HYDROGEOLOGY AND GROUND-WATER QUALITY IN THE BLACK BELT AREA OF WEST-CENTRAL ALABAMA, AND ESTIMATED WATER USE FOR AQUACULTURE, 1990

By Robert E. Kidd and Darrell S. Lambeth

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CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
square mile (mi^2)	259.0	hectare
acre	4,047	square meter
gallon per minute (gal/min)	0.06308	liter per second
million gallons per day (Mgal/d)	0.04381	cubic meter per second
inches per year (in/yr)	2.54	centimeters per year

Sea Level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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ABSTRACT

Commercial production of catfish in west-central Alabama began about 1970, and by 1991 catfish ponds covered about 16,000 acres in the Black Belt area of the State. The rapid increase in catfish farming or aquaculture and the associated demand for ground water led the U.S. Geological Survey in cooperation with other Federal and State agencies in 1990 to initiate a study to better define the ground-water resources in the Black Belt area.

The major aquifers in the study area are sand and gravel beds in the Eutaw, Gordo, and Coker Formations. Recharge to these aquifers occurs primarily in areas where those formations crop out. The average recharge to the major aquifers in the study area, as estimated from baseflow analysis of streams in the outcrop area, is 11.4 inches per year.

Water from the major aquifers in the study area generally is of good quality and suitable for most uses. Water from the Eutaw aquifer, however, contains chloride in concentrations greater than 500 milligrams per liter in central Greene County and in downdip areas in Marengo and Wilcox Counties and is not suitable for public water supply. Some ground water with elevated chloride concentrations is used for catfish farming in these areas, however.

The total estimated water use for aquaculture in the study area in 1990 was 21.83 million gallons per day, 16.08 million gallons per day from ground-water sources, and 5.75 million gallons per day from surface water sources. About 13.54 million gallons per day of water was used for filling catfish ponds and an additional 8.29 million gallons per day was used to replace evaporation losses.

INTRODUCTION

Commercial production of catfish in Alabama began about 1970 and by 1991 aquaculture ponds covered about 16,000 acres in and near the Black Belt area of west-central Alabama (plate 1). This increase in aquaculture and the associated demand for ground water in the area, prompted the need for a better understanding of the ground-water resources in the Black Belt area. To address this need, the U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS), is developing a comprehensive program to study the effects of multiple uses of land and water resources in the area. As part of this comprehensive program, the U.S. Geological Survey (USGS), in cooperation with SCS and the Alabama Department of Economic and Community Affairs (ADECA), studied the ground-water resources and inventoried water use for aquaculture in the area. The objectives of that study were to describe (1) the hydrogeology of the major aquifers, (2) the quality of the ground water, (3) the recharge to and discharge from the major aquifers, and (4) the estimated water use for aquaculture in 1990. This report presents the results of the study, which was conducted during 1990-91.

Description of the Study Area

The study area is in west-central Alabama and encompasses an area of about 2,630 mi^2 (square miles). The area includes parts of eight counties: Dallas, Greene, Hale, Marengo, Perry, Pickens, Sumter, and Wilcox (fig. 1). Much of the study area is underlain by black soil and is locally referred to as the Black Belt of Alabama.

The study area lies within the East Gulf Coastal Plain physiographic section and includes parts of five physiographic districts: the Fall Line Hills, the Black Prairie, the Chunnenuggee Hills, the Flatwoods, and the Alluvial Plain (fig. 2). Regional topography in the area dips toward the Gulf of Mexico or the Mississippi embayment. The northern part of the study area, generally north of the line from Eutaw through Greensboro to Marion, lies within the Fall Line Hills district. This district is characterized by flat to moderately-rolling sandy uplands dissected by deeply-entrenched southward and southwestward flowing streams. A 20- to 25-mile-wide crescent-shaped area from the Mississippi State line in southern Pickens and northern Sumter Counties southeastward to Perry County and western Dallas County, is in the Black Prairie district. This district is underlain by black soil for which the Black Belt area gets its name and is characterized by gently- to moderately-rolling prairie with extensive grasslands and few trees. A 5-mile-wide band that extends eastward from Sumter County across Marengo County in northwestern Wilcox County lies in the Chunnenuggee Hills district (fig. 2). This district is characterized by a series of sand hills and cuestas. Most of the hills and cuestas are about 100 to 200 feet higher than the Black Prairie to the north. A lowland about 5 to 8 miles wide, that extends

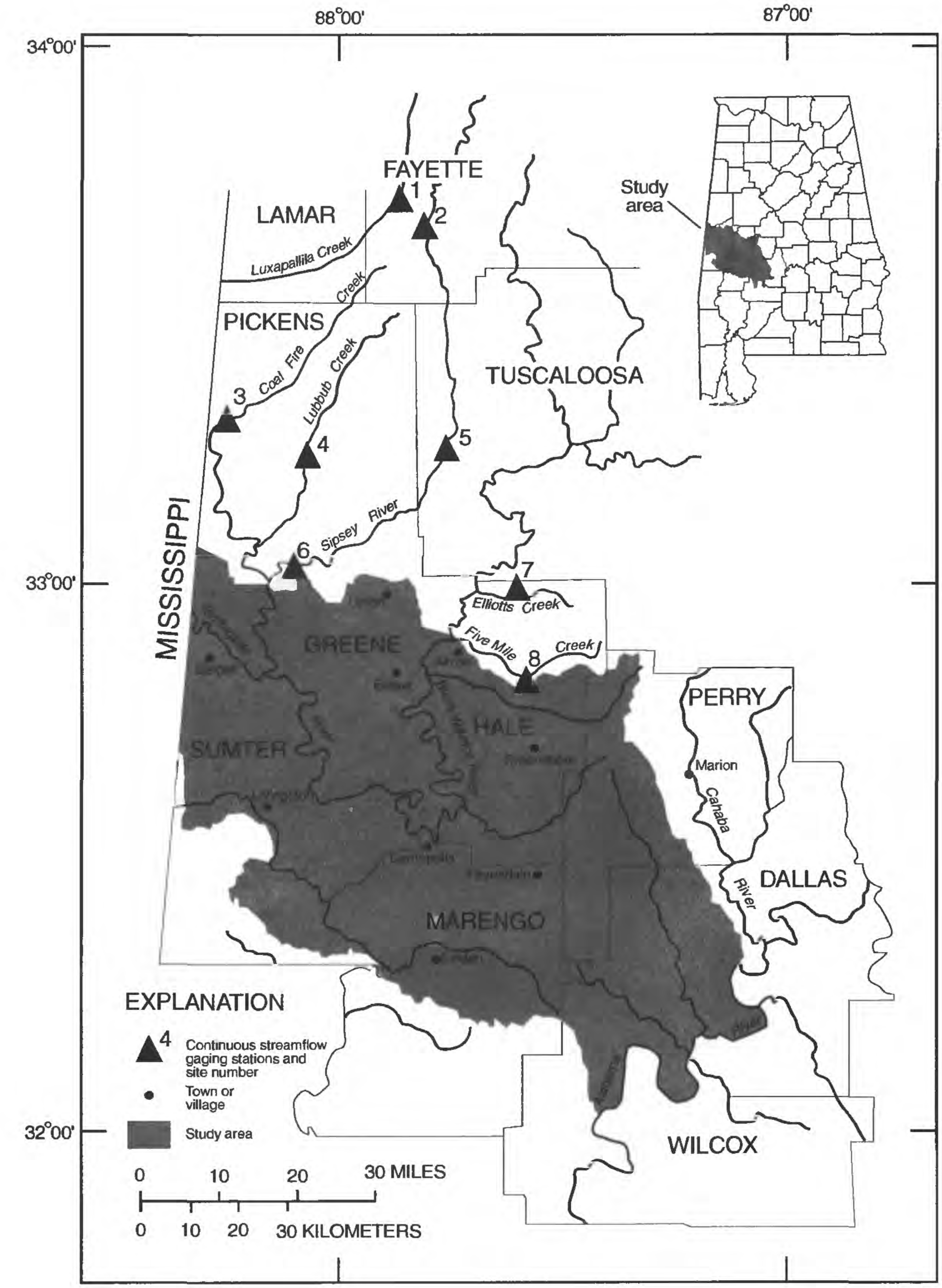

Figure 1. Location of the study area and selected continuous streamflow gaging stations.

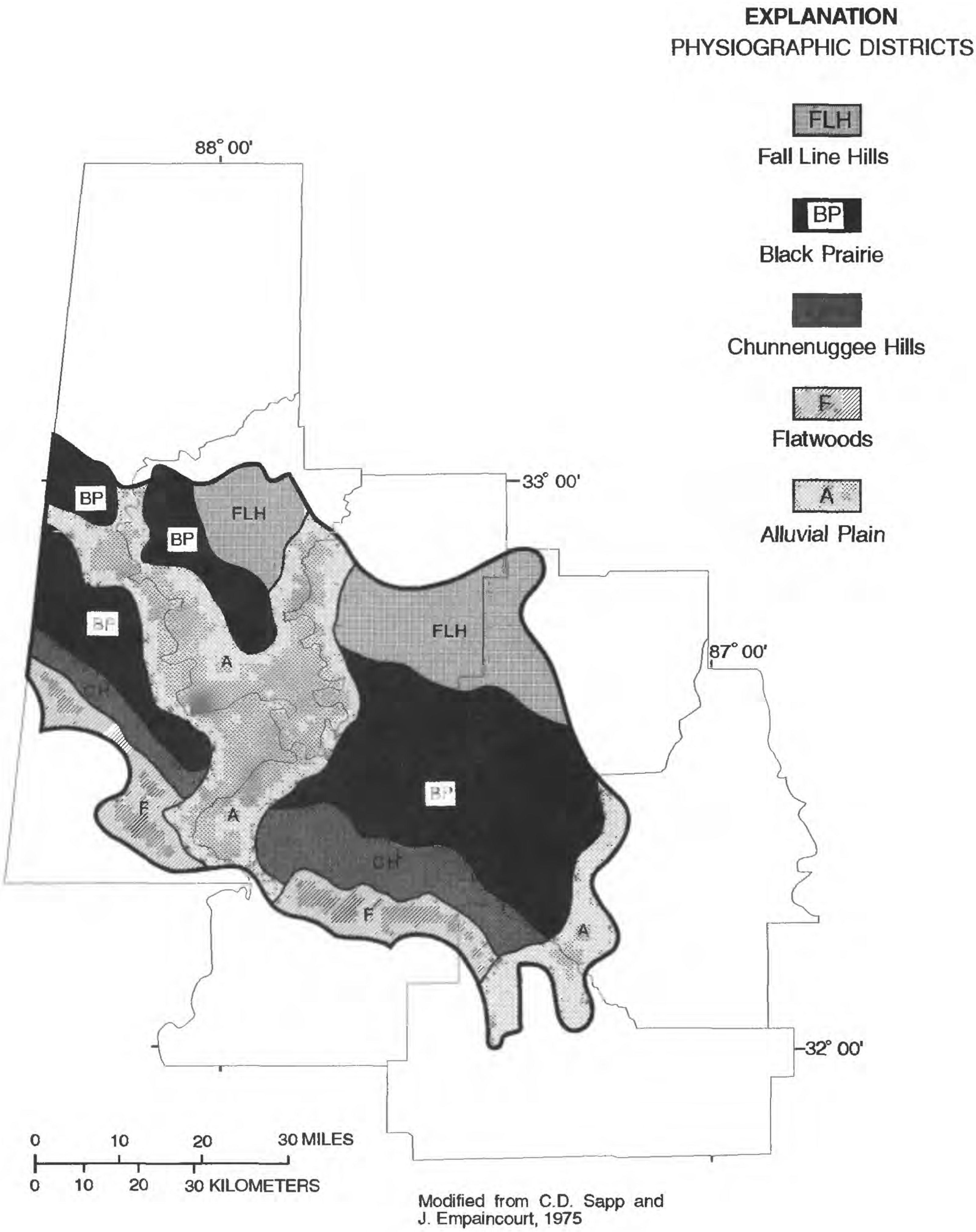

Figure 2. Physiographic districts of the Black Belt area of west-central Alabama.

from Sumter County through central Marengo County into Wilcox County just east of the Alabama River, lies in the Flatwoods district. The broad, flat, flood plains and terraces that lie along the Tombigbee, Black Warrior, and Alabama Rivers are in the Alluvial Plain. These flood plains are underlain by fluvially deposited clays, silts, and sands.

