1985 estimates for daily water withdrawals according to major water-use category for Jefferson County.

NONWITHDRAWAL USE OF WATER

The principal nonwithdrawal uses of water in Jefferson County in 1985 were in sewage treatment and recreation/preservation. The combined discharges from 16 sewage treatment facilities in the county in 1985 were estimated to be 54.52 mgd. The amount of water used for recreation and preservation purposes cannot be quantified.

SUMMARY

The availability of ground water varies with location in Jefferson County. Carbonate rocks underlying some areas of the county, such as Birmingham and Cahaba Valleys, often have extensive networks of solution cavities from which large quantities of water may be obtained. In contrast, well-indurated sandstones of the Pottsville Formation in the northwestern half of the county usually yield only small quantities of water to wells and springs.

The chemical quality of the ground water in Jefferson County generally is good. Excessive concentrations of dissolved iron and high values of hardness are, however, the two most prevalent water-quality problems in the county. Ground water in relatively shallow zones of the Pottsville Formation primarily is of the calcium bicarbonate type, while the water in deeper parts of the formation is of the sodium chloride type.

Table 3.--Estimated daily water use in Jefferson County, Alabama, in 1985

Category	Withdrawals (mgd)	
	Ground water	Surface water
Public water supply	6.26	105.99
Self-supplied industrial/commercial	5.02	30.43
Agricultural	0.23	1.63
Self-supplied domestic	0.24	0.00
Mining	2.67	0.00
Power generation	0.00	7.60
TOTAL	14.42	145.65

Water withdrawals in Jefferson County in 1985 were estimated to be 160.07 mgd. Approximately 145.65 mgd (91 percent) of this total was withdrawn from surface water sources, and the remaining 14.42 mgd (9 percent) was ground water derived from aquifers.

SELECTED REFERENCES

Adams, G.I., Butts, Charles, Stephenson, L.W., and Cooke, C.W., 1926, Geology of Alabama: Alabama Geological Survey Special Report 14, 312 p.

Alabama Department of Environmental Management, 1982, Regulations governing public water supplies: Alabama Department of Environmental Management open-file report, 100 p.

____1989, Administrative Code: Alabama Department of Environmental Management Administrative Code R. 335-7, January 4, 1989.

Baker, R. M., and Mooty, W. S., 1987, Use of water in Alabama, 1985: Alabama Geological Survey Information Series 59D, 51 p.

Barksdale, H. C., LaMoreaux, P. E., and Knowles, D. B., 1968, Hydrology and ground water of non-Appalachia Alabama—Appendix H to report for development of water resources in non-Appalachia Alabama: Alabama Geological Survey for Alabama State Planning Industrial Development Board, 44 p.

Barksdale, H. C., and Moore, J. D., 1976, Water content and potential yield of significant aquifers in Alabama: Alabama Geological Survey open-file report, 425 p.

Bingham, R. H., and Moore, J. D., 1980, Summary of streamflow in Jefferson County, Alabama: Alabama Geological Survey Atlas 16, 21 p.

Butts, Charles, 1910, Description of the Birmingham Quadrangle [Alabama]: U.S. Geological Survey Geologic Atlas, Folio 175.

Chandler, R. V., and Moore, J. D., 1987, Springs in Alabama: Alabama Geological Survey Circular 134, 95 p.

Davis, M. E., 1980, Ground-water levels in Alabama: Alabama Geological Survey Circular 105, 74 p.

Epsman, M. L., Wilson, G. V., Pashin, J. C., Tolson, J. S., Ward, W. E., Chandler, R. V., Winston, R. B., Richter, K. E., Hamilton, R. P., and Rheams, L. J., 1988, Geologic evaluation of critical production parameters for coalbed methane resources; part II, Black Warrior basin: Chicago, Illinois, Gas Research Institute, Annual Report, 178 p.

Fetter, C. W., Jr., 1980, Applied hydrogeology: Columbus, Ohio, Merrill Publishing Company, 488 p.

Freeze, R. A., and Cherry, J. A., 1979, Groundwater: Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 604 p.

Gillett, Blakeney, and Moore, J. D., 1987, Ground-water levels in Alabama: 1986 water year: Alabama Geological Survey Circular 112F, 329 p.

Hill, R. A., 1940, Geochemical patterns in Coachella Valley, California: National Research Council, American Geophysical Union Transactions of 1940, Part 1, p. 46-53.

Johnston, W. D., Jr., 1930, Physical divisions of northern Alabama: Alabama Geological Survey Bulletin 38, 48 p.

____1933, Ground water in the Paleozoic rocks of northern Alabama: Alabama Geological Survey Special Report 16, 414 p.

Kidd, J. T., and Shannon, S. W., 1977, Preliminary areal geologic maps of the Valley and Ridge province, Jefferson County, Alabama: Alabama Geological Survey Atlas 10, 41 p.

Kidd, J. T., and Richter, K. E., 1979, Areal geology of Jefferson County, Alabama: Alabama Geological Survey Atlas 15, 89 p.

Knight, A. L., 1976a, Urbanization and flooding in Shades Creek basin, Jefferson County, Alabama: Alabama Geological Survey Information Series 55, 73 p.

____1976b, Water availability, Jefferson County, Alabama: Alabama Geological Survey Special Map 167, 31 p.

Moffett, T. B., and Moser, P. H., 1978, Ground-water resources of the Birmingham and Cahaba Valleys of Jefferson County, Alabama: Alabama Geological Survey Circular 103, 79 p.

Newton, J. G., and Hyde, L. W., 1971, Sinkhole problem in and near Roberts Industrial Subdivision, Birmingham, Alabama, a reconnaissance: Alabama Geological Survey Circular 68, 42 p.

Newton, J. G., Copeland, C. W., and Scarbrough, L. W., 1973, Sinkhole problem along proposed route of Interstate Highway 459 near Greenwood, Alabama: Alabama Geological Survey Circular 83, 63 p.

Osborne, W. E., Szabo, M. W., Neathery, T. L., and Copeland, C. W., Jr., compilers, 1988, Geologic map of Alabama, northeast sheet (1:250,000): Alabama Geological Survey Special Map 220.

Peirce, L. B., 1955, Hydrology and surface-water resources of east-central Alabama, with a section on quality of water by Eugene Brown: Alabama Geological Survey Special Report 22, 318 p.

____1959, Surface-water resources and hydrology of west-central Alabama, with a section on quality of water by James W. Geurin: Alabama Geological Survey Special Report 24, 236 p.

Piper, A. M., 1944, A graphic procedure in the geochemical interpretation of water analyses: American Geophysical Union Transactions, v. 25, p. 914-923.

Robinson, W. H., Ivey, J. B., and Billingsley, G. A., 1953, Water supply of the Birmingham area, Alabama: U.S. Geological Survey Circular 254, 53 p.

Sapp, C. D., and Emplaincourt, Jacques, 1975, Physiographic regions of Alabama: Alabama Geological Survey Special Map 168, 1 pl.

Scott, J. C., 1977, Drainage areas for Jefferson County, Alabama: Alabama Geological Survey Atlas 11, 55 p.

Simpson, T. A., 1965, Geologic and hydrologic studies in the Birmingham red-iron-ore district, Alabama: U.S. Geological Survey Professional Paper 473-C, 47 p.

Spigner, B. C., 1975, Hydrogeology of Mississippian aquifers on the southeast flank of the Birmingham anticline, Jefferson County, Alabama: University of Alabama unpublished Master's thesis, 76 p.

Szabo, M. W., Osborne, W. E., and Copeland, C. W., Jr., compilers, 1988, Geologic map of Alabama, northwest sheet (1:250,000): Alabama Geological Survey Special Map 220.

U.S. Department of Commerce, 1988, Alabama, 1987: National Climatological Data Center Climatological Data Annual Summary, v. 93, no. 13, 16 p.

U.S. Department of Commerce, Bureau of Census, 1988, 1986 local population estimates: Current Population Reports Series P-26, 86-S-SC (Advance print-out), U.S. Department of Commerce, Bureau of Census.

U.S. Environmental Protection Agency, 1983, National revised primary drinking water regulations: Federal Register, v. 48, no. 194, p. 45502-45521.

____1986, National primary and secondary drinking water regulations, fluoride; final rule: Federal Register, v. 51, no. 63, p. 11396-11412.

U.S. Public Health Service, 1962, Public Health Service drinking water standards, 1962: U.S. Public Health Service Publication 956, 61 p.

APPENDIX A

Well numbers correspond to those shown on plate 1.

Depth of well and water level: Reported depths are given in feet; measured depths are given in feet and tenths of a foot; S indicates a spring.

Geologic unit (aquifer): Qr, regolith; ℙpv, Pottsville Formation; ℙMpw, Parkwood Formation; Mf, Floyd Shale; Mb, Bangor Limestone; Mh, Hartselle Sandstone; Mpm, Pride Mountain Formation; Mtfp, Tuscumbia Limestone and Fort Payne Chert undifferentiated; Srm, Red Mountain Formation; Oc, Chickamauga Limestone; Olol, Little Oak and Lenoir Limestones undifferentiated; On, Newala Limestone; Olv, Longview Limestone; O€ccr, Chepultepec and Copper Ridge Dolomites undifferentiated; €cr, Copper Ridge Dolomite; €k, Ketona Dolomite; €c, Conasauga Formation.

Altitude: Altitudes are in feet above mean sea level determined from 7.5-minute U.S. Geological Survey topographic maps.

Method of lift: B, bucket; J, jet; N, none; P, piston; S, submersible; T, turbine; F, flow; C, centrifugal.

Use of water: D, domestic; Ind, industrial; I, irrigation; PS, public supply; S, stock; U, unused; R, recreation.

Source of data: A, Knight, 1976; B, Moffett and Moser, 1978; C, Davis, 1980; D, Chandler and Moore, 1987; E, Gillett and Moore, 1989; F, collected for this report.