Because of its proximity to the Gulf of Mexico, west-central Alabama has a moist temperate climate. Annual precipitation amounts are fairly uniform throughout the area. Mean annual rainfall, based on data for period 1970-90, ranges from 6.9 inches for March to 3.4 inches for October (U.S. Department of Commerce, 1970-90).

Methods of Study

Data collection in this study included inventorying wells, collecting ground-water samples, estimating recharge to and discharge from the major aquifers, and estimating water use for aquaculture. The estimation of water use for aquaculture involved an inventory of commercial catfish ponds. Available data for wells in the study area were compiled and analyzed, and an inventory of large-capacity wells, primarily public-supply wells, was made. The information collected in this well inventory included water-use data, well depths, well yields, aquifers in which the wells were screened and, where possible, water levels. At five of the wells inventoried, water samples were collected to determine the occurrence of common dissolved constituents.

Water samples also were collected from 100 wells throughout the study area to determine the distribution of specific conductance and dissolved chloride concentrations in ground water in the area. Recharge to and discharge from the major aquifers in the study area were estimated from baseflow analysis. Streamflow data from eight daily record sites in the outcrop areas of the major aquifers were analyzed in the baseflow analysis using methods developed by Rutledge (1991, 1992). Water-use requirements for aquaculture were calculated from data obtained from an inventory of catfish ponds. For each of the ponds inventoried, the size, location, topographic setting, surrounding land use, and source of water supply was documented, and an estimate of water use was made.

Previous Investigations

Reports describing various aspects of the geology, hydrology, and water chemistry in all or part of the study area have been published by the U.S. Geological Survey, the Geological Survey of Alabama, and other agencies. The geology and ground-water resources of Wilcox County have been described by LaMoreaux and Toulmin (1959). Newton and others (1961) reported on the geology and ground-water resources of Marengo County. Wahl (1966) described the geology and ground-water resources of Greene County. The mineral, water, and energy resources of Wilcox

County have been described by LaMoreaux and others (1969). Newton and others (1971) described the availability of water in Marengo County. Reed (1972) reported on the geology of Perry County, and Reed, Willmon, and Jefferson (1972) described water availability in Perry County. Davis and others (1975) reported on water availability and geology of Hale County. The water availability and geology of Sumter County have been described by Davis, Sanford, and Jefferson (1980). Scott, Golden, and Newton (1981) reported on the geology and water availability of Dallas County. The deposits of Cretaceous and Tertiary age in the study area have been described in reports by Monroe (1941), Copeland (1968), and Davis (1987). Miller (1992) described the general hydrology of the Coastal Plain aquifers.

Other reports describing the geology, hydrology, and water quality in all or part of the study area include those by Mooty (1987), DeJarnette and Crownover (1987), Davis (1987), Barksdale and others (1986a, 1986b), Planert and Sparks (1987), Gardner (1981), and Planert and others (1991). Mooty (1987), and DeJarnette and Crownover (1987) included the study area in their descriptions of the geohydrology and susceptibility of major aquifers to surface contamination. They also presented an inventory of public supply wells and presented potentiometric surface maps of the major aquifers in the area. Davis (1987) and Barksdale and others (1986a, 1986b) presented maps of the potentiometric surfaces and estimated ground-water withdrawals from the Eutaw and Tuscaloosa aquifers (Gordo and Coker aquifers in this report). Planert and Sparkes (1985) estimated the hydraulic conductivity of the confining bed between the Eutaw and Gordo aquifers in Marengo County. Gardner (1981) described the hydraulic characteristics of the Gordo and Eutaw aquifers in west-central Alabama by using a three-dimensional model. Planert and others (1991) developed a regional ground-water flow model for the Southeastern Coastal Plain aquifer system in Alabama, which included aquifers in the study area.

Acknowledgments

The authors extend their appreciation to the many people who provided information and assistance with this investigation, particularly Perry Oakes, Gregory Whitis, and William Hemstreet of the Alabama Fish Farming Center. Special thanks also go to George Smelley and Barry Bates for allowing access to their ponds for the installation of water-quality monitors. During the well and pond inventory, assistance was provided by the following Soil Conservation Service personnel: Winford Andrews, Gregory Gresham, Andrew Williams, Charles McAlpine, Floyd Wood, Roland Perry, Hugo Bethane, and Anthony Eaton. The Black Belt Water Resources Study Steering Committee provided leadership and guidance throughout the study. Successful completion of the study would not have been possible without the assistance of the catfish farmers and well owners who provided access to their property and furnished well and water-use information.

HYDROGEOLOGY

Geologic units that crop out in the study area are shown in figure 3. The units are of sedimentary origin, and consist mainly of sand, clay, gravel, silt, chalk, and sandstone. These deposits range in age from Late Cretaceous to Quaternary. The outcropping units include, in ascending order: the Gordo Formation; the Eutaw Formation; the Selma Group, which consists of the Mooreville and Demopolis Chalks, the Ripley Formation, and the Prairie Bluff Chalk, all of Late Cretaceous age; the Clayton and Porters Creek Formations, undifferentiated; the Naheola Formation; and the Nanafalia Formation, all of Tertiary age. Alluvial and terrace deposits of Quaternary age overlie the older deposits in, and adjacent to, the flood plains of the Tombigbee, Black Warrior, and Alabama Rivers, and some of the larger streams in the study area.

The Coker Formation crops out north of the study area and underlies the Gordo Formation (fig. 4). Rocks of Early Cretaceous age do not crop out in Alabama, but thin northward and pinch out in the subsurface near the northern boundary of the study area (fig. 5). Pink nodular limestone fragments and red and green shale, found near the top of the Lower Cretaceous rocks, distinguish them from the massive sand of the overlying Coker Formation of Late Cretaceous age. The Cretaceous deposits overlie Paleozoic sedimentary rocks.

The water-bearing characteristics of the geologic units that underlie the study area are described in figure 6. The water-bearing characteristics described for each geologic unit apply to one or more sand or sand-and-gravel beds within the unit. The beds of permeable materials within an aquifer commonly are hydraulically connected, but in some instances, are separated by layers of low-permeability clay, chalk, limestone, or other material. No attempt is made in this report to delineate the occurrence of these sand and gravel beds within each formation.

Deposits of Quaternary Age

Deposits of Quaternary age overlie older formations throughout a large part of the study area (fig. 3). These deposits consist of alluvial and terrace deposits associated with the flood plains of present and ancestral large streams. They consist mainly of gravel, sand, silt, and clay. The alluvial deposits generally range in thickness from 0 to 60 feet, but are as much as 80 feet thick in some places. Terrace deposits are as much as 100 feet thick.

Data for 12 wells tapping the deposits of Quarternary age are given in table 1 (plate 2). Terrace deposits yield sufficient quantities of water for domestic supplies. Alluvial sediments are a potential source of large supplies where sand beds are of sufficient saturated thickness.

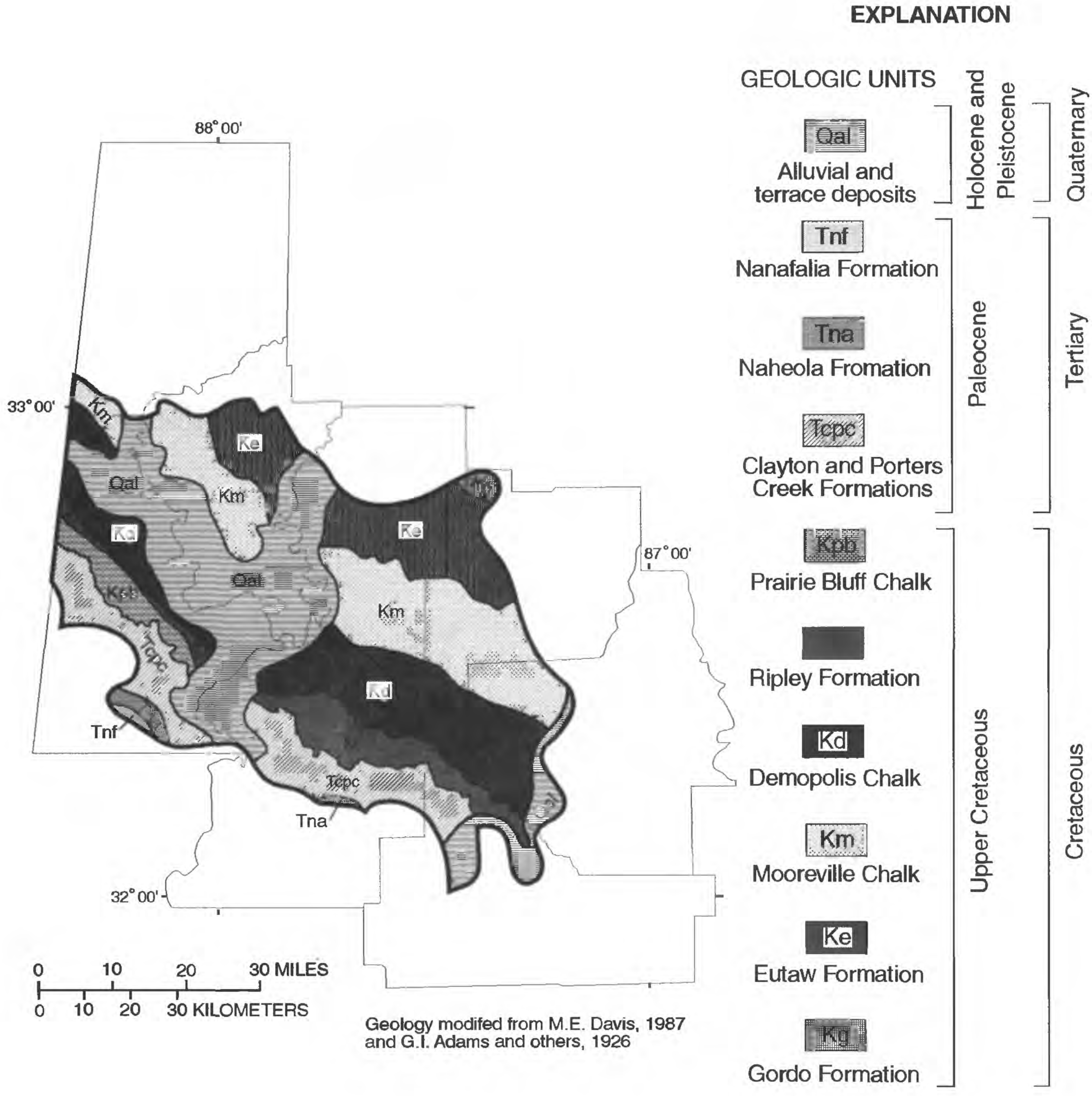

Figure 3. Generalized geology of the Black Belt area of west-central Alabama.

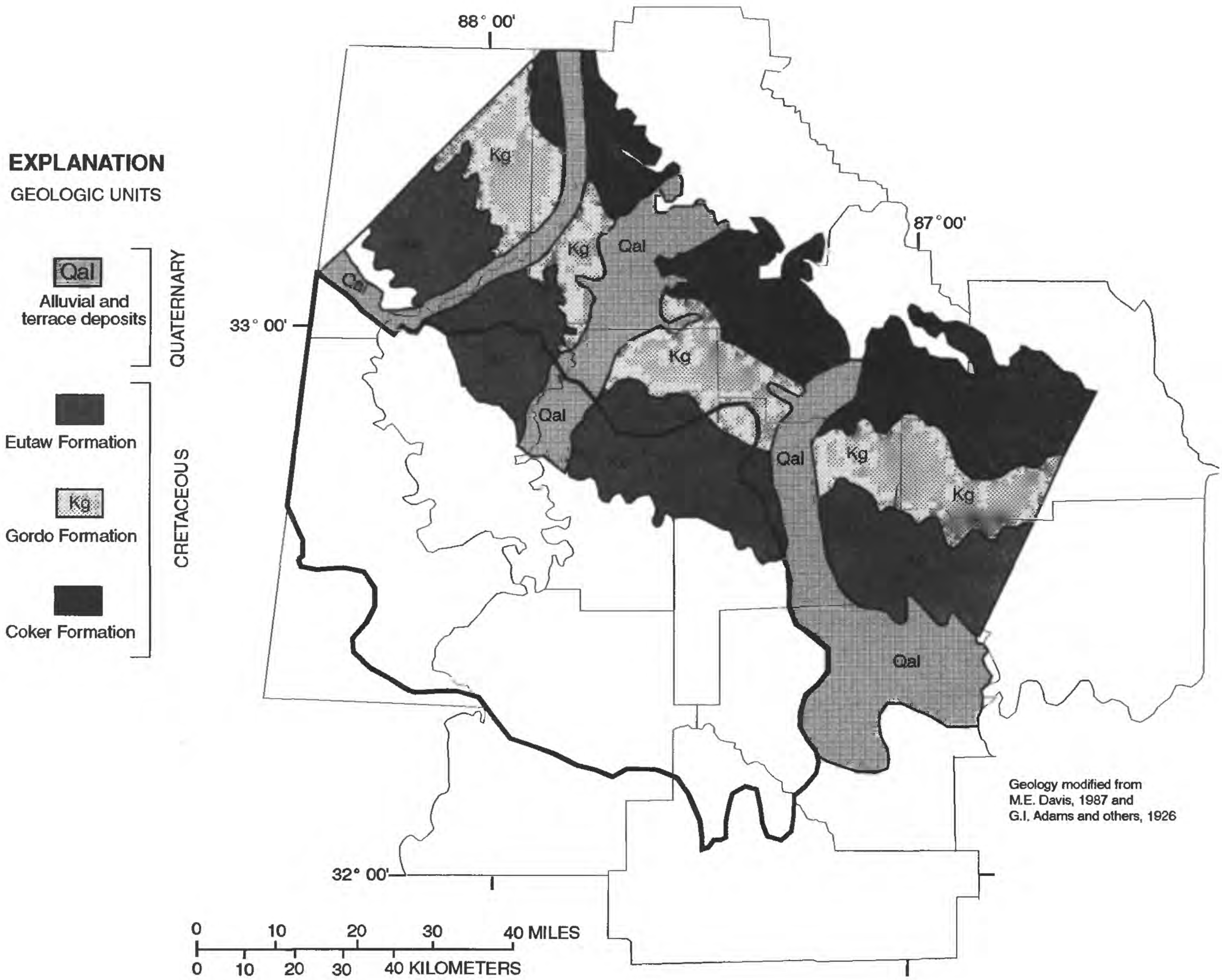

Figure 4. Estimated areas of recharge of the major aquifer in the Black Belt area of west-central Alabama.

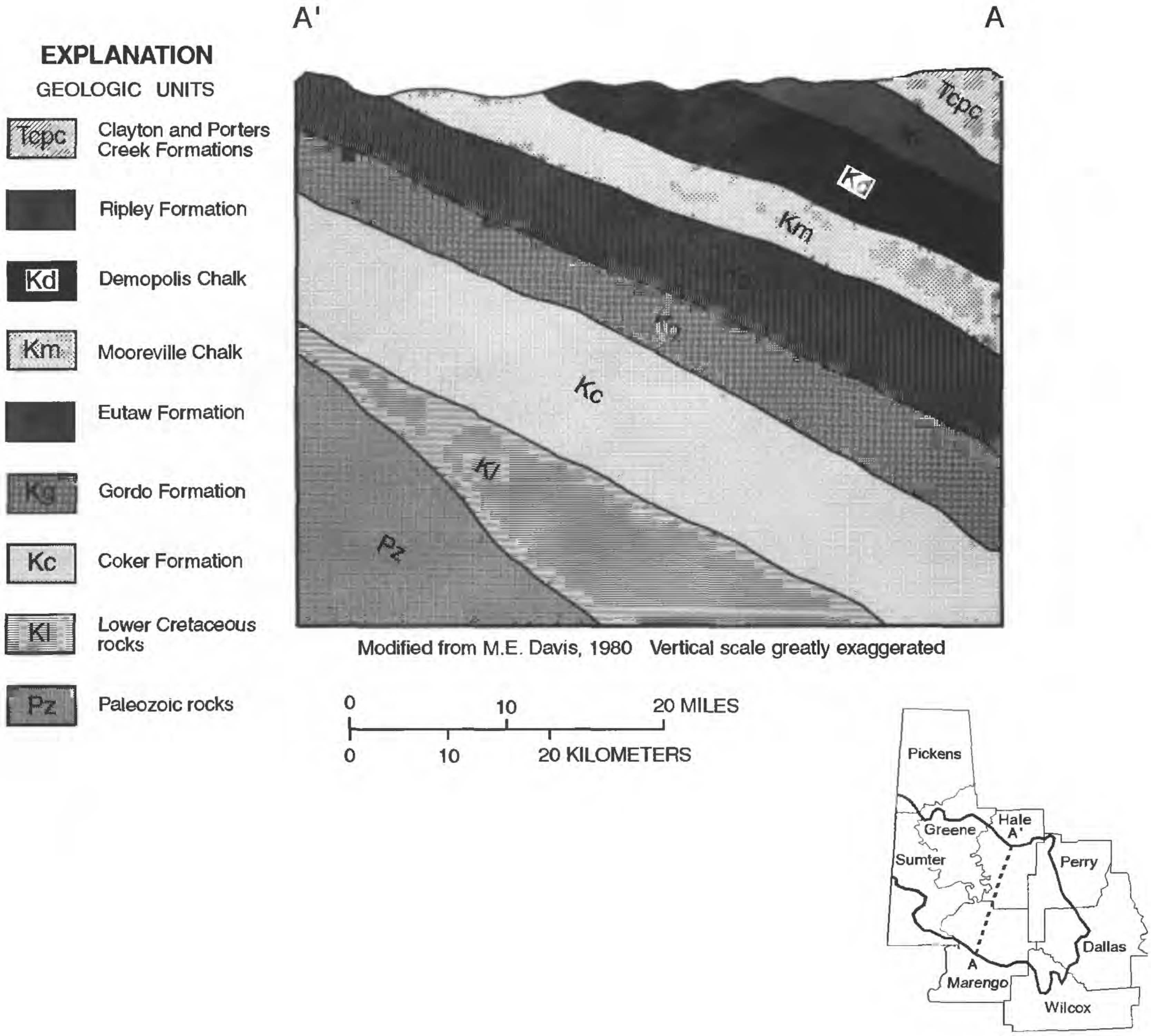

Figure 5. Diagrammatic geologic section of the Black Belt area of west-central Alabama.

Erathem	System	Series	Group	Geologic unit	Thickness (feet)	Lithology	Aquifer	Water-bearing properties
Cenozoic	Quaternary	Holocene	Wilcox	Alluvium	0-80	Clay, silt, sand, and gravel	Alluvial aquifer	Supplies water to shallow dug and driven wells in the flood plains of the major streams and rivers. Adjacent to major streams, where induced recharge is possible, large quantities of water can be withdrawn from these beds.
Cenozoic	Quaternary	Pleistocene	Wilcox	Terrace deposits	0-100	Clay, silt, sand, and gravel	Shallow aquifer	Will yield 10 gal/min or more to individual wells where saturated sands are of sufficient thickness.
Cenozoic	Tertiary	Paleocene	Wilcox	Nanafalia Formation	150-200	Sand, sandy marl, sandy clay, and lignite	Nanafalia aquifer	Source of public supplies south of the study area.
Cenozoic	Tertiary	Paleocene	Midway	Naheola Formation	100-190	Silty clay, fine-grained sand, lignite, laminated sand and clay	Naheola aquifer	Wells south of the study area reportedly produce as much as 50 gal/min.
Cenozoic	Tertiary	Paleocene	Midway	Porters Creek and Clayton Formations	270-520	Massive marine clay		Not a source of water.
						Chalky marl, limestone and conglomerate, thin basal sand	Clayton aquifer	Yields less than 10 gal/min.
Mesozoic	Cretaceous	Upper Cretaceous	Selma	Prairie Bluff Chalk	50-100	Massive, compact chalk and calcareous sandy clay		Not a source of water.
Mesozoic	Cretaceous	Upper Cretaceous	Selma	Ripley Formation	35-300	Calcareous sandstone, sandy chalk, sandy calcareous clay, and fossiliferous sandstone	Ripley aquifer	Minor source of water. Generally yields 10 gal/min or less.
Mesozoic	Cretaceous	Upper Cretaceous	Selma	Demopolis Chalk	200-500	Fossiliferous chalk; calcareous clay		Not a source of water.
Mesozoic	Cretaceous	Upper Cretaceous	Selma	Mooreville Chalk	350-420	Silty chalk, calcareous clay; thin layers of limestone and calcareous sandstone		Not a source of water.
Mesozoic	Cretaceous	Upper Cretaceous		Eutaw Formation	400	Fine- to coarse-grained sand, clay and chalky sand	Eutaw aquifer	Primary source of ground water in the study area. Reportedly will yield 2 Mgal/d or more to individual wells.
Mesozoic	Cretaceous	Upper Cretaceous	Tuscaloosa	Gordo Formation	300-450	Reddish-yellow sand and purple mottled clay; poorly-sorted coarse-grained sand and gravel in lower part	Gordo aquifer	Excellent source of water. Reportedly will yield 2 Mgal/d or more to individual wells.
Mesozoic	Cretaceous	Upper Cretaceous	Tuscaloosa	Coker Formation	500-1,000	Sand, gravel and clay. Coarser sand beds and gravel beds near base	Coker aquifer	Potential source of 1 Mgal/d or more to individual wells.
Mesozoic	Cretaceous	Lower Cretaceous rocks			0-1,000	Pink nodular limestone fragments and red and green shale near top		
Paleozoic	Pennsylvanian to Cambrian rocks				1,000+	Sandstone, shale, limestone, dolomite, and chert		

Figure 6. Correlation chart showing geologic units and aquifers in the Black Belt area of west-central Alabama, and their water-bearing properties.

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama, 1991

NOTE: Well numbers correspond to those shown on plate 2.
Geographic coordinate number: Latitude (DDMMSS) and Longitude (DDDMMSS).
Type: D, drilled; Du, dug; Dr, driven.
Depth of well and water level: Depth of well given in feet; reported water levels are in feet above (-) or below land surface; measured water levels are in feet and tenths.
Well diameter: casing diameter(s) in inches.
Water-bearing unit: Kl, lower Cretaceous (?); Kc, Coker Formation; Kg, Gordo Formation; Ke, Eutaw Formation; Kr, Ripley Formation; Tnf, Nanafalia Formation; Qal, alluvial deposits; Qt, terrace deposits.
Altitude of land surface: Altitudes given in feet above National Geodetic Vertical Datum of 1929, from topographic map or determined by aneroid barometer; altitudes given in feet and tenths determined by standard survey leveling.
Date of measurement: month/day/year.
Method of lift: F, flowing; J, jet; S, submersible; T, turbine.
Use of well: D, domestic; P, public supply, Q, aquaculture; S, stock; U, unused.