Abbreviations: gpm, gallons per minute; USGS, U.S. Geological Survey; GSA, Geological Survey of Alabama; --, indicates data not available or not known; cfs, cubic feet per second.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
B-1	Town of Trafford (Horace Love)	H. W. Peerson (1950)	300	IPpv	480	25 11.4 14.4 9.3 17.4	1952 7-2-68 10-25-68 5-5-69 12-11-69	N	U	A	Casing: 8-in from surface to 42 ft; none below. Reported drawdown 20 ft after 18 hrs pumping 60 gpm, 65 ft after 5 hrs pumping 120 gpm in December 1954. Used as observation well by the USGS. Included in semiannual ground-water level monitoring program.
B-01	George McKenzie	Chapman (1957)	127	IPpv	475	57	6-13-89	J	D	F	Casing: 6-in. Reported ample supply of good quality water. Furnishes water for one house.
C-1	Warrior Ice Co.	--	701	IPpv	600	41	1928	N	U	A	Casing: 10-in from surface to 46 ft; none below. Reported yield 15 gpm. Published in Johnson (1933) as well no. 3. Destroyed.
C-02	Kenneth Musgrove	-- (1980)	80	IPpv	405	13.4	6-13-89	J	D	F	Casing: 6-in. Reported ample supply. Furnishes water for one house.
D-01	Doug West	--(1980)	100	IPpv	365	--	--	J	I	F	Reported ample quantity of water for one house. Outdoor use only.
E-01	S. Melton	--	100	IPpv	355	20.5	6-7-89	J	I	F	Reported ample quantity of water for one house. Outdoor use only.
F-01	George Myrick	-- (1960)	106	IPpv	438	18.2	6-12-89	J	D	F	Reported ample quantity of water and high iron content. Furnishes water for one house.
G-01	Jack Nix	-- (1960)	100	IPpv	545	32.3	6-12-89	J	D, I	F	Reported ample quantity of water and high iron content. Furnishes water for one house.
G-02	Sonja Isbell	-- (1980)	100	IPpv	490	37.2	6-13-89	S	I	F	Casing: 8-in. Outdoor use only. Reported ample quantity of water and high iron content.
H-02	V. S. Stallings	--	55	IPpv	585	13	6-13-89	J	D	F	Casing: 6-in. Reported ample supply of good quality water. Source of water for one house.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
I-1	Penny Spring	--	S	O€ccr	610	--	--	F	S	A, B, D	Average discharge 2,380 gpm (5.23 cfs) from 16 measurements (1928-77). Minimum discharge 498 gpm (1.11 cfs) on 8-13-28; maximum discharge 3,779 gpm (8.64 cfs) on 4-15-77. No. 95 in Johnson (1933, pt. 2, table 23). Miscellaneous flow-measurement station (1968-71, 1973-76).
I-2	Birmingham Water Works	H. W. Peerson (1950)	208	€c	650	55	1950	T	PS	A	Casing: 8-in to 126 ft; 6-in to 151 ft. Reported yield 200 gpm in 1950.
I-3	Jack Carter, Jr.	-- (1950)	30	O€ccr	622	8.3	2-18-77	N	U	B	--
I-4	J. J. Renda	T. Washburn (1950)	97	O€ccr	645	53.0	2-18-77	J	D	B	--
I-5	Stewart	--	S	O€ccr	600	--	--	N	U	B	Estimated discharge 75 gpm (.17 cfs) on 2-18-77; 40 gpm (.09 cfs) on 6-8-77.
I-6	L. D. Grigsby	Higginbotham (1948)	75	€k	615	2	2-17-77	N	U	B	--
I-7	W. A. Mays	-- (1965)	80	ℙMpw	605	0	2-17-77	S	D	B	--
I-8	W. T. Partain	-- (1950)	165	O€ccr	598	--	--	S	D	B	--
I-01	Clyde Gardner	-- (1987)	275	O€ccr	862	150	6-16-89	S	D, S	F	Casing: 6-in. Reported ample quantity of good quality water for one house and stock needs.
J-01	Levi Crumpton	--	150	O€ccr	915	77	6-19-89	S	D	F	Casing: 6-in. Reported ample quantity of good quality water for one house.
K-01	C. W. Stewart	Interstate Drillers (1971)	75	Mh	865	50	6-20-89	S	D	F	Casing: 8-in. Reported ample quantity of good quality water for one house.
K-02	Henry Cook	--	100	ℙpv	715	31.5	6-20-89	J	D	F	Casing: 6-in. Reported ample quantity of good quality water for one house.
L-1	City of Trussville	Interstate Drillers Inc. (1968)	145	Mtfp	755	13.6	2-8-68	--	--	A, B	Casing: 10-in to 80 ft. Test well. Destroyed.
L-2	City of Trussville	Interstate Drillers Inc. (1968)	219	Mtfp	755	29	1968	--	--	A, B	Casing: 8-in to 132 ft. Drawdown 72 ft after 4 hrs pumping 200 gpm, 4 hrs pumping 400 gpm, and 8 hrs pumping 600 gpm on 2-8-68 and 2-9-68. Test well. Destroyed.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measure-ment	Method of lift	Use of water	Source of data	Remarks
L-3	City of Trussville	Interstate Drillers Inc. (1967)	215	Mtfp	755	14	1968	--	--	A, B	Casing: 8-in. Test well. Destroyed.
L-4	City of Trussville	H. W. Peerson (1960)	158	Mtfp	750	--	--	T	PS	A, B	Casing: 16-in to 40 ft; 10-in to 84 ft. Reported drawdown 74 ft after 4 hrs pumping 250 gpm, 6 hrs pumping 314 gpm, and 14 hrs pumping 415 gpm on 4-29-60.
L-5	City of Trussville	H. W. Peerson (1936)	186	Mtfp	740	42	1936	T	PS	A, B, C, E	Casing: 14-in to 62 ft; 12-in from 62 to 108 ft; 10-in from 108 to 132 ft; 6-in from 132 to 186 ft. Reported drawdown 22.5 ft after 24 hrs pumping 183 gpm in 1936. Included in semiannual ground-water level monitoring program.
L-6	City of Trussville	H. W. Peerson (1936)	186	Mtfp	730	43	1936	T	PS	A, B	Casing: 14-in to 47 ft; 12-in from 47 to 115 ft; 10-in from 115 to 186 ft. Reported drawdown 21.5 ft after 24 hrs pumping 174 gpm in 1936.
L-7	Birmingham Water Works	H. W. Peerson (1957)	237	O€ccr	720	--	--	T	PS	A	Casing: 12-in to 12 ft; 10-in to 30 ft. Drawdown 110 ft after 24 hrs pumping 132 gpm; 110 ft after 7 hrs pumping 145 gpm. Known as Spring Lake well.
L-8	City of Trussville	H. W. Peerson (1950)	320	Mtfp	790	29	1950	T	PS	A, B	Casing: 10-in from surface to 60 ft; 8-in from surface to 160 ft; 6-in from surface to 254 ft; none below. Reported specific capacity 5.6 gpm per foot of drawdown for 11 hr test pumping 230 gpm in 1950.
L-9	City of Trussville	Newbourne	178	Mtfp	820	30	1944	T	PS	A, B	Casing: 6-in from surface to 153 ft; none below. Reported drawdown 25 ft after 18 hrs pumping 200 gpm in 1944.
L-10	City of Trussville	S. L. Graves (1969)	215	Mtfp	755	--	--	T	PS	B	Pumping 1,000 gpm (1978). Trussville Water Board well no. 5.
L-11	Joyce Busby	-- (1970)	100	Mtfp	770	41.6	2-18-77	J	U	B	--
L-12	Teresa Martin	-- (1950)	60	Mtfp	785	44.5	2-18-77	B	U	B	--

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
L-13	Seth Box	--	S	O€ccr	715	--	--	N	U	B	Estimated discharge 15 to 20 gpm (.03 to .04 cfs) on 2-18-77.
L-14	J. O. McKee	--	60	O€ccr	747	3	2-18-77	N	U	B	--
L-15	Pine Hill Sanitarium	--	S	O€ccr	790	--	--	N	U	B, D	Estimated discharge 210 gpm (.47 cfs) on 3-2-77; 50 gpm (.11 cfs) on 6-8-77.
L-16	George Posey	Albritton (1957)	100	Mtfp	865	60	2-18-77	J	D	B	--
L-17	Ethel Farr	-- (1957)	136	Mtfp	920	92.0	2-18-77	N	U	B	--
L-18	--	--	S	Mtfp	880	--	--	N	U	B	Estimated discharge 100 gpm (.22 cfs) on 3-9-77; and 15 gpm (.03 cfs) on 6-7-77. Known as Edwards Lake Spring.
L-19	--	--	S	€k	735	--	--	N	R	B, D	Estimated discharge 1,150 gpm (2.56 cfs) on 6-7-77. Two adjoining springs discharge an estimated 230 gpm (.51 cfs). Supplies lake which reportedly never goes dry.
L-20	Alabama State Highway Department	--	--	Mtfp	880	--	--	F	U	B	Reported estimated yield 10 gpm on 3-77.
L-21	City of Trussville	H. W. Peerson (1963)	219	Mtfp	845	--	--	--	--	B	Roebuck Plaza well no. 3. Reported yield 250 gpm in 1963.
L-22	City of Trussville	H. W. Peerson (1963)	110	Mtfp	720	24	1963	T	PS	B	Casing: 24-in to 26 ft; 18-in to 55 ft; 16-in to 78 ft. Pumping 650 gpm (1978). Trussville Water Board well no. 4.
L-01	State of Alabama Department of Youth Services	--	S	O€ccr	795	--	--	J	R	F	Spring water used (along with well no. L-02) to fill swimming pool. Water from both sources accumulates in sump, then is pumped to pool. Estimated discharge 50 gpm (.11 cfs) on 6-19-89.
L-02	State of Alabama Department of Youth Services	--	200 (?)	O€ccr	795	--	--	T	R	F	Water from well (along with spring no. L-01) used to fill swimming pool. Water is pumped to sump, then pumped to pool. Formerly used as water supply for entire campus.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
M-1	Birmingham Water Works	H. W. Peerson (1953)	264	O€ccr	740	5	1953	T	PS	A	Casing: 12-in to 90 ft; none below. Reported drawdown 108 ft after 14 hrs pumping at 230 gpm in 1953.
M-2	Birmingham Water Works	H. W. Peerson (1958)	157	O€ccr	710	2	1958	T	PS	A, B	Casing: 12-in from surface to 14 ft; 10-in from surface to 28 ft; none below. Reported drawdown 46 ft after 1 hr pumping 200 gpm, 1 hr pumping 400 gpm, 1 hr pumping 600 gpm, and 1 hr pumping 820 gpm.
M-3	Town of New Castle	H. W. Peerson	450	IPpv	560	--	--	T	PS	A	Casing: 12-in from surface to 50 ft; 6-in from surface to 50 ft; none below. Reported yield 30 gpm.
M-4	Birmingham Water Works	H. W. Peerson (1946)	160	O€ccr	--	70	1946	N	U	A	Casing: 8-in from surface to 135 ft; none below. Reported drawdown 15 ft after 24 hrs pumping 140 gpm in 1946.
M-5	H. Y. Carson	--	S	€k	660	--	--	--	D	A, B, D, F	Average discharge 600 gpm (1.34 cfs) from 29 measurements (1928-88). Minimum discharge 202 gpm (.45 cfs) on 8-15-28; maximum discharge 1,324 gpm (2.95 cfs) on 4-17-71. Water quality and flow measurement station. No. 101 in Johnson (1933, pt. 2, table 3). Known as Robinwood (or Caldwell) Spring. Included in ground-water monitoring program.
M-6	Howard Baggett	Howard Baggett (1955)	325	€c	600	--	--	N	U	A	Casing: 8-in to 40 ft; none below. Reported yield 750 gpm.
M-7	Jefferson County	--	S	€k	620	--	--	N	U	A, B, D	Estimated discharge 510 gpm (1.14 cfs) on 3-24-77; 240 gpm (.53 cfs) on 6-7-77.
M-8	--	--	S	€c, €k	620	--	--	N	U	A, B, D	Reported discharge 500 gpm (1.14 cfs). Known as Robinwood Spring no. 2.
M-9	Margaret Burr	-- (1941)	--	Srm	585	--	--	J	D	B	Estimated flow 15 gpm from casing 4 ft above ground on 2-17-77.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
M-10	Boy Scouts of America	--	S	Mpm, Mtfp	575	--	--	N	U	B, D, F	Estimated discharge 800 gpm (1.78 cfs) on 3-1-77; 40 gpm (.09 cfs) on 6-7-77; 25 gpm (.05 cfs) on 6-16-89. Known as Indian Valley Boy Scout Camp Spring.
M-11	A. C. Hewitt	Morris (1915)	125	Mtfp	735	50	2-17-77	J	U	B	--
M-12	Gentry Contractors	--	100	Mb	640	10	2-16-77	J	D	B	--
M-13	Munger Realty Co.	--	S	O€ccr	642	--	--	J	D	B, D	Estimated discharge 40 gpm (.09 cfs) on 2-17-77. Furnished water for 3 houses. Known as Neaves Spring.
M-14	E. O. Boettcher	-- (1920)	40	€c	625	9.6	2-16-77	J	U	B	--
M-15	Willie Bailey	-- (1920)	--	€k	580	11.7	3-1-77	J	D	B	Reported yield 2 gpm.
M-16	H. B. Moore	Gurley (1960)	128	O€ccr	620	10	2-17-77	J	D	B	Furnished water for 3 houses.
M-17	H. B. Brewer	--	132	O€ccr	740	119.1	2-16-77	N	U	B	--
M-18	Sam Thomas	Gurley (1962)	130	O€ccr	635	10	2-16-77	--	D	B	--
M-19	--	--	S	O€ccr	585	--	--	N	U	B, D	Estimated discharge 100 gpm (.22 cfs) in 1977.
M-20	Pinkie Wood	-- (1910)	20	Qr	640	10.3	2-16-77	B	U	B	Dug well. Abandoned.
M-21	--	--	S	O€ccr	645	--	--	N	U	B, D	Estimated discharge 1,800 gpm (4.01 cfs) on 2-15-77; 1,720 gpm (3.82 cfs) on 6-7-77.
N-01	Jim Walter Resources	--	S	ℙpv	480	--	--	N	U	F	Estimated discharge 1 gpm on 6-9-89. Reported good quality. Known as Mineral or Watson Spring.
N-02	D. W. Holmes	-- (1936)	100	ℙpv	590	30	1989	J	I	F	Reported ample supply but too high in iron content to use inside house without filter.
P-01	Richard Lollar	Beard Drilling (1960)	62	ℙpv	425	20-30	1989	S	I	F	Reported ample supply but too high in iron content to use inside house without filter.
R-01	Irene K. Perry	--	110	ℙpv	380	30-35	1989	P	D	F	Reported ample supply for 2 houses.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
S-01	Dan Griffith	-- (1940)	210	ℙpv	505	22.5	6-1-89	J	I	F	Reported ample supply for outdoor use. Formerly used to furnish water for one house with iron filter. High iron content.
S-02	Himmie Waldrop	Green (1973)	193	ℙpv	300	100	1989	S	I	F	Reported ample supply for outdoor use. Reportedly intercepted faults while drilling.
S-03	--	--	--	ℙpv	410	--	--	J	D	F	Source of water for 1 house.
S-04	Ella Rogers	--	200	ℙpv	405	14.6	6-6-89	J	D	F	Quantity is reported adequate for one house. Quality is adequate.
T-1	Federal Barge Lines	John Jett (1922)	125	ℙpv	340	--	--	N	U	A	Casing: 6-in from surface to 100 ft; none below. Reported yield 65 gpm.
T-01	Elmer Goodwin	--	200	ℙpv	330	23.4	4-29-85	N	U	F	Casing: 8-in. Unused.
T-02	Ivan Kemis	--	81	ℙpv	340	31.1	10-20-88	N	U	E	Casing: 6-in. Unused. Included in semi-annual ground-water level monitoring program.
T-03	William Park	McCarty Drillers (1971)	125	ℙpv	590	71.2	6-2-89	S	D, S	F	Reported ample quantity of good quality water for one house and stock. Uses sediment filter. Water reported to get muddy following nearby coal mine blasting.
T-04	E. W. Wadsworth	McCarty Drillers (1975)	210	ℙpv	400	27.0	6-6-89	S	D	F	Reported adequate quantity of good quality water for one trailer.
V-1	Purity Ice Co.	-- (1923)	300	Ꞓcr	600	--	--	N	U	A	Casing: 10-in from surface to 20 ft; none below. Reported yield 300 gpm.
V-2	Tutwiler Hotel	E. M. Newbourne (1912)	380	Ꞓc	580	--	--	--	--	A, B	Reported yield 60 gpm. Destroyed.
V-3	Frank Nelson Building	E. M. Newbourne (1921)	622	Ꞓc	590	--	--	N	U	A	Reported yield 100 gpm.
V-4	Arnold Foods	-- (1911)	310	Ꞓc	600	--	--	--	--	A	Reported yield 100 gpm. Destroyed.
V-5	Crystal Carbonic Co.	H. W. Peerson (1936)	202	Ꞓc	600	12.7	8-21-52	--	--	A	Casing: 10-in from surface to 19 ft; 8-in from 39 to 115 ft; none below; perforated from 45 to 115 ft. Reported yield 200 gpm. Destroyed.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
V-6	Southern Dairies	H. W. Peerson (1926)	440	Єc	590	90	1952	N	U	A, B	Reported yield 300 gpm.
V-7	Birmingham Stove and Range	H. W. Peerson	205	Єk	550	--	--	T	Ind	B	Reported yield approximately 50 gpm. Reported pumping water level approximately 30 ft on 3-25-77. Reliable industrial supply well since approximately 1966.
W-1	Lone Star Cement Co.	Lone Star Cement Co. (1947)	300	Єc	440	--	--	--	--	A, B	Reported yield of 100 to 105 gpm.
W-2	Miller Lumber Co.	H. W. Peerson (1941)	205	Єk	590	5.6	8-27-68	N	U	A, B	Casing: 6-in from surface to 13 ft; none below. Reported yield 20 gpm.
W-3	City of Irondale	H. W. Peerson (1941)	165	Mb	750	--	--	T	PS	A, B	Casing: 10-in from surface to 163 ft; none below. Reported yield 240 gpm.
W-4	City of Irondale	H. W. Peerson (1949)	250	Mb	750	28	1949	T	PS	A, B	Casing: 10-in from surface to 68 ft; 8-in from surface to 160 ft; none below. Reported yield 200 gpm.
W-5	City of Irondale	H. W. Peerson (1964)	225	Mb	720	15	1964	T	PS	A	Casing: 16-in from surface to 70 ft; 12-in from surface to 97 ft; 10-in slotted pipe from 90 to 160 ft; none below. Reported yield 300 gpm.
W-6	Irondale Ice Co.	H. W. Peerson (1949)	210	Mb	740	--	--	T	Ind	A, B	Casing: 8-in from surface to 12 ft; none below. Reported yield 275 gpm.
W-7	City of Irondale	H. W. Peerson (1954)	312	Mb	640	20	1954	T	PS	A, B	Casing: 10-in from surface to 126 ft; 8-in from surface to 209 ft; slotted from 125 to 200 ft; none below. Reported drawdown 12 ft after 24 hrs pumping an average of 360 gpm on 9-3-54 and 9-4-54.
W-8	Eastwood Mall	Adams-Massey Drilling Co.	80	Mb	900	21 55.3 68.3	1960 7-2-68 8-27-68	T	Ind	A, B	Casing: 10-in from surface to 15 ft; none below. Reported yield 1,200 gpm.
W-9	Eastwood Mall	Adams-Massey Drilling Co. (1959)	90	Mb	900	20 63	1960 1968	T	Ind	--	Casing: 10-in from surface to 10 ft; none below. Reported yield 1,350 gpm. Well no. EM-2 in Spigner, 1975.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
W-10	Eastwood Mall	Adams-Massey Drilling Co. (1959)	86	Mb	900	16	1960	T	Ind	A, B	Casing: 10-in from surface to 14 ft; none below. Unused (1978). Well no. EM-3 in Spigner, 1975.
W-11	Eastwood Mall	H. W. Peerson (1965)	134	Mb	900	28.5 30.4	10-28-65 8-27-68	T	Ind	A	Casing: 18-in from surface to 47 ft; 16-in from 28 to 108 ft; perforated from 66 to 108 ft; 14-in perforated from 97 to 134 ft. Drawdown 69 ft after 24 hrs pumping an average of 573 gpm on 10-15-65 and 10-16-65.
W-12	W B. Baker Dairy	H. W. Peerson (1948)	126	Mb	710	--	--	T	Ind	A, B	Casing: 6-in from surface to 87 ft; none below.
W-13	Connor's Steel Corp.	H. W. Peerson (1943)	335	Єk	650	27	1948	T	Ind	A, B	Casing: 20-in from surface to 6 ft; 12-in from surface to 43 ft; 10-in from surface to 86 ft; 8-in from surface to 211 ft; slotted from 110 to 210 ft; none below. Reported drawdown 70 ft after pumping 24 hrs at 271 gpm on 9-15-43.
W-14	Connor's Steel Corp.	H. W. Peerson (1955)	403	Єk	660	41.0 67.5	11-15-55 3-24-77	T	Ind	B	Reportedly pumped 390 gpm in September 1955.
W-15	City of Irondale	Graves Well Drilling Co. (1971)	290	Mtfp	742	74	8-13-71	T	PS	B	Reportedly pumped 625 gpm in June 1977. Irondale Water Works well no. 4.
W-16	City of Irondale	Graves Well Drilling Co. (1976)	303	Mtfp	738	94.2	1-9-76	T	PS	B	Reportedly pumped 1,200 gpm in June 1977. Irondale Water Works well no. 5.
W-17	Jim Walters Resources	--	--	Srm	--	--	--	F	U	B	Reported yield 180 gpm on 3-9-77. Reportedly drains water from abandoned mine.
W-18	Josephine Caliano	--	S	OЄccr	755	--	--	N	U	B	Estimated discharge 10 gpm on 2-28-77 and 180 gpm on 3-9-77. Known as Brown Spring.
W-19	James H Dickson	--	S	OЄccr, Єk	655	--	--	--	R	B	Estimated discharge 470 gpm on 2-28-77. Furnishes water to Cascade Plunge swimming pool and recreation area.
W-20	Buchanan Lumber Co.	-- (1969)	400	Єk	595	2.4	3-15-77	N	U	B	Reported yield 60 gpm on 3-15-77. Abandoned.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
W-21	Dolcito Quarry	Reese Malette (1975)	180	Єk	480	--	--	F	U	B	Reported yield 40 gpm on 3-15-77. Well drilled in bottom of quarry.
W-22	Southern Railway	H. W. Peerson	366	Mb, Mh	760	12 16.3	9-18-52 3-9-77	T	Ind	B	Reported yield 50-100 gpm on 3-9-77.
W-23	Eastwood Mall	Graves Well Drilling Co. (1970)	297	Mtfp	725	73	3-23-77	T	Ind	B	Reported yield 1,000 to 1,100 gpm on 3-23-77. Used for air conditioning.
W-24	Bill Pelkey	--	S	Mb	720	--	--	N	U	B	Estimated discharge 120 gpm on 3-11-77; 20 gpm on 6-7-77.
W-25	Gulas Restaurant	H. W. Peerson (1951)	85	Mtfp	820	--	--	F	U	B	--
W-26	Alabama Boys Industrial School	--	S	Єk, Єc	660	--	--	N	U	B, F	Estimated discharge 2,010 gpm on 2-28-77; 2,030 gpm on 6-6-77 and 500 gpm on 6-28-89.
W-27	City of Birmingham	--	S	Єk	660	--	--	N	R	B	Estimated discharge 1,380 gpm on 2-23-77, and 250 gpm on 6-6-77. Known as Avondale Spring.
X-1	Southern Railway System	H. W. Peerson (1952)	561	Mtfp	770	--	--	--	--	A, B	Casing: 16-in from surface to 40 ft; 10-in from surface to 90 ft; 8-in from surface to 110 ft; none below. Reported to flow 3 gpm on 1-1-52. Reported drawdown 140 ft after 24 hrs pumping 60 gpm on 1-9-52. Destroyed.
X-2	Billy Cardwell	W. A. Campbell (1968)	160	ℙpv	620	26	1968	J	PS	A	Reported drawdown 6 ft after 20 minutes bailing 17 gpm in 1968.
X-3	Eastwood Mobile Home Park	Interstate Drillers (1966)	250	ℙpv	750	--	--	F, T	PS	A	Casing: 8-in from surface to 38 ft; none below. Reported yield 100 gpm.
X-4	Norris Yards	--	295	Mh	780	--	--	T	Ind	A	Casing: 10-in from surface to 150 ft; none below. Reported yield 100 gpm.
X-5	Franklin Daniel	Cole (1962)	60	Mb	765	4.2	3-11-77	J	PS	B	Reported yield 6 gpm.
X-6	Dorothy M. Terry	H. Richardson (1957)	75	Mh	800	2.7	2-14-77	J	D	B	--
X-7	James O. Morrison	-- (1955)	86	Mh	805	23.9	2-14-77	J	D	B	--
X-8	A. J. Jones	Blan (1969)	102	Mh	790	38.2	2-14-77	J	D	B	Reported yield 7 gpm.
X-9	John Marigna	--	S	Mb, Mf	590	--	--	N	U	B	Estimated discharge 30 gpm on 4-7-77.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
X-10	Audrey Alexander	-- (1920)	75	Olv	630	31.1	4-6-77	J	D	B	--
X-11	V. F. Davis, Jr.	Southern Supply (1964)	280	Єk	810	--	--	S	D	B	--
X-12	C. C. Ainsworth	H. W. Peerson (1962)	242	Єk	610	12.3	4-7-77	S	D	B	--
X-01	Randy Robison	coal company (1987)	100	ℙpv	710	45	6-20-89	S	I	F	Outdoor use only. Reported high iron content.
X-02	J. T. Poole	--	26	Qr	585	18.6	6-22-89	B	D	F	Only source of water. Reported ample supply of good quality water for one house.
Y-1	Leeds Water Board	--	S	Oc	618	--	--	T	PS	A, B	Reported discharge 800 gpm on 4-12-77, 420 gpm on 6-7-77. Water-quality monitoring station. Period of record: 1957, 1977, and 1986 to current year. Currently a public water supply. Known as Rowan Spring.
Y-2	Leeds Water Board	Graves Well Drilling Co. (1975)	195	Mtfp	680	41.5	1975	T	PS	B	Pumping 750 gpm in June 1972; 1,000 gpm in 1978.
Y-4	Ronnie Dorough	--	S	Olol	595	--	--	N	U	B	Estimated discharge 30 gpm on 4-13-77.
Y-5	Mrs. Howard Baird	J. E. Bearden (1972)	55	Mtfp	685	15.3	4-6-77	J	D	B	Reported yield 4 gpm on 4-13-77.
Y-6	Rock Wool Co.	--	S	Mf	655	--	--	N	U	B	Estimated discharge 30 gpm on 4-13-77. Known as Leeds Mineral Spring.
AA-1	J. B. Deshazo	Glover (1953)	93	On	590	3.9	4-6-77	J	S	B	Reported yield 9 gpm on 4-13-77.
AA-2	Dr. G. J. Roscoe	Glover (1970)	175	On	595	17.1	4-6-77	J	D	B	Chlorinator in use.
AA-3	Dr. G. J. Roscoe	Glover (1920)	35	Qr	595	20.8	4-6-77	B	D	B	--
AA-4	Lynn Glover	Glover (1973)	150	Olv	580	--	--	S	D	B	Reported yield 4 gpm on 4-14-77.
AA-5	J. C. Tonnemecher	-- (1972)	196	Єk	650	47.8	4-1-77	S	D	B	Reported yield 7 gpm on 4-14-77.
AA-6	Paul Romei	--	S	Єk	660	--	--	J	D	B	Furnished water for 4 to 5 houses in 1977.
AA-7	Kim Alexander	Bearden (1977)	75	ℙpv	660	21.5	4-14-77	S	D	B	Reported yield 10 gpm on 4-14-77.
AA-8	J. R. Martin	--	S	Єk	595	--	--	J	D	B	Estimated discharge 10 gpm on 4-1-77.
AA-9	Dale Ray	Dale Ray	60	Qr	600	7.7	4-6-77	J	U	B	Dry at times during the year.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
AA-11	John D. Lawley	--	100	ℙpv	600	--	--	J	D	B	--
AA-12	Junior Summerville	-- (1972)	80	Olol	560	9.5	4-14-77	S	D	B	Reported yield 9 gpm on 4-14-77.
AA-13	Dale Ray	--	60	Qr	605	30.2	4-6-77	J	D	B	Unreliable source.
AA-14	Betty Deshazo	--	S	On	605	--	--	J	D	B	Estimated discharge 395 gpm on 4-14-77; 13 gpm on 6-7-77.
AA-01	John Jackson	-- (1974)	180	Єk	655	5-10	6- -89	S	D	F	Reported ample supply of good quality water for one house.