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measurement	Method of lift	Use of well	Remarks
1	3250000881831	N. Sumter County W.A.	Griner	D	1,982	--	Kc	132	-34.4	6/12/91	F	P	--
2	3249300880635	Thetford, M.	--	D	--	4	--	110	-3.5	3/14/91	F	-	Flow 18 gal/min 5/11/65
3	3240530880423	McLelland, J.M.	Radford and Sons	D	170	6	Ke	140	2.3	3/13/91	-	Q	--
4	3255340880118	Solomon, C.T.	--	D	205	4	Ke	195	38.5	3/13/91	S	-	--
5	3255310880113	Solomon, C.T.	--	D	445	6, 4	Ke	185	44.6	3/13/91	S	-	Reported capacity 220 gal/min, 1988
6	3250050875320	City of Eutaw	--	D	407	4	Ke	172.14	47.6	4/16/90	-	U	Screened from 395-407 feet
7	3250280875313	City of Eutaw	Layne-Central	D	441	16, 10	Ke	205	95.2 85.8	3/14/91 6/24/65	-	P	--
8	3250100874503	Britton, C.J.	Tubberville	D	240	3	Ke	140	--	--	F	-	Measured flow 9 gal/min , 7/9/63
9	3250350874459	Britton, J.	--	D	--	6	--	130	21.5	3/12/91	S	Q	--
10	3249400874438	Bonnet, N.	Willis Reese	D	400	6	Ke	145	15.6	3/12/91	S	Q	--
11	3249300874436	Bonnet, N.	Willis Reese	D	--	6	--	120	--	--	F	Q	Estimated flow 75 gal/min
12	3252370874426	City of Akron	--	D	530	4, 2	Kc	120	1.5	4/09/90	-	U	--
13	3249310874317	Woods, T.	--	D	200	6	Ke	130	--	--	F	Q	Depth reported by owner. Estimated flow 75 gal/min, 3/12/91

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
14	3250100873417	Hunt, O.	--	Du	--	36	--	320	40.6	3/13/91	-	-	--
15	3244380872453	--	--	D	--	4	--	440	40.6	3/13/91	-	-	--
16	3246430873010	Lenson Bros.	--	D	--	--	--	300	73.1	3/11/91	-	S	--
17	3245260873119	Montz, L.	--	D	--	--	--	205	14.6	3/11/91	-	-	--
18	3244150873128	Davis, T.	--	Du	90	36	Ke	270	13.8	3/13/91	-	U	--
19	3247410873156	Aritton, J.	--	Du	--	--	--	325	45.2	3/12/91	-	U	Contruscted 1911
20	3244090873222	Montz, L.	--	D	--	8	--	220	34.2	3/14/91	-	-	--
21	3245280873344	Glover, J.	Reese	D	--	--	--	170	--	--	F	Q	--
22	3247060873346	Steale, J.	--	Du	--	36	--	275	39.5	3/12/91	-	-	--
23	3244590873645	Washburn, J.	--	D	--	4	--	260	128.7	3/12/91	-	-	--
24	3243110873723	Jay, L.	Tubberville	D	--	--	--	270	5.6	3/14/91	S	-	--
25	3242400873852	Hall, L.	Tubberville	D	400	6	Ke	230	--	--	S	Q	--
26	3244190874119	McCray, H.	Allen and Willis	D	--	--	--	240	--	--	S	Q	--
27	3243050874119	Jay, J.C.	Allen and Willis	D	460	6	Ke	220	82.1	3/13/91	S	Q	--
28	3248180874231	Langham, D.	--	D	--	--	--	130	--	--	F	Q	Flow estimated 15 gal/min, 3/13/91
29	3248190874234	Langham, D.	--	D	--	--	--	130	--	--	F	Q	Flow estimated 3 gal/min, 3/13/91
30	3249150874302	Woods, T.	--	D	200	4	Ke	130	--	--	F	Q	Depth reported by owner
31	3249140874303	Woods, T.	--	D	200	4	Ke	130	--	--	F	Q	Depth reported by owner
32	3249130874303	Woods, T.	--	D	200	6	Ke	130	--	--	F	Q	Depth reported by owner
33	3249080874525	Vise, T.	--	D	580	5	Ke	133	--	--	F	Q	Measured flow 12 gal/min, 11/13/62
34	3248370874532	Vise, T.	Calvin Engle	D	1,490	12, 8	Kl(?)	129	--	--	F	Q	Known as Wedgeworth well. Reported flow 2,500 gal/min ,1922, measured flow 1,240 gal/min, 4/18/44, 680 gal/min, 5/11/64; 900 gal/min, 10/3/68.

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
35	3247560874532	Johnson, W.	--	D	300	--	Ke	150	--	--	-	Q	Water salty, does not flow
36	3249020874534	Vise, T.	--	D	320	12	Ke	129	--	--	F	Q	Measured flow 14 gal/min, 10/3/68
37	3249130874535	Vise, T.	Tubberville	D	200	12	Ke	110	--	--	F	Q	Well depth estimated
38	3249040874543	Vise, T.	--	D	300	--	Ke	143	--	--	F	Q	--
39	3245130874546	Lawson, C.R.	Black Belt	D	300	--	Ke	160	100	--	S	Q	--
40	3242400874558	McCray, H.	Black Belt	D	370	6	Ke	114	--	--	F	Q	Estimated flow 20 gal/min 3/16/91
41	3247440874604	Bailey	Black Belt	D	350	8, 4	Ke	160	35.0	3/12/91	S	Q	Water level reported by owner
42	3248470874641	Hamilton, C.	--	D	110	--	Ke	110	--	--	F	Q	Flow estimated 75 gal/min 3/12/91
43	3248510874650	Hamilton, C.	--	D	110	10	Ke	110	--	--	F	Q	Flow estimated 75 gal/min 3/12/91
44	3245430874657	May, S.W., Jr.	Black Belt	D	300	4, 2	Ke	140	33.3	3/13/91	J	-	--
45	3244070874721	Glover, J.	--	D	--	6	--	100	--	--	F	Q	Estimated flow 50 gal/min 3/13/91
46	3244060874735	Glover, J.	--	D	--	6	--	100	--	--	F	Q	Estimated flow 60 gal/min 3/13/91
47	3244080874755	Glover, J.	--	D	--	6	--	100	--	--	F	Q	Estimated flow 20 gal/min 3/13/91
48	3248230875158	Hamilton, C.	--	D	110	4	--	140	40	--	-	D	Water level reported by owner
49	3248220875201	Hamilton, C.	--	D	110	6	Ke	130	10	--	-	Q	Water level reported by owner. Salty taste.
50	3246590875217	Johnson, L.J.	Byrd	D	--	6	--	120	20.1	3/12/91	-	Q	Depth reported to be less than 300 ft. Salty taste.
51	3248200875413	Bishop, J.	Radford and Sons	D	--	6	--	135	12.6	3/14/91	S	Q	--
52	3245170875416	Hollingsworth, A.	Radford and Sons	D	--	6	--	175	47.7	3/14/91	S	Q	--
53	3247130875659	Spree, T.	Radford and Sons	D	>600	6	Kg, Kc	185	58.7	3/13/91	S	Q	Well depth estimated to be over 600 ft

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
54	3246050875857	Beeker, C.	Allen and Willis	D	700	6	Kg	185	55.8	3/15/91	S	Q	Well depth estimated
55	3245410880004	Hearndon, D.	Radford and Sons	D	650	6	Kg	140	16.7	3/13/91	S	Q	Well depth estimated
56	3245280880034	Hearndon, D.	Radford and Sons	D	650	6	Kg	135	12.1	3/13/91	S	-	Well depth estimated
57	3245500880041	Colgrove, J.	Radford and Sons	D	600	6	Ke	135	14.4	3/12/91	S	Q	Well depth estimated
58	3245190880146	Town of Boligee	F.C. Null	D	620	4	Ke	120	-3.5 -8.5	3/14/91 5/11/65	F	-	Flow 18 gal/min 5/11/65
59	3247370880219	Colgrove, J.	Jackie Smith	D	800	4	Ke	120	--	--	J	Q	Well depth estimated
60	3244470880252	Spree, T.	Roger Smith	D	860	4	Ke	125	--	--	F	Q	Flow estimated 10 gal/min 3/12/91
61	3244540880259	Spree, T.	Johnny Radford	D	660	6	Ke	120	25.5	3/12/91	J	-	--
62	3245380880410	Spree, T.	--	D	860	4	Ke	115	--	--	F	Q	Flow estimated 15-20 gal/min
63	3245400880427	Spree, T.	--	D	750	6	Ke	110	--	--	F	-	Well depth estimated. Flow estimated 10 gal/min
64	3245100880502	Spree, T.	--	D	--	4	--	110	--	--	F	-	Flow estimated 10-15 gal/min
65	3247140881013	Hill Ranch	--	D	--	--	--	160	33.0	11/13/90	-	-	--
66	3246210881218	Long, Tom	--	D	900	4	Ke	172	41.0	4/05/90	-	S	--
67	3236250874953	Town of Forkland	Graves Drilling	D	723	6, 4	Ke	100	14.0	3/15/91	F	P	--
68	3239250874238	Barnette R. and S.	Allen and Willis	D	480	6	Ke	145	--	--	S	Q	Water level 25 ft when drilled
69	3240300874221	Langford, P.	Allen and Willis	D	500	6	Ke	150	--	--	S	Q	--
70	3240030874159	Landry, G.	Radford and Sons	D	500	6	Ke	160	--	--	-	Q	--
71	3242050874142	England, M.	--	D	--	6	--	175	--	--	S	Q	Pumped 60 gal/min 3/13/91
72	3237490874122	State Cattle	Black Belt	D	300	8	Ke	115	--	--	-	-	--

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
		Ranch											
73	3235520874108	Miller, D.	--	D	340	4	Ke	110	--	--	P	Q	--
74	3236390874051	Mitchell, H.	--	D	600	8	Ke	115	1.0	5/24/01	-	Q	Flowing well until 1990
75	3236310873927	Morrison Bros.	--	D	--	8	--	155	34.2	3/14/91	-	-	--
76	3237150873926	Blaylock, J.	Wilks (or Wilkins)	D	600	4	Ke	160	--	--	S	Q	--
77	3242100873854	Clements, A.	Tubberville	D	400	4	Ke	210	--	--	S	Q	--
78	3242040873805	Tidmore, C.	Tubberville	D	250	4	Ke	170	--	--	S	Q	--
79	3240170873723	Hall, D.	Allen and Willis	D	450	4	Ke	190	39.6	3/12/91	-	-	--
80	3235540873636	Kyser, B.	--	D	>400	--	Ke	165	47.4	5/24/91	-	Q	--
81	3236580873550	Smelley, G.	Allen and	D	--	8, 4	--	180	47.6	5/22/91	-	Q	--
82	3242100873540	Greensboro Utilities Dept.	Layne-Central	D	390	18, 8	Ke	258	104.8	3/18/91	T	P	--
									84.0	-/--/29			
83	3241100873533	Greensboro Utilities Dept.	Layne-Central	D	706	18, 10	Kg	287	117	1957	T	P	Screen between 635.5 and 705.5 ft
84	3242050873528	City of Greensboro	--	D	278	10	Ke	257	63.2	3/30/90	-	U	Screened from 258 to 278 ft
85	3242160873523	Greensboro Utilities Dept.	Layne-Central	D	710	16, 8	Kg	259	136.5	3/14/91	T	P	8-in. screen 630 to 700 ft
86	3236260873514	Weeks, S.	Allen and Willis	D	--	3	--	190	42.6	3/14/91	-	-	--
87	3239550873351	Kyser, B.	--	D	450	4	Ke	225	54.6	3/12/91	-	-	--
88	3236090873239	Dombhart Farms	--	D	--	--	--	150	17.1	5/14/91	-	Q	--
89	3236020873158	McLin, B.E.	--	D	--	3	--	210	53.3	3/14/91	-	-	--
90	3238290872832	--	--	Du	--	--	--	230	--	3/13/91	-	-	--
91	3242250872738	Johnson, H.	--	Du	--	36	--	280	--	--	-	-	--
92	3239040872540	Kynrd, E.	--	Du	20	36	--	320	15.5	3/13/91	-	-	--
93	3241420872426	Jones, G.	--	D	36	--	Ke	420	22.2	3/13/91	-	-	--
94	3238550872246	Smith, R.	--	Du	32	--	Ke	370	19.6	3/13/91	-	-	--
95	3236060872223	Barton, B.	--	D	--	6	--	260	169.3	3/13/91	S	Q	--
96	3237190871934	City of Marion	Layne-Central	D	391	16, 10	Ke	315	187.5	3/21/91	T	P	--
									163.4	10/21/86			
97	3234330871834	Barnette, R.	--	D	--	--	--	240	--	--	S	Q	--

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
98	3233350872016	Good, J.	--	D	400	6	Ke	215	159.6	3/13/91	S	Q	--
99	3232170873033	Morrisette Ponds	--	D	86	--	Ke	155	75	3/12/91	-	Q	--
100	3233240873539	Harless, R.	Allen and Willis	D	700	--	Ke	130	2.2	5/24/91	-	Q	--
101	3229130873542	Bates, J.	--	D	800	6	Ke	140	--	--	S	Q	--
102	3231030873551	Church of God and Christ Mennonite	--	D	--	--	--	200	65.0	3/14/91	-	-	--
103	3229050873553	Bates, J.	--	D	800	6	Ke	140	--	--	S	Q	--
104	3232480873708	Garris, D.	Allen and Willis	D	--	--	--	140	6.0	5/24/91	-	Q	--
105	3234170873849	Horn, H.	Radford and Sons	D	650	4	Ke	155	25.3	3/14/91	S	Q	--
106	3234460873857	Langeston, J.	--	D	--	4	--	140	12.7	5/23/91	-	-	--
107	3234360874001	Doman, W.	--	D	420	4	Ke	145	29	5/22/91	S	Q	--
108	3234080874024	Jackson, L.	--	D	430	4	Ke	130	2	5/22/91	S	Q	--
109	3234300874056	Hampton, D.	--	D	430	6	Ke	135	--	--	-	Q	--
110	3230380874323	Jones, M., Jr.	Terry Drilling	D	1,200	4	Ke	170	51.5	3/15/91	-	Q	--
111	3230200874406	Sparks, Dr. F.H.	F.C. Null	D	850	--	Ke	150	23.3	3/21/91	-	-	--
112	3232150874436	Mullins, G.	--	D	750	--	Ke	170	68.6	5/23/91	-	-	--
113	3230260874451	Collins, R.M.	F.C. Null	D	750	4	Ke	170	60.4	3/21/91	J	D	--
114	3230120874927	City of Demopolis	Layne-Central	D	1,002	18	Ke	160	66.1 82 77 49.3	3/18/91 -/--/85 -/--/70 12/11/57	T	P	--
115	3230550875041	Culpepper, T.M.	--	D	900	4	?	110	12.0	2/22/90	-	N	Casing slotted 860 to 900 ft
116	3229280875132	McKinley, T.E.	F.C. Null	D	860	6, 2.5	Ke	174	62.7	3/21/91	-	H	--
117	3230480880527	Spidle, H.	--	Du	17.2	--	Ke	180	--	--	-	H	--
118	3227220881318	Hardwick, E.	--	Du	21.4	30	Qal	190	2.6	3/13/91	-	D	Concrete casing
119	3227540881234	--	--	Du	6.9	48	Qal	175	2.0	3/13/91	-	-	Concrete casing
120	3223280881155	Oates, F.	--	Du	21	36	Qal	330	15.9	3/13/91	-	D	Brick casing
121	3227440881137	--	--	Du	15.25	30	Qal	150	3.2	3/13/91	-	-	Concrete casing
122	3226210875913	Cross, F.	--	D	15	8	Qt	92	2.7	3/14/91	-	D	--

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
123	3227140875549	American Cynamid Co.	--	D	42	4	Qt	103	5.8	3/14/91	-	U	--
124	3224550875501	Simmons, R.	Jim Byrd	D	1,100	4	Ke	130	2.4	3/13/91	-	D	--
125	3225270875454	McDowell, J.J.	Allen and Willis	D	1,100	4	Ke	180	68.6	3/14/91	-	D	--
126	3222560875359	Wilson, D.	--	D	160	4	Qt	185	44.5	3/14/91	-	S	--
127	3228070875328	McClendon, G.F.	--	D	1,000	4	Ke	175	38.4	3/14/91	-	D	--
128	3226380875152	Vaughn, P.	Merry Bros.	D	1,208	5, 3	Ke	210	97.9 75	3/21/91 1/25/56	-	D	--
129	3226110874703	Crepps, J.R.	Eaves and Norwood	D	1,165	4, 2	Ke	275	73.8	3/21/91	-	D	--
130	3228460874317	Spencer, W.M.	--	D	--	4	--	205	69.5	3/13/91	-	S	--
131	3223050874309	Dill, L.	--	D	1,100	--	Ke	160	23.9	3/19/91	-	D	--
132	3225220874029	Rankin, J.	--	D	1,100	--	Ke	175	10.9	3/19/91	-	D	--
133	3224180873756	Phillips, J.	Black Belt	--	760	--	Ke	210	68.3 46.7	3/25/91 5/02/56	-	D	--
134	3226150873545	City of Faunsdale	Powell Drilling	D	1,035	8	Kg	305	178.0	3/21/91	T	P	Screen from 990 to 1,031 ft
135	3227290873536	City of Faunsdale	Dollings Drilling	D	720	4	Ke	237	99.3	3/21/91	-	P	--
136	3225010873416	Brankin, B.	--	D	1,027	6	Ke	255	--	--	S	Q	--
137	3228200873258	James Bros.	J.L. Hawk	D	600	4	Ke	229	88.6 69.8	3/21/91 4/27/56	-	D	--
138	3224510873214	Devere, J.	C. Radford	D	980	--	Ke	294	161.8	3/21/91	-	D	--
139	3226350872945	City of Uniontown	--	D	--	--	--	270	129.8	3/21/91	-	P	--
140	3222340872815	Friendship Church	--	D	--	4	--	280	144.1	3/19/91	-	D	--
141	3224460872451	Wilson, B.	--	D	900	6	Ke	190	137.9	3/28/91	S	Q	--
142	3223230872201	Pearce, D.	--	D	900	--	Ke	180	139.0	3/15/91	S	Q	--
143	3225520872146	Nichols, R.	--	D	800	--	Ke	165	--	--	S	Q	--
144	3222590872045	Pearce, D.	--	D	900	--	Ke	140	--	--	S	Q	--
145	3222140871342	Yeager, J.	Radford and Sons	D	500	4	Ke	210	78.4	3/19/91	-	S	Hog farm
146	3225530871238	Miller, J.	--	D	670	6	Ke	215	144.2	3/22/91	S	Q	--

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
147	3225430871226	Miller, J.	--	D	640	6	Ke	190	--	--	S	Q	--
148	3221180871213	Aimwell Baptist Church	Radford and Sons	D	--	--	--	175	48.4	3/19/91	-	H	--
149	32:8230871440	City of Orrville	W.J. Bozeman	D	546	8, 6	Ke	192	84.7	3/18/91	S	P	Reported drawdown 94 ft after 10 hrs pumping 100 gal/min in 1959
150	3219340871550	Lovelace, J.H.	Brady	D	800	4	Ke	170	46.9	3/19/91	-	D	--
151	3221120871655	Kendrick, Bill	Brady	D	750	4	Ke	160	22.6	3/19/91	-	D	--
152	3217070871835	Pierce, D.	--	D	--	--	--	--	--	--	F	Q	Flowing well
153	3218300871839	C. Farms	Brady	D	750	4	Ke	150	18.7	3/19/91	-	S	Inactive well
154	3219230871851	C. Farms	--	D	750	--	Ke	150	9.8	3/19/91	-	-	Inactive well
155	3216080871935	Pierce, D.	--	D	950	6	Ke	210	68.5	3/19/91	-	-	--
156	3217060872205	Safford Baptist Church	Brady	D	950	4	Ke	235	100.8	3/14/91	-	D	--
157	3216440872443	Christian Light M.B. Church	--	D	--	4	--	235	96.3	3/14/91	-	-	--
158	3220450872454	St. James M.B. Church	--	D	175	4	Ke	275	141.7	3/18/91	-	D	--
159	3221300872553	Shady Grove M.B. Church	Willis and Allen	D	450	4	Ke	265	132.1	3/18/91	-	D	--
160	3218550872728	New Aimwell M.B. Church	--	D	--	4	--	230	94.0	3/19/91	-	-	--
161	3221570872915	Gary, N.	Brady	D	1,700	4	Ke	235	40.4	3/19/91	-	D	--
162	3216030873306	Skinner, Frank	Black Belt	D	123	4, 2	Kr	217	45.1	5/09/56	-	S	2-in. screen 117 to 123 ft
163	3220450873356	McKnight, Tippy	--	D	--	4	Ke	263	83.1 89.6	3/22/91 5/08/56	-	D,S	--
164	3221390873614	McKnight, Tippy	F.C. Null	D	1,005	6	Ke	228	96.6	3/22/91	-	S	--
165	3216060873726	City of Thomaston	Layne-Central	D	1,385	16, 8	Ke	190	49.4	3/18/91	T	P	No casing 1,310 to 1,385 ft
166	3215200873730	State of Alabama	--	D	1,222	4	Ke	154	27.0	4/10/90	-	-	Screened 1,202 to 1,222 ft

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measure-ment	Method of lift	Use of well	Remarks
167	3215280873733	State of Alabama Thomaston Prison Camp	W.J. Bozeman and Sons	D	1,224	4	Ke	154	28.8	3/21/91	-	U	Screened 1,204 to 1,224 ft
168	3216460873750	City of Thomaston	Layne-Central	D	1,085	10, 6	Ke	200	80.6	3/18/91	T	P	Drawdown 274 ft after pumping 100 gal/min 8 hrs 11/3/67
169	3218000873746	St. James Baptist Church	--	D	1,100	6	Ke	180	59.3	3/19/91	-	-	--
170	3221230873827	Jones, M.	Bridges	D	960	4	Ke	260	130.1	3/22/91	-	D,S	--
171	3219260874011	Lowery, L.	--	D	1,100	4	Ke	180	60.9	3/19/91	-	-	--
172	3215570874126	Dunn, A. Jr.	--	D	1,200	--	Ke	160	33.8	3/19/91	-	-	--
173	3221580874455	Huggins and Hert	F.C. Null	D	1,100	5, 2.5	Ke	146	22.1 3.2	3/21/91 2/08/56	J	D,S	--
174	3217460874527	Mashburn, Melvin	F.C. Null	D	1,283	5, 2.5	Ke	175	45.7	3/25/91	J	D,S	Perforated 1,241 to 1,283 ft
175	3220590874653	Hopewell Baptist Church	--	D	18.6	30	Qal	125	4.8	3/11/91	-	D	Casing: concrete
176	3218290874704	Smith, E.	--	Du	30	--	Kr	180	17.5	3/11/91	-	D	Casing: concrete
177	3218000874750	City of Linden	Layne-Central	D	1,109	12, 6	Ke	139	--	--	T	P	Yield 125 gal/min 11/10/47
178	3218500874751	--	--	D	--	--	--	--	30.0	3/18/91	-	-	--
179	3218020874803	Harrell, K.	--	Du	25.67	30	Kr	140	19.6	3/12/91	-	D	Casing: concrete
180	3219200874811	Wynn, Mrs.	F.C. Null	D	1,210	5, 2.5	Ke	162	45.6	3/21/91	-	D,S	--
181	3216550874914	Thomas, J.P.	People	D	--	5	--	130	37.1	3/12/91	-	D	Casing: steel
182	3216580874917	Baugh, B.J.	--	D	--	6	--	132	40.7	3/12/91	-	D	--
183	3221240875558	McCants, W.	Allen and	D	35	--	QaL	80	12.1	3/13/91	-	d	--
184	3221530880501	--	--	D	24	30	Qt	185	2.8	3/13/91	-	D	Concrete casing
185	3221520880527	Ebeneezer Baptist Church	--	Du	28	30	Qt	185	10.9	3/13/91	-	D	Concrete casing
186	3221540880600	Stewart	--	Du	41.8	48	Qt	200	8.4	3/13/91	-	D	--
187	3221480881027	Durby	--	Du	15.5	36	Tnf	300	12.7	3/13/91	-	D	Concrete casing
188	3213320874736	Hale, W.R.	--	D	1,200	4	Ke	275	6.4	3/15/91	-	U	--
189	3212480874500	Jordan, D.	--	D	--	3.5	--	242	146.7	3/15/91	-	-	--
190	3211440874332	Moore, S.	--	D	700	4	Kr	315	234.7	3/19/91	-	-	--

Table 1.--Records of selected wells in the Black Belt area of west-central Alabama--Continued

Well number	Geographic coordinate number	Well owner	Drilled by	Type	Well depth (feet)	Well diameter (inches)	Water bearing unit	Altitude of land surface	Water level above (-) or below land surface datum	Date of measurement	Method of lift	Use of well	Remarks
191	3213180872917	Roberson, W.	--	D	200	--	Kr	250	53.0	3/25/91	-	D	--
192	3214360872649	Martin, R.	--	D	1,200	--	Ke	185	34	3/25/91	-	D	Well depth and water level estimated by owner
193	3209370872645	Martin, R.	--	D	1,405	6, 4	Ke	165	--	--	-	Q	--
194	3210010872640	Fendley, G.	--	D	1,300	--	Ke	170	43.0	3/19/91	S	D	--
195	3208290872537	McCall, J.	--	D	100	--	Kr	150	--	--	-	D	--
196	3211490871910	Hall, C.	--	D	--	--	--	120	--	--	F	D	--
197	3213230871804	Caine, P.	--	D	1,200	6	Ke	150	--	--	-	D	--
198	3214580871749	Jones, L.	--	D	--	--	--	130	--	--	F	D	--
199	3212020871609	Hamilton, F.	--	D	--	--	--	100	--	--	F	S	--
200	3214540871417	Cambridge Christian Church	--	Dr	--	--	--	205	13.1	3/20/91	-	D	--
201	3205270872507	Childers, R.	Champion	D	208	6	Kr	70	17.7	3/14/91	S	D	--
202	3207230872514	Moore, R.W.	--	D	--	--	--	140	51.6	3/25/91	-	D	--
203	3204070872641	Childers, R.	Champion	D	364	--	Kr	140	69.9	3/25/91	S	D	--

Deposits of Tertiary Age

Deposits of Tertiary age overlie the Cretaceous sediments and crop out across the extreme southern part of the study area (figs. 3 and 5). These deposits consist of sand, silt, clay, marl, limestone, conglomerate, and lignite. Deposits of Tertiary age in the study area consist of the Clayton and Porters Creek Formations, undifferentiated, the Naheola Formation, and the Nanafalia Formation of the Wilcox Group. All of these formations are of Paleocene age. None of these formations are major aquifers in the study area.