BB-1	The Country Club of Birmingham	H. W. Peerson (1958)	352	Mb	685	6	1-26-59	T	I	A, B, F	Casing: 10-in from surface to 92 ft; none below. Reported drawdown 32 ft after 30 hrs pumping at 630 gpm on 1-26-59 and 1-27-59. Reported formation of numerous small sinkholes within a 1-acre area when pumped at maximum capacity. Now pumping sparingly at 200 gpm as emergency use only (1989).
BB-2	Homewood Dairy	W. H. Chapman (1932)	113	Mb	780	--	--	P	Ind	A	Reported yield 48 gpm.
BB-3	H. J. Tillia	H. W. Peerson (1950)	545	ℙpv	1,060	77	1950	T	--	A	Casing: 6-in from surface to 20 ft; none below. Reported drawdown 12 ft after 16 hrs pumping 165 gpm in May 1950.
BB-4	W. L. Coggins	H. W. Peerson	100	ℙpv	926	5	4-30-56	J	D	A	Reported yield 5 gpm.
BB-01	Robert Smith	-- (1982)	124	ℙpv	465	36.3	6-22-89	S	D	F	High iron content. Ample quantities of water for one gun shop.
BB-02	The Country Club of Birmingham	Weldon Drillers (1987)	776	Mb	695	6	6-27-89	N	U	F	Casing: 12-in to 8-in. Reported 102 ft drawdown after pumping 115 gpm in 1987. Quantity considered inadequate for irrigation. Abandoned.
BB-03	The Country Club of Birmingham	Weldon Drillers (1987)	366	Mb	728	2	1989	N	U	F	Casing: 8-in and 6-in. Reported drawdown 66 ft after pumping 250 gpm in 1987. Considered insufficient quantity for irrigation needs. Reported high iron content. Abandoned.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
CC-1	Elmwood Cemetery	H. W. Peerson (1936)	350	Єk	580	63 9.1	7-31-52 3-7-77	T	I	A, B	Casing: 8-in from surface to 217 ft; none below. Reported yield 200 gpm. Well no. 22 in Robinson and others, 1953.
CC-2	The Club	H. W. Peerson	175	Mtfp	1,020	--	--	N	U	A	Test hole. Reported dry at time of drilling.
CC-3	The Club	H. W. Peerson (1950)	123	Mtfp	1,020	69	1950	N	U	A, B	Casing: 8- in from surface to 32 ft; none below. Drilled into mine at 113 ft below land surface. Reported yield 185 gpm. Used for air conditioning of The Club prior to 1977.
CC-4	Republic Steel Corp.	H. W. Peerson (1942)	395	Mh	700	40	1952	N	U	A	Casing: 12-in from surface to 20 ft; 10-in from surface to 50 ft; 8-in from surface to 234 ft; 6-in from 233 to 346 ft; perforated from 264 to 346 ft. Reported flow 50 to 60 gpm in 1942. Reported drawdown 71 ft pumping 290 gpm in 1942.
CC-5	Republic Steel Corp.	H. W. Peerson (1942)	391	Mh	694	215 164.4 150.4 68.0	1954 3-2-55 4-55 11-8-55	--	--	A	Casing: 16-in from surface to 33 ft; 10-in from surface to 112 ft (perforated from 47 to 112 ft); 8-in from 99 to 272 ft (perforated from 148 to 247 ft); 6-in from 250 to 355 ft; none below. Reported yield 290 gpm. Destroyed.
CC-6	R. E. Riley	-- (1951)	60	Mf	648	7.1 7.0	4-2-53 4-9-54	--	--	A	Casing: 4-in from surface to 40 ft; none below. Destroyed.
CC-7	Chappell	H. W. Peerson (1948)	135	Mf	686	686	--	--	--	A	Casing: 6-in from surface to 40 ft; none below. Reported yield 6 gpm. Destroyed.
CC-8	Woodward Iron Works	Joy Manufacturing Co. (1949)	1,830	IPpv	619	--	--	N	U	A	Reported flowing 5 to 10 gpm when drilled in 1949. Reported not to be flowing in 1957. Estimated flow 2 gpm on 12-16-69. Reported in Simpson (1965) as diamond drill hole W-36.
CC-9	Woodward Iron Co.	Joy Manufacturing Co. (1949)	1,862	IPpv	632	--	--	N	U	A	Estimated flow 1 gpm on 12-16-69. Reported in Simpson (1965) as diamond drill hole W-34.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
CC-10	U.S. Steel Corporation	--	72	Mf	694	5.7 11.0 16.2	4-3-53 4-23-54 12-16-69	B	S	A	--
CC-11	Woodward Iron Co.	H. W. Peerson (1954)	140	Mb	642	32.0 34.6 17.8	7-31-67 12-15-69 3-7-77	N	U	A, B	Casing: 6-in from surface to 68 ft; none below. Used as observation well by USGS. Reported in Simpson (1965) as well no. 2.
CC-12	Mrs. Dollie Willis	McCarty (1951)	59	Mf	647	29.8 25.4	4-1-53 12-15-69	N	U	A	--
CC-13	J. Robinson	-- (1945)	78	ℙpv	783	39.0 61.2 53.7	4-2-53 4-22-54 12-15-69	N	U	A	--
CC-14	W. Cammack	Whittle Brothers, Inc. (1951)	74	ℙMpv	683	30.9 31.4	3-31-53 4-22-54	--	--	A	Casing: 6-in from surface to 74 ft. Reported yield 2 gpm. Destroyed.
CC-15	Portera	--	S	Єcr	685	--	--	N	U	B	Estimated discharge 150 gpm on 3-8-77. Reported dry on 6-8-77.
CC-16	Gulf States Creosoting	H. W. Peerson (1929)	400	Єc	525	4.0	8-20-52	--	--	B	Destroyed.
CC-17	Barbers Dairy	H. W. Peerson	--	Mb	680	--	--	N	U	B	Well sides have collapsed.
DD-1	Air Reduction Sales Co.	H. W. Peerson (1937)	404	Єk	540	36	1937	--	--	A	Casing: 8-in from surface to 27 ft; 6-in from surface to 145 ft; none below. Reported drawdown 35 ft after pumping 150 gpm in 1937. Destroyed.
DD-2	Woodward Iron Co.	H. W. Peerson	300	Єcr	500	9.5	12-27-56	--	--	A	Casing: 6-in from surface to 35 ft. Destroyed.
DD-3	Brighton High School	H. W. Peerson (1954)	202	Єcr	600	--	--	--	--	B	Destroyed.
DD-4	Bessemer Water Works	--	S	Єc	495	--	--	N	R	B, F	Estimated discharge 300 gpm on 3-8-77; 150 gpm on 6-6-77; 60 gpm on 6-26-89. Known as Hawkins Spring.
EE-1	O. P. Swearengin	C. S. Glover (1956)	114	ℙpv	520	45 72.1 71.3	1956 2-3-60 12-15-69	J	D	A	Casing: 6-in from surface to 20 ft; none below. Reported drawdown 40 ft after 30 minutes pumping 4.3 gpm on 2-4-60.
EE-01	Woodrow Kelley	-- (1988)	160	ℙpv	583	46.6	5-31-89	J	I	F	Reported ample supply of good quality water. Used for garden only.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
EE-02	Ira Hyche	Graves Well Drilling (1989)	555	IPpv	575	180	5-31-89	S	I	F	Drilled into abandoned water-filled coal mine. Reported ample amounts of water for watering two large gardens.
EE-03	H. C. Helms	Dabbs	12	Qr	545	2-3	1989	J	I	F	Dug well. Reported to have started flowing 5 to 10 years ago. Ample quantities of water for yard use. Overnight pumping reported to not significantly lower water level.
FF-01	S. C. Stinnett	--	S	IPpv	440	--	--	F	U	F	Estimated discharge of 0.5 gpm on 5-26-89. Reported never dry.
FF-02	Walter Griffice	McCarty Drillers (1981)	128	IPpv	345	89.7	5-29-89	J	D	F	Reported ample supply of water for house and yard. Reportedly contains some iron, but still usable.
FF-03	Annie Gray	-- (1940)	52	IPpv	425	38.3	5-31-89	B	D	F	Auxiliary use only.
GG-01	U.S. Steel	--	100	IPpv	405	--	--	J	D	F	Used for eight fishing shacks predominantly during weekends. Reported bad quality. Generally used for nonconsumptive use.
GG-02	Paul Salter	Roy Wood	60	IPpv	265	20.3	5-25-89	J	D	F	Reported yield of about 15 gpm. Furnishes water for about 10 weekend fishing trailers. Pungent hydrogen sulfide odor.
GG-03	M. E. Gossett	-- (1981)	150	IPpv	505	--	--	J	D	F	Two, 0.5 gpm wells and a 1,000 gallon underground holding tank with a float mechanism furnish sufficient water for one house but not for extensive yard work. Reported good quality.
HH-01	E. W. Gilbert	C & H Coal Co. (1982)	100	IPpv	505	32	1989	J	D	F	Furnishes water for one house. Reported slight iron staining.
II-01	T. W. Maddox	Taylor (1970)	70	IPpv	675	22.7	5-25-89	J	D	F	Reported adequate supply for one house, but excessive iron content necessitates washing clothes in town.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
II-02	Audrey Britt	-- (1960)	150	IPpv	575	--	--	S	D	F	Reported adequate quantity for one house. Coliform count is too high and can not be used for consumptive uses.
JJ-01	Jesse Howton	McCarty Well Drillers (1948)	125	IPpv	550	50	1989	J	D	F	Reported ample quantities for one house. Reported high iron content.
JJ-02	Wayne Jones	Coal Systems	79	IPpv	575	19.5	5-25-89	S	S	F	Reported ample quantity of water for stock use, but used infrequently. Reported high iron content.
KK-1	Hercules Powder Co.	H. W. Peerson (1954)	300	Oc	540	10	1-27-55	T	Ind	A, B	Reported yield 700 gpm.
KK-2	Gorman Armstrong	James McCarty (1948)	365	Єcr	520	20 20	1948 1965	S	D	A	Casing: 6-in from surface to 16 ft; none below. Reported yield 22 gpm.
KK-3	Alabama Highway Department	-- (1956)	190	Єcr	520	32.5	12-28-76	S	D	B	Reported yield 10 gpm on 2-9-77.
KK-4	M. H. Clark	H. W. Peerson (1942)	121	Mtfp	500	10	12-28-76	J	D	B	Bedrock at 20 ft. Reported yield 10 gpm on 12-28-76.
KK-5	Sherman Williams	-- (1970)	72	Srm	500	21.8	12-25-76	J	D	B	Bedrock at 25 ft.
KK-6	Robert Abercrombie	--	85	Єcr	562	68.7	12-17-76	S	D	B	Bedrock at 1 ft. Reported yield 9 gpm on 12-17-76.
KK-7	Louise Johnston	--	40	Єc	490	3.4	12-17-76	N	U	B	Bedrock at 3.4 ft. Reported sulfur taste.
KK-8	J. H. McKelvey	--	S	Oc	535	--	--	J	D	B	Estimated discharge 30 gpm on 12-17-76.
KK-9	William C. Nicholson	McCarty (1968)	540	Mtfp	580	97.5	12-28-76	J	D	B	Bedrock at 40 ft.
KK-10	Hercules, Inc.	--	S	Єk	460	--	--	N	U	B	Estimated discharge 90 gpm on 2-9-77; 15 gpm on 6-6-77.
KK-01	Mr. & Mrs. Carter	--	110	Єcr	510	20	5-24-89	J	D	F	Reported ample supply of good quality water for one house. City water available, but not connected.
KK-02	Ikey Parsons	Glover (1964)	65	IPpv	460	19.3	5-24-89	J	I	F	Reported ample supply for yard use. Reported high iron content.
LL-1	James M. Cowart	James McCarty (1953)	206	Mf	775	31.9 36.3	3-5-53 4-9-54	S	D	A	Casing: 6-in from surface to 21 ft; none below.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
LL-2	U. S. Steel Corp.	James McCarty (1952)	42	Mf	525	28.4 29.0 16.6	4-1-53 4-22-54 12-12-69	N	U	A	--
LL-3	Bernie G. Wisenhunt	E. Eubank (1949)	67	Mf	540	20 48 34.4	1949 1952 12-11-69	J	D	A	Casing: 6-in from surface to 22 ft. Reported drawdown 10 ft after pumping 30 gpm in 1949. Published in Robinson, Ivey, and Billingsley (1953) as well no. 24.
LL-4	A. Farr	-- (1952)	52	Mf	549	17.5 18.9	3-9-53 4-9-54	--	--	A	Casing: 4-in from surface to 18 ft; none below. Destroyed.
LL-5	R. L. Stevens	-- (1952)	141	Mf	519	23.2 17.5	7-2-53 12-11-69	J	D	A	--
LL-6	J. C. Eubanks	--	44	Mf	519	19.2 16.8 12.6	4-30-53 4-22-54 12-11-69	N	U	A	--
LL-7	C. A. Walls	Loveless (1948)	48	Mf	520	8.3 35.0	4-22-54 12-11-69	B	D	A	--
LL-8	D. Headrick	-- (1940)	48	Mf	529	18.4 16.4 17.5	4-30-53 4-22-54 12-11-69	B	D	A	--
LL-9	Harold Crane	H. W. Peerson	115	Mtfp	505	--	--	N	U	A, E	Occasional water-level measurements from 1968 to 1983. Included in the semi-annual ground-water level determination program from 1983 to the present. Thirteen water-level determinations from 11-9-83 to 4-3-89 indicate an average water level of 4.86 ft below land surface datum. The highest water level was at .33 ft (5-3-84); the lowest was at 10.15 ft (11-9-83).
LL-10	Goodwin Massey	--	50	Mf	532	+2.0 17.3 8.6	4-10-53 4-22-54 12-12-69	B	D	A	--
LL-11	--	--	S	Єc	515	--	--	N	U	B	Estimated discharge 450 gpm on 6-6-77. Known as Moore's Spring.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
LL-12	David E. Glenn	--	S	Єk	495	--	--	N	U	B, F	Estimated discharge 1,750 gpm on 3-25-77; 550 gpm on 6-8-77; 500 gpm on 6-26-89. Habitat of a rare watercress darter. Known as Glenn Spring.
LL-13	--	--	S	Єcr	495	--	--	N	U	B	Estimated discharge 950 gpm on 3-25-77; 250 gpm on 6-6-77. Known as Prince Spring.
LL-14	James D. Lightsey	-- (1956)	30	Єc	480	4.2	12-17-76	J	D	B	Bedrock at 12 ft.
LL-01	Robert Harrison	-- (1940)	100	Mf	523	40-50	1989	J	I	F	Reported ample quantity of water for yard use, but contains objectionably high iron content.
MM-1	J. C. Miller	Joy Manufacturing Co. (1952)	44	Mf	610	11.7 24.9	3-31-53 12-11-69	J	D	A	Casing: 6-in from surface to 24 ft; none below. Reported flow 8 gpm.
MM-2	B. M. McElroy	-- (1952)	96	Mf	567	36.4 37.0 40.6	4-9-53 4-22-54 12-12-69	B	D	A	--
MM-3	O. G. Smith	-- (1950)	96	ꟻPMpw	600	24.5 22.2 23.3	4-1-53 4-9-54 12-11-69	B	D	A	--
OO-01	William Green	Eubanks (1975)	200	ꟻPMpw	625	38.6	6-23-89	J	I	F	Reported ample quantity of good quality water. Outdoor use only.
PP-1	B. W. Bush	McMickens	55	ꟻPMpw	607	42.8 42.7	3-26-56 12-12-69	J	D	A	--
PP-2	E. Gober	McMickens (1943)	40	Mf	540	4.1 2.4	4-9-53 12-11-69	N	U	A	Casing: 6-in from surface to 11 ft; none below.
PP-3	City of Greenwood	H. W. Peerson (1938)	304	Mtfp	570	--	--	N	U	A	Casing: 15-in from surface to 10 ft; 10-in from surface to 260 ft; 6-in from 260 to 304 ft. Reported drawdown 60 ft while pumping 90 gpm in 1938.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
PP-4	City of Greenwood	H. W. Peerson (1953)	150	Mtfp	500	4	1953	N	U	A	Casing: 10-in from surface to 43 ft; none below. Reported drawdown 7 ft after 4 hrs pumping 200 gpm; 18 ft after 20 hrs pumping 425 gpm.
PP-5	C. E. Dunkling	Loveless	50	Mf	524	9.3 23.0	3-20-56 12-12-69	J	D	A	--
PP-6	Walter Sims	Henry Green (1955)	67	ꟾPMpw	525	22.7	3-21-56	T	D	A	--
PP-7	Alvin D. Strong	--	51	ꟾPpv	764	31.3	3-28-56	N	U	A	--
PP-8	William Spencer	--	--	Mtfp	575	3.7	2-11-77	N	U	B	--
PP-9	Canus Duncan	Gurley (1949)	143	Mtfp	550	54.5	2-10-77	R	U	B	Bedrock at 70 ft.
PP-10	Carl Bell	--	S	Mtfp	545	--	--	C	PS	B	Estimated discharge 200 gpm on 2-10-77; 90 gpm on 6-6-77.
PP-11	William E. Chapman	--	160	Mtfp	630	75.0	2-11-77	J	U	B	--
PP-12	Charles T. Walker	State of Alabama (1930)	230	Mtfp	580	81.1	2-11-77	S	D	B	Reported yield 8 gpm on 2-11-77.
PP-13	O. C. Poole	-- (1960)	210	Ꞓcr	605	42.3	12-16-76	J	D	B	--
PP-14	P. A. Criss	H. W. Peerson	120	Mh	535	--	--	S	U	B	--
PP-15	P. A. Criss	H. W. Peerson	280	Mtfp	560	65.6	2-11-77	S	U	B	--
PP-16	W. R. Shrader	Belcher (1964)	126	Mtfp	550	46.7	12-30-76	J	D	B	Reported yield 6 gpm on 2-10-77.
PP-17	W. C. Horsley	H. W. Peerson (1945)	77	Oc	630	28.7	12-16-76	J	U	B	Bedrock at 40 ft. Reported yield 7 gpm on 2-8-77.
PP-18	P. A. Criss	--	60	Mtfp	540	20.1	2-11-77	J	U	B	--
PP-19	Fannie M. Horton	McCarty (1956)	150	Mtfp	660	89.4	2-10-77	J	D	B	Bedrock at 38 ft.
PP-20	A. B. Kendrick	-- (1966)	100	Ꞓc	550	2.5	12-16-76	S	D, S	B	Reported yield 10 gpm on 2-8-77.
PP-01	Bent Brook Public Golf Course	McCarty Drillers (1988)	318	Mtfp	528	--	--	S	I, R	F	Reported pumping 860 gpm on 6-26-89. Used to fill pond that is used for irrigation.
QQ-1	J. M. Patterson	-- (1947)	87	Ꞓcr	530	--	--	J	D	B	Bedrock at 10 ft.
QQ-2	J. R. Yessick	--	100	Ꞓcr	535	5	7- -75	J	D	B	--
QQ-3	Lloyd Gentry	Marvin Moore (1961)	90	Ꞓcr	560	1.6	12-17-76	J	D	B	Reported to flow every winter.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
QQ-4	James Beasley	--	--	Oc	575	18.5	12-28-76	N	U	B	--
QQ-5	Mrs. James F. Russell	McCarty Drillers (1966)	--	Mtfp	645	14.6	12-28-76	S	D	B	--
QQ-6	T. T. Marchant	--	65	Єcr	--	--	--	--	D	B	Reported yield 4 gpm on 2-7-77.
QQ-7	W. D. Wiggins	-- (1927)	50	Єc	565	40.1	12-16-76	N	U	B	--
QQ-8	Horace Fancher	-- (1961)	150	Єcr	555	21.8	12-9-76	J	D	B	Bedrock at 50 ft. Reported yield 6 gpm on 2-2-77.
QQ-9	O. S. Rogers	Morris (1943)	92	Єc	590	37.4	12-16-76	R	D	B	Bedrock at 30 ft.
QQ-10	Charles Payne	Associated Drillers, Inc. (1972)	--	Єcr	565	41.5	12-9-76	S	D	B	--
QQ-11	D. L. Carroll	-- (1959)	96	Єc	660	68.8	12-9-76	J	D	B	--
QQ-12	Ethel Howard	--	S	Mtfp	555	--	--	J	D	B	Estimated discharge 45 gpm on 12-29-76.
QQ-13	Mrs. Charles Wheeler	-- (1973)	100	Єc	545	33.8	12-9-76	J	D	B	--
QQ-14	Mrs. J. E. Weed	--	30	Qr	530	15	12-9-76	B	U	B	--
QQ-15	Exie Ammons	H. W. Peerson (1974)	257	Oc	650	--	--	J	D	B	Bedrock at 40 ft.
QQ-16	G. W. Davis	McCarty (1953)	143	Єcr	650	115.8	12-29-76	J	D	B	Reported yield 6 gpm on 2-7-77.
QQ-17	Jimmy Rosser	--	--	Єc	520	29.8	12-9-76	J	D	B	--
QQ-18	Joe Fowlkes	-- (1974)	125	ℙMpw	615	2.1	12-29-76	J	D	B	--
QQ-19	D. M. Pinson	McCarty Drillers (1962)	138	Oc	605	--	--	J	D	B	Reported yield 7 gpm on 2-7-77. Furnishes water to 1 family and 12 cows. Never dry.
QQ-20	D. M. Pinson	Associated Drillers, Inc. (1968)	--	Oc	570	30.6	12-30-76	S	U	B	Reported yield 3 gpm on 2-7-77.
QQ-21	Edwin Snider	-- (1948)	--	Єc	503	3	12-9-76	N	U	B	Bedrock at less than 10 ft.
QQ-22	Jimmy Rosser	--	S	Єc	503	--	--	N	D, S	B	Reported discharge 50 to 60 gpm on 12-9-76. Furnished water to 4 families and 200 dairy cattle in 1977.
QQ-23	Edwin Snider	-- (1971)	85	Єc	503	10	12-9-76	J	S, D	B	Reported yield 7 gpm on 2-2-77. Furnished water to 200 dairy cattle in 1977.