Nanafalia Formation

The Nanafalia Formation crops out only in small areas in Sumter County in the extreme southwestern corner of the study area (fig. 3). The Nanafalia overlies the Naheola and has a thickness of about 150 to 200 feet. The formation consists of sand, sandy marl, sandy clay, and lignite. The Nanafalia is tapped for public supplies south of the study area; however, within the study area, the limited occurrence of this unit precludes its use as a ground-water source.

Naheola Formation

The Naheola Formation crops out in a narrow band in the southwestern corner of the study area in Sumter County, and in a small area at the extreme southern part of the study area in Marengo County (fig. 3). The Naheola Formation has been subdivided into two members, Oak Hill Member (lower part) and the Coal Bluff Marl Member (upper part). The Oak Hill Member consists of laminated, silty clay containing interbeds of fine-grained sand and a thin bed of lignite near the top and generally is about 80 to 150 feet thick. The Coal Bluff Marl Member consists of laminated sand and clay, and is about 20 to 40 feet thick.

The Naheola Formation is not a ground-water source of any consequence in the study area, however, south of the study area it yields water for municipal and domestic supplies. Wells tapping the formation south of the study area reportedly produce as much as 40 gal/min.

Clayton and Porters Creek Formations

The Clayton Formation overlies the Prairie Bluff Chalk in Sumter, Marengo, and Wilcox Counties and is, in turn, overlain by the Porters Creek Formation (fig. 3). The Clayton Formation consists principally of chalky marl, limestone, and conglomerate, although a thin basal sand bed is commonly present in this unit. The overlying Porters Creek Formation consists of massive marine clays. The combined thickness of the Clayton and Porters Creek Formations is 270 to 520 feet in the study area. The Clayton yields less than 10 gal/min to shallow dug wells in some outcrop areas. The Porters Creek is relatively impermeable and not a ground-water source.

Deposits of Cretaceous Age

Cretaceous deposits crop out from the northern boundary of the study area to the southern parts of Marengo and Sumter Counties and the northern part of Wilcox County (fig. 3). These sediments strike northwestward and dip southwestward at 30 to 50 ft/mi (feet per mile). A subsurface profile of the southwestward-dipping units of Cretaceous age is shown in the diagrammatic geologic section in figure 5. Upper Cretaceous deposits include the major aquifers in the study area. These aquifers consist of beds of sand in the Coker, Gordo, and Eutaw Formations. Sands in the Ripley Formation, also in the Upper Cretaceous, are a minor aquifer in the study area. Because of the availability of water from shallower aquifers, Lower Cretaceous rocks are seldom tapped by wells in Alabama. However, interpretation of electric logs, sample cuttings, and analyses of water from test wells indicate that sand beds in the unit are very permeable and contain freshwater in updip areas. The water in these strata becomes progressively more saline downdip.

Prairie Bluff Chalk

The Prairie Bluff Chalk overlies the Ripley Formation, and crops out immediately south of, and parallel to, the Ripley (fig. 3). The Prairie Bluff is about 50 to 100 feet thick, and consists mainly of massive compact chalk and calcareous sandy clay. The Prairie Bluff is relatively impermeable and is not a ground-water source in the study area. It is a confining unit between the Clayton and Ripley aquifers.

Ripley Formation

The Ripley Formation overlies the Demopolis Chalk and crops out in the study area from west-central Sumter County across central Marengo, southern Perry, Dallas, and northern Wilcox Counties (fig. 3). The Ripley consists of beds of calcareous sandstone, sandy chalk, sand, sandy calcareous clay, and thin beds of fossiliferous sandstone. The thickness of the formation ranges from 35 to 300 feet.

The Ripley aquifer, which consists of sand beds in the Ripley Formation, is a minor ground-water source in the study area. Data for eight wells tapping the Ripley are given in table 1. Downdip, south of the study area, the Ripley is a source of public water supply, but in the study area wells tapping the Ripley generally yield 10 gal/min or less.

Demopolis Chalk

The Demopolis Chalk overlies the Mooreville Chalk, and crops out in a belt as much as 8 miles wide in northeastern Sumter County (fig. 3). The formation consists mainly of silty micaceous fossiliferous chalk. The basal beds are overlain by nearly pure chalk which contains 75 to 90 percent calcium carbonate. The thickness of the formation ranges from 200 to 500 feet. The Demopolis is not a ground-water source in the study area.

Mooreville Chalk

The Mooreville Chalk crops out parallel to and immediately south of the Eutaw Formation. The outcrop extends from southwestern Pickens County southeastward across the study area in central Dallas County (fig. 3). The Mooreville consists of silty chalk and calcareous clay interbedded with thin layers of limestone and calcareous sandstone. The thickness of the Mooreville ranges from 350 feet in Sumter County to about 420 feet in Dallas County. The Mooreville is not a ground-water source in the study area, but, together with the Demopolis Chalk, forms a confining unit for the underlying Eutaw aquifer.

Eutaw Formation

The Eutaw Formation overlies the Gordo Formation and crops out across central Hale, Perry, and northern Greene Counties (fig. 3). The thickness of the Eutaw in the study area is about 400 feet. The lower part of the formation consists of thin to massive beds of fine- to coarse-grained sand with interbedded clay. The middle part consists chiefly of fine- to medium-grained, well sorted sand with interbedded clay. The upper part of the formation consists of about 100 feet of very fine-grained sand locally containing layers of sandstone and chalky sand.

Sand and gravel beds in the upper and lower parts of the Eutaw Formation constitute the Eutaw aquifer. The Eutaw aquifer is the most extensively used ground-water source in the study area (table 1; plate 2). Data from 116 wells tapping the Eutaw are given in table 1. Most of the public water systems in the study area pump water from the sand beds of this aquifer. Mooty (1987) reported that wells developed in the Eutaw aquifer are capable of producing as much as 1,500 gal/min. Gardner (1981) used transmissivities of 2,200 ft^2/d (square feet per day) to 5,800 ft^2/d in simulating the ground-water flow system of the Eutaw aquifer in west-central Alabama. Planert and Sparkes (1985) calculated the transmissivity of the Eutaw to be 2,000 ft^2/d in northeastern Marengo County.

Gordo Formation

The Gordo Formation overlies the Coker Formation and crops out in northern Perry County and north of the study area in a northwestward trending belt (figs. 3 and 4). The formation consists of 300 to 450 feet of nonmarine lenticular beds of gravel, sand, and clay (fig. 6). The Gordo can be distinguished from the underlying Coker by its darker and more reddish sands and purple mottled clays. Poorly-sorted, coarse-grained sand and gravel are prevalent in the lower part of the formation. The upper part of the formation consists of lenticular clay and fine- to coarse-grained sand. The sand and gravel beds in the Gordo Formation constitute the Gordo aquifer.

The Gordo aquifer is one of the major aquifers in the study area. It is a principal source of water for Greensboro, Marion, Faunsdale, Union, North Dallas County, and the Dallas County public water supply systems. Data for wells tapping the Gordo aquifer are given in table 1. The Gordo aquifer is used as a source of water as far south as northeastern Marengo County.

Two municipal wells at Greensboro have specific capacities of 36 and 24 gal/min/ft (gallons per minute per foot) of drawdown. Based on these data, it is estimated that wells of 1,000 gal/min or more could be constructed in the Gordo aquifer. Gardner (1981) used transmissivities of 2,600 ft^2/d to 8,100 ft^2/d in simulating the ground-water flow system of the Gordo aquifer in west-central Alabama. Planert and Sparkes (1985) estimated the transmissivity of the Gordo to be 10,000 ft^2/d in northeastern Marengo County.

Coker Formation

The Coker Formation is the basal unit of the Upper Cretaceous Series in Alabama, and is present in the subsurface throughout the study area. The thickness of the formation ranges from 500 to 1,000 feet. The Coker consists of a basal nonmarine zone of sand, gravel, and clay that was deposited in a deltaic environment. The coarser sand beds and beds of gravel are near the bottom of the formation. The sands generally become progressively finer grained and less abundant toward the top of the formation where clay predominates. However, in Sumter County medium- to coarse-grained sand and gravel beds are present in the upper part of the Coker in some places. In Hale County, a clay zone is a confining unit between the Coker aquifer and the overlying Gordo aquifer. In Dallas County, the upper part of the formation may include a lenticular bed of fine- to medium-grained sand, which is of hydrologic importance for water supplies. Sand and gravel beds in the formation comprise the Coker aquifer (fig. 6).

The Coker aquifer is little used in the study area because of the excessive depth of the aquifer and the availability of water in the shallower Gordo and Eutaw aquifers. Three wells inventoried in the study area produce water from the Coker aquifer. These are the public-supply wells at Akron (well 12 in table 1), the well owned by the North Sumter County Water Authority (well 1 in table 1), and a well in central Greene County (well 53 in table 1). The North Sumter

County Water Authority well is located about 2.5 miles south of Geiger on Alabama Highway 17, and is the most downdip Coker well in Alabama (well 1 in table 1). This well is screened from 1,912 to 1,982 feet.

Data are insufficient to evaluate the hydraulic characteristics of the Coker aquifer throughout the study area. However, based on an aquifer test conducted June 12-13, 1991, at the North Sumter County Water Authority well, the Coker had a transmissivity of 5,000 ft^2/d and a potentiometric head of 34.4 feet above land surface.

Lower Cretaceous Rocks

Lower Cretaceous rocks underlying the Coker Formation are not a major source of water in the study area, because of the depth of these rocks and elevated chloride concentrations in water from these deposits. One water-supply well for 14 catfish ponds in west-central Hale County is screened at a depth of 1,410 feet in a water-bearing unit that could be in Lower Cretaceous rocks. This well flowed at an estimated 2,500 gal/min in 1922, but by 1968 the rate of flow had decreased to 900 gal/min. Water from this well had a chloride concentration of more than 2,400 mg/L in 1991.

Recharge to and Discharge from the Major Aquifers

The major aquifers in the study area are sand and gravel beds in the Eutaw, Gordo, and Coker Formations (fig. 6). Water in these aquifers occurs under artesian conditions in most of the study area. Water enters the aquifers in topographically high outcrop areas, flows laterally along short flow paths to discharge into streams or downdip into the confined parts of the aquifers (Miller, 1992).

Recharge

Ground-water recharge is the replenishment of ground water by downward infiltration of water from rainfall, streams, and other sources (American Society of Civil Engineers, 1987, p. 222). In the study area, rainfall is the primary source of recharge. The rainfall that percolates through the soil to the water table is ground-water recharge, and the areas where accretions to ground water occur are called recharge areas.

Recharge areas for the major aquifers in the study area generally are congruent with the outcrops of the Eutaw, Gordo, and Coker Formations (fig. 4). Most of the recharge area of the Gordo aquifer and all of the recharge area of the Coker aquifer are north of the study area (DeJarnette and Crownover, 1987; Mooty, 1987).

Ground water moves from recharge areas to downgradient discharge areas, such as stream valleys, swamps, lakes, or pumping centers. Water can also move from one aquifer to another through intervening low-permeability material, called confining beds, into an underlying aquifer. Gardner (1981) concluded that large amounts of water in the Eutaw and Gordo aquifers are leaking upward through confining layers to discharge in Alabama, Black Warrior and Tombigbee River Valleys.

Ground water that moves from recharge areas and discharges to streams sustains the flow of the streams (baseflow), especially during periods of no rainfall. Although this water is considered to be surface runoff from the drainage basin, it is derived from ground-water storage. One of the most widely used methods for determining ground-water recharge rates in the humid eastern United States involves analysis of streamflow data to determine baseflow (Vechiolli and others, 1990). Assuming there is no long-term change in the amount of ground water in storage, ground-water discharge, as measured by the baseflow of a stream, approximately equals the amount of ground-water recharge to the aquifer underlying the basin. Other discharge from the ground-water reservoir, such as withdrawals by wells or evapotranspiration from the water table, need to be considered in estimating recharge.

Methods developed by Rutledge (1991, 1992) were used to estimate recharge to the major aquifers in the study area. The methods used were calculation of the master recession curve and streamflow partitioning. The calculation of the master recession curve is requisite to the streamflow partitioning method of streamflow analysis. An empirical method is used to obtain from streamflow record a nonlinear master recession curve, which is a mathematical expression for streamflow recession during times of negligible direct runoff. The method is based on the assumption that the storage delay factor, which is the time per log cycle streamflow of recession, varies linearly with the logarithm of streamflow. In this method, the analyst uses a computer program to read a data file of daily mean streamflow and can select segments of streamflow recession curves for analysis.

The streamflow partitioning method can be used to estimate a continuous record of ground water discharge, or baseflow, from the streamflow hydrograph. The integration of this record over a period of several years provides an estimate of recharge. This method is based on the assumption that ground-water discharge is equal to streamflow during periods of negligible surface runoff; and that ground-water discharge between these periods can be interpolated.

Streamflow data from eight daily-record sites north of the study area were analyzed (fig. 1). These sites are on unregulated streams in the outcrop areas of the major aquifers and the period of record for each site was 10 years or more. Recharge determined from streamflow partitioning ranged from 7.0 in/yr at Fivemile Creek near Greensboro to 14.3 in/yr at Sipsey River near Pleasant Ridge (table 2). The average recharge to the major aquifers was estimated to be

Table 2.--Recharge to the major aquifers in the Black Belt area of west-central Alabama, estimated from baseflow of streams at selected gaging stations

[Map number corresponds to those on figure 1. Major aquifer outcrop: 1, Coker; 2, Gordo; 3, Eutaw (listed in order of descreasing outcrop area). mi^2, square mile; in/yr, inches per year.]

Map number	Station number	Station name	Major aquifer outcrop	Drainage area (mi^2)	Time period analyzed (years)	Estimated recharge (in/yr)
1	02442000	Luxapallila Creek near Fayette	1	130	1945-70	12.7
2	02445500	Sipsey River at Fayette	1	282	1939-59	10.2
3	02444000	Coal Fire Creek near Pickensville	1	126	1955-80	11.9
4	02445000	Lubbub Creek near Carrollton	2, 3	112	1954-64	8.6
5	02446500	Sipsey River near Elrod	1	528	1928-90	14.0
6	02447000	Sipsey River near Pleasant Ridge	3, 2, 1	769	1939-59	14.3
7	02465493	Elliotts Creek at Moundville	3, 2	32	1977-90	12.4
8	02465500	Fivemile Creek near Greensboro	3, 2	73	1955-71	7.0

11.4 in/yr. It should be noted that recharge generally decreases downdip of the aquifer outcrop areas (Miller, 1992).

The recharge estimates are based on the outcrop areas of the major aquifers excluding those areas overlain by alluvial deposits, which are considered drainage areas. Recharge rates on the order of 11 in/yr seem reasonable because the surficial sediments in the outcrop areas of the Eutaw, Gordo, and Coker Formations were estimated from geophysical logs to be about half sand and half clay. Davis and others (1975) also determined that these formations were 50 percent sand in Hale County. The recharge area of the Eutaw aquifer is in Pickens, Greene, Hale, Perry, Autauga, Chilton, and Dallas Counties, and covers an area of about 600 mi^2 (fig. 4). The recharge area of the Gordo aquifer is mainly in Pickens, Tuscaloosa, Hale, Bibb, Autauga, Perry, and Chilton Counties, and covers an area of about 300 mi^2. The recharge area of the Coker aquifer is mainly in Tuscaloosa, Bibb, and Chilton Counties, and covers an area of about 400 mi^2. Based on the above information, the recharge values for the major aquifers were estimated to be 340 Mgal/d for the Eutaw aquifer; 170 Mgal/d for the Gordo; and 230 Mgal/d for the Coker.

Natural Discharge and Ground-Water Withdrawals

Discharge from the major aquifers in the study area includes natural discharge through seeps and springs, which provide the base (dry weather) flow of streams and ground-water withdrawals from wells. Discharge to the streams and rivers is enhanced where the channels are deeply entrenched into the aquifers. Discharge to streams can occur by upward leakage through the low-permeability confining unit or through fractures in consolidated confining units, such as the Mooreville and Demopolis Chalks (Gardner, 1981). Most of the remainder of the discharge is through wells. Wells are used for domestic, stock, industrial, aquacultural, public water supply, and irrigation purposes. A substantial amount of water is lost from the aquifer through flowing artesian wells. Based on previous reports and data collected during this study, an estimated 20.7 Mgal/d discharges through flowing wells in the study area. Many wells in the study area that formerly flowed have ceased to flow in recent years as a result of lowering of the potentiometric surfaces of the aquifers. The largest pumping centers in the study area are near the cities and town that use ground water for public supplies. The total ground-water withdrawals in the study area and in the aquifer recharge areas to the north were about 72.8 Mgal/d in 1990 (Baker and Mooty, 1993).

The steady decline in the potentiometric surface of the Eutaw aquifer is indicated by hydrographs of water levels in selected wells screened in the Eutaw (fig. 7). Local depressions in the potentiometric surface of the aquifers were indicated in studies by DeJarnette and Crownover (1987), Mooty (1987), and Gardner (1981). These depressions generally coincide with natural

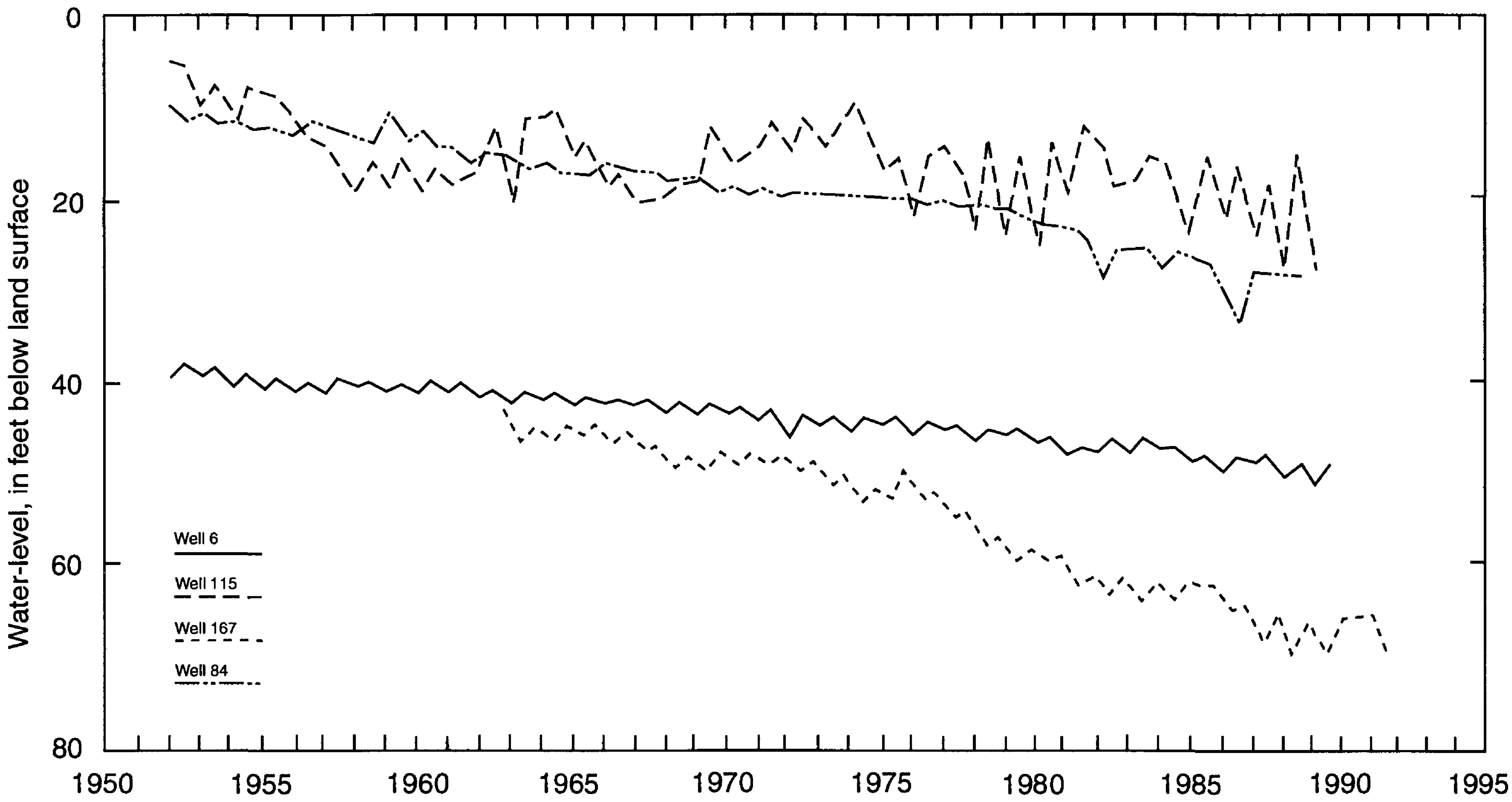

Figure 7. Hydrographs of selected wells in the Eutaw aquifer in the Black Belt area of west-central Alabama.

discharge areas along major rivers and major pumping centers near the larger cities and towns in and near the study area. Depressions have formed in the potentiometric surfaces of the Eutaw, Gordo, and Coker aquifers at the city of Demopolis (Williams and others, 1986a, 1986b) and in the potentiometric surface of the Eutaw aquifer at Marion (Williams and others, 1986b).

GROUND-WATER QUALITY

The chemical quality of ground water may limit its usefulness for particular purposes. Water used for municipal supplies generally must meet drinking water standards that provide for maximum chloride and dissolved-solids concentrations of 250 and 500 mg/L, respectively. Quality requirements for industrial water depend on the type of use made of the water. Some industries have quality requirements that are far more exacting than requirements for municipal supplies; other industries, such as aquaculture, can use moderately mineralized water. Domestic water users are usually concerned with the hardness of water and with iron and chloride content of the water. Hard water is objectionable for some uses because it increases soap consumption and may deposit scale in pipes and boilers; soft water under certain conditions may induce corrosion. General terms used in this report to describe hardness of water expressed as milligrams per liter of calcium carbonate are: soft, 0-60 mg/L; moderately hard, 61-120 mg/L; hard, 121-180 mg/L; and very hard, 181 mg/L or more. Iron in excess of 0.3 mg/L may cause staining of porcelain or enamel fixtures, clothing, or other fabrics.