Appendix A.--Records of selected wells and springs in Jefferson County, Alabama—Continued

Well or spring no.	Owner	Driller and year completed	Depth of well (ft)	Geologic unit (aquifer)	Altitude of land surface (ft)	Water level: Above (+) or below land surface (ft)	Water level: Date of measurement	Method of lift	Use of water	Source of data	Remarks
QQ-24	Edwin Snider	McCarty Drillers (1952)	125	Єc	495	3-4	12- -76	J	U	B	--
QQ-25	Paul Hassell	Glover (1958)	75	Єc	520	38.0	12-16-76	J	D	--	Reported yield 7 gpm on 2-4-77. Bedrock at 50 ft.
QQ-26	Edwin Snider	-- (1951)	--	Єc	483	6-10	12- -76	J	D	B	Reported yield 8 gpm on 2-2-77.
QQ-27	Robert O. Parsons	Casey (1970)	150	Єcr	540	92.6	12-16-76	J	D	B	Bedrock at 69 ft.
QQ-28	Charles Collier	Cleon Glover (1963)	350	Єcr	560	--	--	S	D	B	Bedrock at 29 ft.
QQ-29	W. C. McDougal	Cleon Glover (1961)	197	Єcr	542	27.9	12-16-76	J	U	B	Reported yield 4 gpm on 2-4-77. Bedrock at 20 ft.
QQ-31	Edwin Snider	James McCarthy (1970)	600	Єc	498	3	1970	N	U	B	--
QQ-32	James Roberts	Casey (1971)	160	Oc	580	--	--	S	D	B	--
QQ-33	W. L. Dawson	--	85	Srm	600	46.2	12-28-76	S	D	B	--
QQ-36	Roupes Valley Water Authority	S. L. Graves (1974)	160	Mtfp	560	89.9	12-26-76	T	PS	B	Reported yield 750 gpm after 24 hrs pumping test with a specific capacity of 65 gpm/ft in 1974.
QQ-37	Roupes Valley Water Authority	S. L. Graves (1975)	210	Mtfp	540	84.8	5-1-75	T	PS	B	Reported yield 500 gpm after 24 hrs pumping test with a specific capacity of 9.5 gpm/ft in 1975.
QQ-01	Robert M. Russell	--	--	Єcr	480	9	1989	J	D, I	F	Water is obtained from approximately a 6 ft x 6 ft x 9 ft deep sinkhole. Water reportedly seldom fluctuates and furnishes an ample supply of good quality water for a house, a barber shop, a trailer, and a very large garden. Sinkhole has reportedly not been dry in last 40 years.
RR-01	Dale Stewart	Brasher (1974)	55	IPpv	525	--	--	--	I	F	Outdoor use only. Reported ample quantity and quality for one house.

APPENDIX B

Explanation

Qr, regolith; ℙpv, Pottsville Formation; ℙMpw, Parkwood Formation; Mf, Floyd Shale; Mb, Bangor Limestone; Mh, Hartselle Sandstone; Mpm, Pride Mountain Formation; Mtfp, Tuscumbia Limestone and Fort Payne Chert undifferentiated; O∈ccr, Chepultepec and Copper Ridge Dolomites undifferentiated; ∈cr, Copper Ridge Dolomite; ∈k, Ketona Dolomite; ∈c, Conasauga Formation.

Abbreviations: °C, degrees Celsius; µmhos/cm, micromhos per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; ND, not detected.

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama

Parameter	Well or spring number					
	B-01	C-02	D-01	E-01	F-01	G-01
Date of collection	6-13-89	6-13-89	6-13-89	6-7-89	6-12-89	6-12-89
Water-bearing unit	ℙpv	ℙpv	ℙpv	ℙpv	ℙpv	ℙpv
Well depth (feet)	127	80	100	100	106	100
Specific conductance (µmhos/cm)	107	183	435	420	284	310
Temperature (°C)	19.0	19.5	22.0	20.0	18.5	19.0
Bicarbonate (mg/L)	36	46	270	170	170	160
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	30	38	220	140	140	130
pH	6.2	6.2	8.1	7.2	7.8	6.8
Silica (mg/L)	18	11	12	28	22	31
Calcium (mg/L)	8.1	12	0.3	40	23	27
Magnesium (mg/L)	2.6	7.2	0.2	16	5.8	12
Sodium (mg/L)	8.3	12	110	21	30	17
Potassium (mg/L)	0.4	1.9	0.4	1.1	1.4	1.6
Sulfate (mg/L)	2.8	31	0.9	51	ND	18
Chloride (mg/L)	7.4	5.6	3.5	6.4	2.0	4.4
Fluoride (mg/L)	ND	<0.05	0.10	ND	0.08	0.12
Nitrate as N (mg/L)	1.16	1.87	ND	ND	ND	0.02
Ammonia as N (mg/L)	0.04	ND	0.13	0.11	0.19	0.07
Orthophosphate as P (mg/L)	ND	ND	0.28	ND	ND	ND
Arsenic (µg/L)	1	ND	<0.5	2	<0.5	ND
Barium (µg/L)	40	60	10	70	330	150
Cadmium (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	ND
Chromium (µg/L)	ND	ND	<0.5	ND	<0.5	<0.5
Iron (µg/L)	80	20	190	160	350	100
Lead (µg/L)	ND	ND	ND	ND	ND	ND
Manganese (µg/L)	10	10	10	150	70	120
Mercury (µg/L)	ND	0.2	0.2	ND	0.1	ND
Selenium (µg/L)	3	3	2	1	ND	2
Silver (µg/L)	<0.5	<0.5	<0.5	ND	ND	ND
Strontium (µg/L)	30	20	10	300	170	140
Zinc (µg/L)	30	40	10	50	30	60
Total dissolved solids (mg/L)	70	112	260	247	169	190
Hardness as $CaCO_3$ (mg/L)	31	60	2	170	82	120

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number					
	G-02	H-02	I-01	J-01	K-01	K-02
Date of collection	6-13-89	6-13-89	6-16-89	6-19-89	6-20-89	6-20-89
Water-bearing unit	ℙpv	ℙpv	O€ccr	O€ccr	Mh	ℙpv
Well depth (feet)	100	55	275	150	75	100
Specific conductance (µmhos/cm)	410	154	240	267	322	83
Temperature (°C)	20.0	20.0	15.1	18.0	18.0	19.0
Bicarbonate (mg/L)	230	87	140	150	180	43
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	190	71	110	120	150	35
pH	6.9	7.0	7.0	7.5	7.4	6.2
Silica (mg/L)	32	24	8.0	8.8	8.0	24
Calcium (mg/L)	34	18	26	37	60	2.4
Magnesium (mg/L)	18	5.2	13	8.8	1.2	2.4
Sodium (mg/L)	18	5.8	1.8	2.0	3.1	4.8
Potassium (mg/L)	1.9	0.8	0.7	0.9	0.5	0.5
Sulfate (mg/L)	24	3.9	1.2	2.0	1.9	2.8
Chloride (mg/L)	3.9	2.2	2.9	2.2	2.7	1.9
Fluoride (mg/L)	0.10	<0.05	ND	<0.05	0.05	<0.05
Nitrate as N (mg/L)	ND	ND	ND	0.50	1.45	ND
Ammonia as N (mg/L)	0.11	0.01	0.01	ND	ND	0.01
Orthophosphate as P (mg/L)	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	ND	2	1	1	ND	<0.5
Barium (µg/L)	120	260	10	10	<5	<5
Cadmium (µg/L)	ND	ND	ND	<0.5	1	<0.5
Chromium (µg/L)	ND	<0.5	1	1	1	<0.5
Iron (µg/L)	11,800	10	ND	10	10	7,300
Lead (µg/L)	ND	ND	ND	13	3	1
Manganese (µg/L)	230	60	<5	10	10	340
Mercury (µg/L)	0.1	0.1	ND	0.1	ND	0.2
Selenium (µg/L)	ND	1	<0.5	3	3	<0.5
Silver (µg/L)	ND	ND	ND	ND	<0.5	<0.5
Strontium (µg/L)	100	40	30	40	110	10
Zinc (µg/L)	40	40	<5	40	60	40
Total dissolved solids (mg/L)	257	103	123	138	173	68
Hardness as $CaCO_3$ (mg/L)	160	67	120	130	155	16

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number					
	L-01	L-02	M-5	M-10	N-02	R-01
Date of collection	6-19-89	6-19-89	6-16-89	6-16-89	6-12-89	5-29-89
Water-bearing unit	O€ccr	O€ccr	€k	Mpm, Mtfp	ℙpv	ℙpv
Well depth (feet)	spring	200?	spring	spring	100	110
Specific conductance (µmhos/cm)	249	258	340	116	299	203
Temperature (°C)	15.0	15.0	15.5	15.0	12.5	19.0
Bicarbonate (mg/L)	140	150	200	51	160	100
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	118	120	160	42	130	82
pH	7.5	7.4	7.2	6.8	7.0	7.1
Silica (mg/L)	8.0	7.7	8.3	11	35	17
Calcium (mg/L)	30	29	37	17	30	8.6
Magnesium (mg/L)	13	13	20	1.6	7.5	3.5
Sodium (mg/L)	1.2	1.1	2.1	2.8	21	29
Potassium (mg/L)	0.5	0.4	0.8	1.4	1.6	0.7
Sulfate (mg/L)	2.1	2.2	5.4	8.1	12	16
Chloride (mg/L)	1.8	1.9	2.7	2.7	5.1	2.7
Fluoride (mg/L)	<0.05	<0.05	0.05	<0.05	<0.05	ND
Nitrate as N (mg/L)	0.43	0.41	0.49	0.13	0.10	0.28
Ammonia as N (mg/L)	ND	ND	0.02	0.02	0.07	ND
Orthophosphate as P (mg/L)	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	ND	2	1	2	2	ND
Barium (µg/L)	10	10	40	20	450	220
Cadmium (µg/L)	ND	<0.5	ND	ND	ND	12
Chromium (µg/L)	<0.5	<0.5	<0.5	<0.5	ND	<0.5
Iron (µg/L)	20	10	ND	10	110	20
Lead (µg/L)	ND	2	ND	ND	ND	ND
Manganese (µg/L)	10	10	<5	<5	90	30
Mercury (µg/L)	<0.05	<0.05	0.1	ND	0.2	0.1
Selenium (µg/L)	ND	1	1	2	<0.5	ND
Silver (µg/L)	<0.5	<0.5	ND	ND	ND	<0.5
Strontium (µg/L)	20	20	40	30	170	100
Zinc (µg/L)	10	20	10	10	530	2,600
Total dissolved solids (mg/L)	128	131	177	70	192	128
Hardness as $CaCO_3$ (mg/L)	129	130	180	49	110	36

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number					
	S-01	S-02	S-04	W-26	X-01	X-02
Date of collection	6-1-89	6-1-89	6-6-89	6-28-89	6-20-89	6-22-89
Water-bearing unit	ℙpv	ℙpv	ℙpv	Ꞓk, Ꞓc	ℙpv	Qr
Well depth (feet)	210	193	200	spring	100	26
Specific conductance (µmhos/cm)	185	535	1,225	390	197	580
Temperature (°C)	19.0	22.0	20.0	16.0	24.0	16.0
Bicarbonate (mg/L)	100	300	550	160	88	320
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	82	250	450	130	72	260
pH	6.8	8.2	8.2	8.1	6.6	7.1
Silica (mg/L)	28	16	9.3	8.6	40	7.2
Calcium (mg/L)	18	6.3	0.8	32	12	100
Magnesium (mg/L)	5.9	1.8	0.2	18	11	7.6
Sodium (mg/L)	9.8	110	280	3.8	1.2	3.4
Potassium (mg/L)	0.8	0.7	0.7	1.0	1.2	0.9
Sulfate (mg/L)	7.6	1.9	95	7.2	3.0	5.7
Chloride (mg/L)	4.1	4.2	7.6	4.1	2.2	0.8
Fluoride (mg/L)	<0.05	0.10	0.82	<0.05	0.12	ND
Nitrate as N (mg/L)	0.02	0.02	ND	1.77	0.17	3.30
Ammonia as N (mg/L)	0.06	0.19	0.39	0.01	0.01	ND
Orthophosphate as P (mg/L)	ND	0.10	0.29	ND	ND	ND
Arsenic (µg/L)	1	<0.5	<0.5	ND	1	ND
Barium (µg/L)	290	220	70	20	110	50
Cadmium (µg/L)	ND	ND	<0.5	<0.5	<0.5	<0.5
Chromium (µg/L)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Iron (µg/L)	5,000	70	50	ND	10	ND
Lead (µg/L)	ND	ND	ND	<0.5	ND	ND
Manganese (µg/L)	270	20	<5	<0.5	230	10
Mercury (µg/L)	ND	ND	ND	ND	<0.05	0.2
Selenium (µg/L)	ND	1	2	1	2	2
Silver (µg/L)	ND	ND	1	<0.5	<0.5	ND
Strontium (µg/L)	80	80	20	50	50	70
Zinc (µg/L)	50	80	40	<5	30	20
Total dissolved solids (mg/L)	129	289	665	161	115	298
Hardness as $CaCO_3$ (mg/L)	70	23	3	100	75	280

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number					
	AA-01	BB-1	BB-01	DD-4	EE-01	EE-02
Date of collection	6-20-89	6-27-89	6-22-89	6-26-89	5-31-89	5-31-89
Water-bearing unit	Ꞓk	Mb	ℙpv	Ꞓc	ℙpv	ℙpv
Well depth (feet)	180	352	124	spring	160	555
Specific conductance (µmhos/cm)	555	525	525	568	216	208
Temperature (°C)	18.0	21.0	21.0	22.0	16.0	17.0
Bicarbonate (mg/L)	340	230	280	130	22	98
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	280	190	230	110	18	80
pH	7.3	7.0	6.7	7.8	6.1	6.7
Silica (mg/L)	8.2	7.8	29	7.7	12	25
Calcium (mg/L)	60	45	55	32	4.7	20
Magnesium (mg/L)	32	6.2	24	13	3.3	5.6
Sodium (mg/L)	3.4	7.3	14	6.2	27	15
Potassium (mg/L)	0.5	1.4	1.6	3.3	1.2	1.0
Sulfate (mg/L)	3.4	14	19	29	43	8.2
Chloride (mg/L)	3.3	29	12	5.9	15	8.9
Fluoride (mg/L)	ND	<0.05	0.11	<0.05	<0.05	<0.05
Nitrate as N (mg/L)	0.86	4.31	0.02	1.31	0.12	0.01
Ammonia as N (mg/L)	ND	0.02	0.17	0.02	ND	0.07
Orthophosphate as P (mg/L)	ND	ND	ND	ND	ND	ND
Arsenic (µg/L)	ND	ND	2	ND	ND	1
Barium (µg/L)	30	30	110	40	130	340
Cadmium (µg/L)	1	<0.5	1	ND	4	2
Chromium (µg/L)	ND	1	ND	<0.5	<0.5	<0.5
Iron (µg/L)	<5	10	2,180	ND	410	10
Lead (µg/L)	ND	ND	ND	ND	ND	ND
Manganese (µg/L)	20	<5	300	ND	110	260
Mercury (µg/L)	<0.05	ND	0.1	ND	0.1	0.1
Selenium (µg/L)	2	2	1	1	2	ND
Silver (µg/L)	ND	ND	<0.5	<0.5	<0.5	ND
Strontium (µg/L)	ND	240	130	150	70	110
Zinc (µg/L)	1,100	<5	30	10	160	130
Total dissolved solids (mg/L)	282	243	293	167	118	132
Hardness as $CaCO_3$ (mg/L)	280	140	240	130	25	73

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number					
	EE-03	FF-01	FF-02	FF-03	GG-01	GG-02
Date of collection	6-1-89	5-26-89	5-29-89	5-31-89	5-25-89	5-25-89
Water-bearing unit	Qr	IPpv	IPpv	IPpv	IPpv	IPpv
Well depth (feet)	12	spring	128	52	100	60
Specific conductance (µmhos/cm)	409	40	620	211	580	168
Temperature (°C)	17.0	14.0	17.0	16.0	10.0	20.0
Bicarbonate (mg/L)	200	7	140	26	320	62
Carbonate (mg/L)	0	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	160	6	110	21	260	51
pH	7.1	5.6	6.9	6.7	7.6	6.8
Silica (mg/L)	16	15	17	12	17	8.9
Calcium (mg/L)	21	1.2	42	6.3	41	14
Magnesium (mg/L)	13	1.4	16	4.6	17	5.7
Sodium (mg/L)	40	9.6	57	26	58	25
Potassium (mg/L)	1.4	0.8	1.1	0.7	1.0	1.6
Sulfate (mg/L)	26	8.3	150	5.6	4.0	23
Chloride (mg/L)	5.8	4.6	7.1	32	60	24
Fluoride (mg/L)	0.08	0.11	ND	<0.05	0.17	ND
Nitrate as N (mg/L)	0.02	1.63	0.20	5.67	ND	0.10
Ammonia as N (mg/L)	0.17	0.02	0.02	0.01	0.18	0.51
Orthophosphate as P (mg/L)	ND	ND	ND	ND	0.05	ND
Arsenic (µg/L)	2	ND	ND	3	ND	4
Barium (µg/L)	240	30	50	90	480	210
Cadmium (µg/L)	2	ND	1	1	ND	ND
Chromium (µg/L)	<0.5	<0.5	1	1	<0.5	1
Iron (µg/L)	1,900	840	760	90	170	1,400
Lead (µg/L)	ND	ND	ND	ND	ND	ND
Manganese (µg/L)	100	30	50	230	70	450
Mercury (µg/L)	0.1	ND	0.1	0.1	0.4	0.1
Selenium (µg/L)	2	ND	ND	<0.5	1	1
Silver (µg/L)	ND	ND	<0.5	ND	ND	<0.5
Strontium (µg/L)	170	20	360	30	300	100
Zinc (µg/L)	30	50	70	480	20	40
Total dissolved solids (mg/L)	222	52	360	125	304	135
Hardness as $CaCO_3$ (mg/L)	110	9	170	35	170	59

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number				
	GG-03	HH-01	II-01	LL-12	LL-01
Date of collection	5-29-89	5-29-89	5-25-89	6-26-89	6-23-89
Water-bearing unit	ℙpv	ℙpv	ℙpv	Єk	Mf
Well depth (feet)	150	100	70	spring	96
Specific conductance (µmhos/cm)	135	282	53	340	800
Temperature (°C)	21.0	19.0	20.0	17.0	18.0
Bicarbonate (mg/L)	75	160	20	180	195
Carbonate (mg/L)	0	0	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	62	130	16	150	160
pH	7.3	7.4	6.8	7.0	6.7
Silica (mg/L)	16	26	13	8.4	13
Calcium (mg/L)	17	38	6.8	37	63
Magnesium (mg/L)	3.6	7.6	3.1	17	29
Sodium (mg/L)	6.9	10	7.2	4.5	55
Potassium (mg/L)	1.2	1.1	0.4	1.0	1.3
Sulfate (mg/L)	2.3	5.7	2.4	8.0	140
Chloride (mg/L)	2.3	4.4	5.9	4.4	51
Fluoride (mg/L)	ND	ND	<0.05	<0.05	0.16
Nitrate as N (mg/L)	0.09	0.02	1.95	1.69	5.08
Ammonia as N (mg/L)	ND	ND	0.01	ND	0.01
Orthophosphate as P (mg/L)	ND	ND	ND	ND	ND
Arsenic (µg/L)	1	1	ND	ND	ND
Barium (µg/L)	110	190	50	30	40
Cadmium (µg/L)	1	1	ND	<0.5	<0.5
Chromium (µg/L)	<0.5	ND	1	<0.5	1
Iron (µg/L)	20	20	350	ND	330
Lead (µg/L)	ND	ND	2	ND	ND
Manganese (µg/L)	10	10	50	<5	110
Mercury (µg/L)	0.1	0.1	ND	ND	ND
Selenium (µg/L)	ND	ND	2	1	<0.5
Silver (µg/L)	ND	ND	<0.5	ND	ND
Strontium (µg/L)	170	150	40	50	910
Zinc (µg/L)	90	70	280	10	340
Total dissolved solids (mg/L)	88	172	57	177	472
Hardness as $CaCO_3$ (mg/L)	58	130	30	160	280

Appendix B.--Results of chemical analyses of water from selected wells and springs in Jefferson County, Alabama—Continued

Parameter	Well or spring number		
	OO-01	PP-01	QQ-01
Date of collection	6-23-89	6-26-89	6-26-89
Water-bearing unit	ℙMpw	Mtfp	Ꞓcr
Well depth (feet)	200	318	--
Specific conductance (µmhos/cm)	94	420	520
Temperature (°C)	20.0	17.0	21.0
Bicarbonate (mg/L)	28	130	180
Carbonate (mg/L)	0	0	0
Alkalinity as $CaCO_3$ (mg/L)	23	110	150
pH	5.9	8.1	8.2
Silica (mg/L)	19	9.7	9.1
Calcium (mg/L)	3.3	24	35
Magnesium (mg/L)	2.2	5.9	24
Sodium (mg/L)	11	65	6.5
Potassium (mg/L)	0.6	3.0	1.5
Sulfate (mg/L)	7.6	85	17
Chloride (mg/L)	6.8	17	8.4
Fluoride (mg/L)	<0.05	ND	<0.05
Nitrate as N (mg/L)	0.42	0.04	6.37
Ammonia as N (mg/L)	0.01	ND	ND
Orthophosphate as P (mg/L)	ND	ND	ND
Arsenic (µg/L)	ND	1	ND
Barium (µg/L)	10	50	90
Cadmium (µg/L)	1	ND	ND
Chromium (µg/L)	<0.5	<0.5	<0.5
Iron (µg/L)	630	20	<5
Lead (µg/L)	ND	<5	ND
Manganese (µg/L)	30	<0.5	ND
Mercury (µg/L)	ND	ND	ND
Selenium (µg/L)	ND	2	2
Silver (µg/L)	<0.5	ND	ND
Strontium (µg/L)	30	130	80
Zinc (µg/L)	190	<5	10
Total dissolved solids (mg/L)	67	274	218
Hardness as $CaCO_3$ (mg/L)	17	85	190

APPENDIX C

Explanation

BK, Black Creek coal group; ML, Mary Lee coal group; P, Pratt coal group.

Abbreviations: °C, degrees Celsius; µmhos/cm, micromhos per centimeter; mg/L, milligrams per liter; µg/L, micrograms per liter; --, data unavailable.

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama

Parameter	Well number				
	3353-C	3354-C	3355-C	3356-C	3357-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	2-11-82	2-11-82	2-11-82	2-11-82	2-11-82
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,140	1,058	1,150	1,164	1,160
Specific conductance (µmhos/cm)	1,450	1,650	1,630	1,190	1,700
Temperature (°C)	18	18	18	18	18
Bicarbonate (mg/L)	712	712	796	796	756
Carbonate (mg/L)	0	0	0	0	0
pH	7.8	8.2	8.1	8.1	8.2
Silica (mg/L)	--	--	--	--	--
Calcium (mg/L)	--	--	--	--	--
Magnesium (mg/L)	--	--	--	--	--
Sodium (mg/L)	--	--	--	--	--
Potassium (mg/L)	--	--	--	--	--
Sulfate (mg/L)	0.2	0	0.2	0	1.9
Chloride (mg/L)	180	240	200	180	220
Fluoride (mg/L)	4.2	3.9	4.2	4.9	4.5
Nitrate as N (mg/L)	--	--	--	--	--
Arsenic (µg/L)	--	--	--	--	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	--	--	--
Chromium (µg/L)	--	--	--	--	--
Cobalt (µg/L)	--	--	--	--	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	--	--	--	--	--
Lead (µg/L)	--	--	--	--	--
Manganese (µg/L)	--	--	--	--	--
Mercury (µg/L)	--	--	--	--	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	--	--	--	--	--
Zinc (µg/L)	--	--	--	--	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	--	--	--	--	--

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	3358-C	3359-C	3360-C	3362-C	3363-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	2-11-82	4-7-81	2-11-82	2-11-82	4-7-81
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,102	1,086	1,125	1,107	1,100
Specific conductance (µmhos/cm)	1,500	1,250	1,700	2,500	1,525
Temperature (°C)	18	21	20	18	18
Bicarbonate (mg/L)	740	--	720	690	130
Carbonate (mg/L)	0	--	0	0	8
pH	8.1	8.2	7.7	8.2	9.1
Silica (mg/L)	--	--	11	9.4	11
Calcium (mg/L)	--	--	4	8.6	--
Magnesium (mg/L)	--	--	1.3	3	--
Sodium (mg/L)	--	--	440	660	--
Potassium (mg/L)	--	--	0.6	0.9	--
Sulfate (mg/L)	0.6	--	3	0	0
Chloride (mg/L)	180	--	270	570	250
Fluoride (mg/L)	5.4	--	3.6	4.3	1.7
Nitrate as N (mg/L)	--	--	0	0.07	--
Arsenic (µg/L)	--	--	11	8	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	0	1	--
Chromium (µg/L)	--	--	0	1	--
Cobalt (µg/L)	--	--	0	0	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	--	--	350	50	280
Lead (µg/L)	--	--	0	0	--
Manganese (µg/L)	--	--	0	9	--
Mercury (µg/L)	--	--	0.1	0.1	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	--	--	120	320	--
Zinc (µg/L)	--	--	20	0	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	--	--	1,088	1,597	--

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	3364-C	3365-C	3366-C	3368-C	3369-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	2-11-82	2-11-82	2-11-82	4-7-81	4-7-81
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,127	1,086	1,096	1,072	1,107
Specific conductance (µmhos/cm)	1,580	1,550	1,720	1,250	7,800
Temperature (°C)	18	--	17	21	20
Bicarbonate (mg/L)	804	852	820	--	156
Carbonate (mg/L)	0	0	0	--	20
pH	8.1	8	0.1	8.2	8.4
Silica (mg/L)	--	--	--	--	9.6
Calcium (mg/L)	--	--	--	--	--
Magnesium (mg/L)	--	--	--	--	--
Sodium (mg/L)	--	--	--	--	--
Potassium (mg/L)	--	--	--	--	--
Sulfate (mg/L)	0.7	1.4	0	--	0.2
Chloride (mg/L)	150	170	210	180	190
Fluoride (mg/L)	5.4	4.7	4	--	4.4
Nitrate as N (mg/L)	--	--	--	--	--
Arsenic (µg/L)	--	--	--	--	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	--	--	--
Chromium (µg/L)	--	--	--	--	--
Cobalt (µg/L)	--	--	--	--	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	--	--	--	--	30
Lead (µg/L)	--	--	--	--	--
Manganese (µg/L)	--	--	--	--	--
Mercury (µg/L)	--	--	--	--	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	--	--	--	--	--
Zinc (µg/L)	--	--	--	--	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	--	--	--	--	--

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	3370-C	3371-C	3372-C	3373-C	3423-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	3-1-88	2-10-82	2-10-82	2-18-82	8-27-82
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,137	1,136	1,114	1,088	1,137
Specific conductance (µmhos/cm)	1,550	1,550	1,650	1,600	3,120
Temperature (°C)	24	16	18	19	--
Bicarbonate (mg/L)	670	866	886	870	--
Carbonate (mg/L)	28	0	0	0	--
pH	8.6	8.2	8.1	8.2	8.6
Silica (mg/L)	5.8	--	--	10	--
Calcium (mg/L)	1.4	--	--	2.7	--
Magnesium (mg/L)	0.6	--	--	0.8	--
Sodium (mg/L)	350	--	--	500	--
Potassium (mg/L)	0.5	--	--	0.6	--
Sulfate (mg/L)	0	1.3	1.1	1.3	
Chloride (mg/L)	150	130	210	240	780
Fluoride (mg/L)	1.2	4.7	4.8	3.9	--
Nitrate as N (mg/L)	0.21	--	--	0	--
Arsenic (µg/L)	1	--	--	11	--
Barium (µg/L)	870	--	--	--	--
Cadmium (µg/L)	4	--	--	1	--
Chromium (µg/L)	4	--	--	1	--
Cobalt (µg/L)	0	--	--	0	--
Copper (µg/L)	10	--	--	--	--
Iron (µg/L)	60	--	--	340	--
Lead (µg/L)	2	--	--	0	--
Manganese (µg/L)	80	--	--	5	--
Mercury (µg/L)	0	--	--	0	--
Selenium (µg/L)	3	--	--	--	--
Silver (µg/L)	0	--	--	--	--
Strontium (µg/L)	0	--	--	100	--
Zinc (µg/L)	5	--	--	5	--
Aluminum (µg/L)	200	--	--	--	--
Lithium (µg/L)	210	--	--	--	--
Nickel (µg/L)	0	--	--	--	--
Vanadium (µg/L)	5	--	--	--	--
Total dissolved solids (mg/L)	839	--	--	1,188	--

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	3425-C	3426-C	3428-C	3441-C	3446-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	7-22-82	5-25-88	7-22-82	8-27-82	8-27-82
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,154	1,177	1,148	1,127	1,107
Specific conductance (µmhos/cm)	5,450	1,230	5,200	2,780	1,590
Temperature (°C)	--	21	--	--	--
Bicarbonate (mg/L)	--	630	--	--	--
Carbonate (mg/L)	--	32	--	--	--
pH	8	8.9	7.9	8.7	8.4
Silica (mg/L)	--	8.5	--	--	--
Calcium (mg/L)	--	1.5	--	--	--
Magnesium (mg/L)	--	0.4	--	--	--
Sodium (mg/L)	--	300	--	--	--
Potassium (mg/L)	--	1.6	--	--	--
Sulfate (mg/L)	--	0.3	--	--	--
Chloride (mg/L)	1,200	92	1,200	620	320
Fluoride (mg/L)	--	3.2	--	--	--
Nitrate as N (mg/L)	--	0.13	--	--	--
Arsenic (µg/L)	--	--	--	--	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	--	--	--
Chromium (µg/L)	--	--	--	--	--
Cobalt (µg/L)	--	--	--	--	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	--	1,400	--	--	--
Lead (µg/L)	--	--	--	--	--
Manganese (µg/L)	--	30	--	--	--
Mercury (µg/L)	--	--	--	--	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	--	0	--	--	--
Zinc (µg/L)	--	--	--	--	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	--	750	--	--	--

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	4932-C	4958-C	4961-C	5094-C	5120-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	3-22-88	3-22-88	3-22-88	3-22-88	5-25-88
Water-bearing unit	ML	ML	ML	ML	P-ML
Well depth (feet)	1,242	1,278	1,004	1,034	1,100
Specific conductance (µmhos/cm)	825	2,350	7,200	3,810	1,490
Temperature (°C)	24	22	22	24	22
Bicarbonate (mg/L)	310	800	570	670	640
Carbonate (mg/L)	14	59	11	7	24
pH	8.7	9.1	8.5	8.4	8.8
Silica (mg/L)	10	7.9	4.6	8.6	8.6
Calcium (mg/L)	1.8	2.8	34	13	1.7
Magnesium (mg/L)	0.3	0.7	18	6.9	0.4
Sodium (mg/L)	210	610	1,800	920	390
Potassium (mg/L)	0.4	1	2.4	1.4	1.4
Sulfate (mg/L)	130	0.7	0	6	22
Chloride (mg/L)	25	400	2,700	1,100	160
Fluoride (mg/L)	0.3	4.1	6	2.8	2.6
Nitrate as N (mg/L)	0	0.28	0.75	0	0
Arsenic (µg/L)	--	--	--	--	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	--	--	--
Chromium (µg/L)	--	--	--	--	--
Cobalt (µg/L)	--	--	--	--	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	480	2,200	8,200	840	790
Lead (µg/L)	--	--	--	--	--
Manganese (µg/L)	20	40	110	10	10
Mercury (µg/L)	--	--	--	--	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	0	0	1,900	550	240
Zinc (µg/L)	--	--	--	--	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	545	1,490	4,870	2,390	901

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	5121-C	5125-C	5159-C	5166-C	5215-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	3-1-88	3-22-88	3-22-88	4-5-88	4-5-88
Water-bearing unit	ML	ML	ML	ML	ML
Well depth (feet)	1,188	1,173	1,302	1,275	1,474
Specific conductance (µmhos/cm)	1,209	1,471	6,510	3,230	4,360
Temperature (°C)	21	22	23	24	24
Bicarbonate (mg/L)	580	780	570	610	350
Carbonate (mg/L)	47	36	0	41	0
pH	8.9	8.9	8.3	8.9	8.3
Silica (mg/L)	12	7.1	7.6	6	8.9
Calcium (mg/L)	0.8	2.4	22	5.3	43
Magnesium (mg/L)	0.3	0.5	10	1.6	13
Sodium (mg/L)	300	360	1,700	700	990
Potassium (mg/L)	0.3	1	2.4	1.1	1.6
Sulfate (mg/L)	35	1.9	6.1	0	3.8
Chloride (mg/L)	66	83	2,300	800	1,600
Fluoride (mg/L)	2.7	3.3	4.8	3.5	1.2
Nitrate as N (mg/L)	0.53	0	12.5	1.11	3.85
Arsenic (µg/L)	3	--	--	--	--
Barium (µg/L)	200	--	--	--	--
Cadmium (µg/L)	3	--	--	--	--
Chromium (µg/L)	2	--	--	--	--
Cobalt (µg/L)	0	--	--	--	--
Copper (µg/L)	40	--	--	--	--
Iron (µg/L)	360	960	16,000	99,000	4,500
Lead (µg/L)	3	--	--	--	--
Manganese (µg/L)	20	30	130	880	70
Mercury (µg/L)	0	--	--	--	--
Selenium (µg/L)	1	--	--	--	--
Silver (µg/L)	1	--	--	--	--
Strontium (µg/L)	10	0	1,200	230	1,520
Zinc (µg/L)	10	--	--	--	--
Aluminum (µg/L)	160	--	--	--	--
Lithium (µg/L)	180	--	--	--	--
Nickel (µg/L)	2	--	--	--	--
Vanadium (µg/L)	0	--	--	--	--
Total dissolved solids (mg/L)	752	844	4,410	1,960	2,860

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	5218-C	5227-C	5236-C	5240-C	5262-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	4-1-88	4-5-88	5-25-88	4-1-88	4-5-88
Water-bearing unit	ML, BK	ML	ML	P	ML
Well depth (feet)	1,602	1,505	1,354	697	1,344
Specific conductance (µmhos/cm)	4,350	2,670	1,500	899	3,150
Temperature (°C)	22	24	25	20	23
Bicarbonate (mg/L)	1,100	390	570	550	570
Carbonate (mg/L)	0	20	11	0	25
pH	7.9	8.7	8.5	8.3	8.7
Silica (mg/L)	9.8	9.4	8.7	13	8.8
Calcium (mg/L)	31	8.2	3.3	6.6	6.9
Magnesium (mg/L)	7.9	2.3	0.7	1.4	2.9
Sodium (mg/L)	1,200	630	360	270	690
Potassium (mg/L)	1.8	0.9	1.2	1	1.1
Sulfate (mg/L)	0.8	1.8	12	0.5	4.9
Chloride (mg/L)	1,200	760	220	52	760
Fluoride (mg/L)	7.5	0.9	1.9	11	2.5
Nitrate as N (mg/L)	5.34	0.64	0	0	1.58
Arsenic (µg/L)	--	--	--	--	--
Barium (µg/L)	--	--	--	--	--
Cadmium (µg/L)	--	--	--	--	--
Chromium (µg/L)	--	--	--	--	--
Cobalt (µg/L)	--	--	--	--	--
Copper (µg/L)	--	--	--	--	--
Iron (µg/L)	10,000	520	1,400	520	940
Lead (µg/L)	--	--	--	--	--
Manganese (µg/L)	120	--	30	30	30
Mercury (µg/L)	--	20	--	--	--
Selenium (µg/L)	--	--	--	--	--
Silver (µg/L)	--	--	--	--	--
Strontium (µg/L)	690	--	50	80	300
Zinc (µg/L)	--	240	--	--	--
Aluminum (µg/L)	--	--	--	--	--
Lithium (µg/L)	--	--	--	--	--
Nickel (µg/L)	--	--	--	--	--
Vanadium (µg/L)	--	--	--	--	--
Total dissolved solids (mg/L)	3,040	1,630	901	627	1,770

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number				
	5265-C	5276-C	5340-C	5375-C	5385-C
Location (field)	Oak Grove	Oak Grove	Oak Grove	Oak Grove	Oak Grove
Date of collection	4-1-88	3-1-88	4-5-88	4-5-88	5-11-88
Water-bearing unit	ML	ML	ML	ML	--
Well depth (feet)	1,507	1,336	1,054	1,116	1,006
Specific conductance (µmhos/cm)	3,200	6,930	2,790	1,359	1,760
Temperature (°C)	20	18	22	23	22
Bicarbonate (mg/L)	550	310	690	600	690
Carbonate (mg/L)	30	30	0	12	20
pH	8.8	8.9	8.3	8.6	8.5
Silica (mg/L)	10	4.1	8.4	8.3	6.6
Calcium (mg/L)	4.8	17	9.3	2.3	5.6
Magnesium (mg/L)	4.5	8.5	2.9	0.7	3
Sodium (mg/L)	830	1,500	700	380	520
Potassium (mg/L)	1.2	2.2	1.4	0.7	1.4
Sulfate (mg/L)	3.7	1.4	5	0.9	17
Chloride (mg/L)	1,000	2,100	640	190	360
Fluoride (mg/L)	2.7	1.4	2.4	2.1	2.2
Nitrate as N (mg/L)	0	0.84	1.11	0.53	0.78
Arsenic (µg/L)	--	40	--	--	--
Barium (µg/L)	--	3,000	--	--	--
Cadmium (µg/L)	--	4	--	--	--
Chromium (µg/L)	--	3	--	--	--
Cobalt (µg/L)	--	0	--	--	--
Copper (µg/L)	--	10	--	--	--
Iron (µg/L)	1,300	20	4,700	590	1,400
Lead (µg/L)	--	90	--	--	--
Manganese (µg/L)	40	130	70	20	50
Mercury (µg/L)	--	0	--	--	--
Selenium (µg/L)	--	70	--	--	--
Silver (µg/L)	--	1	--	--	--
Strontium (µg/L)	600	1,400	240	70	130
Zinc (µg/L)	--	60	--	--	--
Aluminum (µg/L)	--	30	--	--	--
Lithium (µg/L)	--	930	--	--	--
Nickel (µg/L)	--	0	--	--	--
Vanadium (µg/L)	--	5	--	--	--
Total dissolved solids (mg/L)	2,160	3,830	1,720	896	1,780

Appendix C.--Results of chemical analyses of water from selected coal degasification wells in Jefferson County, Alabama—Continued

Parameter	Well number			
	2963-C	2973-C	3253-C	5002-C
Location (field)	Pleasant Grove	Pleasant Grove	Pleasant Grove	Pleasant Grove
Date of collection	11-5-82	11-2-82	4-1-88	3-1-88
Water-bearing unit	--	--	--	ML, BK
Well depth (feet)	1,522	1,545	1,548	1,446
Specific conductance (µmhos/cm)	--	1,420	1,474	1,663
Temperature (°C)	--	19	21	20
Bicarbonate (mg/L)	--	908	1,100	880
Carbonate (mg/L)	--	0	14	0
pH	9	7	8.5	8.3
Silica (mg/L)	--	11	8.5	11
Calcium (mg/L)	1	1.8	0.8	2.5
Magnesium (mg/L)	0.5	0.5	1.2	0.6
Sodium (mg/L)	372	400	470	360
Potassium (mg/L)	0.6	0.9	1.4	0.6
Sulfate (mg/L)	0.5	2	8.3	0.7
Chloride (mg/L)	19	40	29	57
Fluoride (mg/L)	--	2.8	3	0.6
Nitrate as N (mg/L)	--	0.03	2.64	0.62
Arsenic (µg/L)	--	5	--	0
Barium (µg/L)	--	--	--	300
Cadmium (µg/L)	--	0	--	3
Chromium (µg/L)	--	0	--	4
Cobalt (µg/L)	--	0	--	0
Copper (µg/L)	--	--	--	10
Iron (µg/L)	2,410	3,200	15,000	320
Lead (µg/L)	--	0	--	3
Manganese (µg/L)	--	77	140	50
Mercury (µg/L)	--	0	--	0
Selenium (µg/L)	--	--	--	0
Silver (µg/L)	--	--	--	0.5
Strontium (µg/L)	--	50	70	40
Zinc (µg/L)	--	20	--	30
Aluminum (µg/L)	--	--	--	0
Lithium (µg/L)	--	--	--	120
Nickel (µg/L)	--	--	--	2
Vanadium (µg/L)	--	--	--	5
Total dissolved solids (mg/L)	1,044	907	1,090	876