Chloride concentration in water can affect the suitability of the water for many uses. If chloride is present in sufficient concentration (in excess of 1,000 mg/L), the water has a salty taste. Water with chloride concentration of less than 250 mg/L generally is desired for domestic and municipal use; however, water with substantially higher chloride concentrations can be used for fish farming. Catfish farmers often add sodium chloride to catfish ponds to control or prevent fish disease. The dissolved chloride concentrations in water from wells sampled in the study area are shown on plate 3. Chloride concentrations in water from the Eutaw aquifers in central Greene County commonly exceed 500 mg/L. Other areas of relatively high chloride concentrations in water from the Eutaw aquifer are in downdip areas in Marengo and Wilcox Counties.

The chemical characteristics of ground water depend on several variables, such as composition of the aquifer, distance from recharge areas, and the period of time water has been in contact with minerals in the aquifer. An evaluation of the results of chemical analyses of ground water in the study area indicates that the water is satisfactory for most uses. The results of chemical analyses of water samples collected from selected wells in the study area are given in table 3.

Table 3.--Selected physical and chemical characteristics of water from wells in the Black Belt area of west-central Alabama, March 14-18, 1991

(Analytical results in milligrams per liter except as indicated; µ/L, micrograms per liter.
Well numbers correspond to those on plate 2 and table 1.)

Property or constituent	Eutaw aquifer Well number 177	Eutaw aquifer Well number 114	Eutaw aquifer Well number 82	Eutaw aquifer Well number 7	Gordo aquifer Well number 83	Coker aquifer Well number 12
Hardness (as $CaCO_3$)	6	5	8	15	9	52
Calcium (Ca), dissolved	1.9	1.7	1.7	4.7	1.9	16
Magnesium (Mg), dissolved	.30	9.30	1.0	.80	1.1	2.9
Sodium (Na), dissolved	210	240	1.4	180	1.4	55
Potassium (K), dissolved	1.7	1.7	4.8	3.1	4.8	3.8
Sulfate (SO_4), dissolved	2.7	.50	5.5	<.20	4.4	7.6
Chloride (Cl), dissolved	94	98	1.9	160	1.9	54
Flouride (F), dissolved	1.6	1.5	<.10	1.2	<.10	<.10
Silica (Sio_2)	8.6	12	13	11	16	13
Iron (Fe), dissolved (µg/L)	160	50	10	70	20	340
Manganese (Mn), dissolved (µg/L)	100	10	20	10	<10	190
Solids, sum of constituents, dissolved	520	581	35	--	38	212
Solids, dissolved (tons per acre-foot)	.71	.79	.05	--	.05	.29

Water in the Eutaw aquifer in the study area generally is suitable for public water supply except in central Greene County, where chloride concentrations commonly exceed 500 mg/L (plate 3). Water samples from isolated wells completed in the Eutaw aquifer in some other parts of the study area have chloride concentrations that exceed 250 mg/L (plate 3); however, water from nearby wells completed in this aquifer have relatively low concentrations of chloride. Results of analyses of major constituents for water samples collected from four wells tapping the Eutaw aquifer are listed in table 3. Dissolved iron concentrations in these samples range from 10 to 160 µg/L (micrograms per liter). Dissolved sodium concentrations in water samples from the Eutaw aquifer are higher than those in samples from the other major aquifers (table 3).

Water from the Gordo aquifer in the study area generally is of good quality and suitable for most uses. Water from four wells tapping the Gordo aquifer in the study area had a range of dissolved chloride concentrations from 1.6 to 630 mg/L (table 1; plate 3). The Greensboro Utility well (well 83 in tables 1 and 3) produces water from the Gordo aquifer and this water was among the least mineralized waters sampled.

The Coker aquifer is tapped by few wells in the study area; therefore, only limited data on the chemical quality of water in this aquifer are available. However, based on data from wells in Hale County in the northern part of the study area and the North Sumter County Water Authority well, water from the Coker Formation in the northern part of the study area generally is soft to moderately hard and can contain iron concentrations in excess of 0.3 mg/L. Chemical analyses of water from the Sumter County well indicated that the chloride concentrations in water from this well were less than 25 mg/L. Water-quality data for wells tapping the Coker aquifer north of the study area indicate that water from this aquifer has chloride concentrations ranging from 2 to 790 mg/L.

WATER USE FOR AQUACULTURE, 1990

Operational water-use requirements for aquaculture were calculated from data obtained from an inventory of catfish ponds. This inventory indicated that 1,118 ponds representing a total surface area of 15,647 acres were in operation in the study area in 1990 (table 4; plate 1). As used in this section of the report, surface water refers to water in flowing streams, and runoff refers to stormwater runoff from precipitation. More than 60 percent of the ponds inventoried depended on rainfall runoff as their only source of water. Less than 1 percent of the ponds depended on ground water as a sole source of water. Water-use data were calculated on a site-by-site basis, using information supplied by the pond owners or operators. Where specific information was unavailable for a particular site, estimates were made based on information from similar sites.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama, 1991

NOTE: Site numbers correspond to those shown on plate 1.
Location: Latitude (DDMMSS) and Longitude (DDDMMSS) sequential number (xx). Altitude of pond surface: Altitudes given in feet above National Geodetic Vertical Datum of 1929, from topographic map or determined by aneroid barometer; altitudes given in feet and tenths determined by instrumental leveling.
Topography: U, undulating; G, flood plain; F, flat; S, hillside; V, valley flat; H, hilltop; W, upland draw. Land use: P, pasture; T, timber.
Water source: 1, runoff; 2, ground water; 3, surface-water stream; 4, runoff and ground water; 5, ground water and surface-water stream; 6, runoff and surface-water stream; 7, runoff, ground water, and surface-water stream. Nearby wells, within 1 square mile. Draining/filling: ---, records or information unavailable.

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topography	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
1	325834088135501	Henderson, B.	Sumter	140	U	P	1	2	25	0	--
2	325517088042501	Montgomery, J.H.	Greene	180	U	P	1	1	7	0	No drainage.
3	324434088041701	Montgomery, J.H.	Greene	200	U	P	1	1	5	0	No drainage.
4	325551088040301	Montgomery, J.H.	Greene	180	U	P	1	1	9	0	No drainage.
5	325742088034201	Steele, B.	Greene	180	G	P	1	2	16	0	No drainage.
6	325516088011501	Solomon, C.T.	Greene	170	U	P	4	8	82.3	2	No drainage; uses no.1 well for filling pond if needed.
7	324628087313301	McCray, H.	Hale	220	U	P	1	5	50	0	No drainage; annually harvested by nets.
8	324731087314301	Aritton, J.	Hale	220	U	T	4	3	25	1	--
9	324658087333201	Seale, J.	Hale	210	U	P	3	6	30	1	--
10	324655087380401	Langham, C.	Hale	160	G, S	P	5	3	26	0	Seine (unusual to drain).
11	324819087422801	Langham, D.	Hale	130	G	T	4	3	40	2	--
12	324908087430401	Woods, T.	Hale	130	F	P	2	2	26	3	Drained annually.
13	324933087432001	Woods, T.	Hale	130	F	P	4	1	12	1	Drained annually.
14	324926087443601	Bonnet, N.	Hale	140	G	T	4	11	115	2	--
15	325034087450001	Britton, J.	Hale	130	F	T	4	3	26	2	Drained and seined every 2 years.
16	324844087452601	Vise, T.	Hale	110	F	T	2	14	154	5	--
17	324752087453101	Johnson, W.	Hale	160	W	T	2	1	7	1	Drained and filled annually.
18	324744087460001	Bailey	Hale	150	U	P	4	3	30	1	Seine.
19	324847087464801	Hamilton, C.	Hale	115	F, G	T	4	5	75	2	Seine.
20	324739087512601	Hamilton, C.	Greene	140	S	--	1	3	15	0	--
21	324820087520301	Hamilton, C.	Greene	130	S	P, T	4	7	15	2	Drained approximately annually
22	324707087521601	Johnson, L.J.	Greene	115	W	P	2	5	47	1	Drained annually

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
23	324734087522401	Smith, J.	Greene	120	W	P	1	2	15	0	--
24	324744087533101	Taylor, Dr. W.A., Jr.	Greene	125	U	P	4	4	176	1	No drainage; harvested 1 or 2 times a year; seine thru.
25	324618087535201	Hardy, M.	Greene	110	U	P	4	6	75	7	--
26	324556087535901	Bauhower, R.	Greene	135	F	P	1	1	24	2	Drained 5 ft and harvested annually.
27	324831087542701	Bishop, J.	Greene	140	U	P	4	13	138	1	No drainage; harvested twice as year as is.
28	324932087550001	Odom, W.R.	Greene	175	U	P	1	15	250	0	Two ponds are drained; others harvested annually without drainage.
29	324546087563001	Colgrove, J.	Greene	170	F	P	1	2	31	0	Drained twice a year without lowering water level.
30	324919087564301	Solomon, C.T.	Greene	160	F	P	1	2	40	0	Partially drained twice a year for harvest.
31	324641087565001	Spree, T.	Greene	180	U	P	4	6	121	3	No drainage; harvested annually as is.
32	324600087585601	Beeker, C.	Greene	180	U	T	1	8	75	1	Partially drained twice a year to seine.
33	325028087594801	Bryant, P., Jr.	Greene	135	F	P	1	4	100	0	Drained 1 or 2 times a year without lowering water level.
34	32454508794901	Hearndon, D.	Greene	145	F	P	1	9	123	3	No drainage; harvested twice as year as is.
35	324623087595601	Hearndon, D.	Greene	135	F	P	1	1	13	0	No drainage; harvested twice a year as is.
36	324556088004301	Colgrove, J.	Greene	135	U	P	4	4	52	1	No drainage; seined twice a year.
37	325103088005701	Bryant, P., Jr.	Greene	160	F	P	1	8	108	0	No drainage; harvested 1 or 2 times a year.
38	324736088022401	Colgrove, J.	Greene	125	F	P	4	1	20	1	Drained annually
39	325200088034501	McLelland, J.M.	Greene	150	U	T	1	3	35	0	No drainage; harvested twice a year as is.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
40	325221088040801	Hales, A.J.	Greene	175	U	P	1	1	12.8	0	Drained and harvested annually.
41	325056088042101	McLelland, J.M.	Greene	140	F, G	T	4	2	18	1	No drainage; harvested twice a year as is.
42	324714088101301	Hill Ranch	Sumter	140	U	P	4	6	50.9	2	Ponds 5 and 6 drained annually to harvest; filled by rain runoff.
43	324708088161201	Smith, T.	Sumter	200	U	P	1	13	211.8	0	Drained every 3 years.
44	325125088173101	McClure, J.	Sumter	130	U	T	1	2	32	0	No drainage; no filling.
45	325012088175601	Kuykendall, J.M.	Sumter	130	U	P	4	2	32.4	1	Drained every 3 to 4 yrs.
46	324441088183701	Dial, P.	Sumter	250	U	P	1	2	14.5	0	Drained every 2 to 3 yrs.
47	324405088164301	The Dial Family	Sumter	240	U	P	1	15	86	0	Drained every 2 to 3 yrs.
48	324027088151001	Boyd, C.	Sumter	220	U	P	1	7	89	0	Drained every 2 to 3 yrs.
49	324031088144601	Boyd, C.	Sumter	180	U	P	1	14	26	0	Drained every 2 to 3 yrs.
50	324534088142501	Smith, W.R.	Sumter	190	U	P	1	4	22	0	Filled by rain runoff, no wells.
51	324241088092201	Nelson, T.	Sumter	140	U	P	4	11	106	1	Drained every 2 years.
52	323856088072501	Pruitt, Jr., D..	Hale	200	U	P	1	4	28	0	Partially drained and harvested annually.
53	324502088050601	Spree, T.	Greene	110	G	T	4	2	35	1	No drainage; harvested annually as is.
54	324540088042701	Spree, T.	Greene	110	G	T	4	5	49	4	No drainage; harvested as is.
55	324538088040101	Spree, T.	Greene	115	G	T	4	1	13	1	No drainage; harvested annually as is.
56	324450088025501	Spree, T.	Sumter	115	F, G	T	4	22	100	2	Drains a few and seines others without draining.
57	324538088010301	Trice, T.	Greene	130	F	P	1	1	18	0	No drainage
58	324522087591001	Hunt, N.C.	Greene	190	U	P	1	5	46	1	Drained halfway annually.
59	324540087541501	Hollingsworth, A.	Greene	140	U	T	4	6	45	1	Drained annually
60	324428087541001	Odom, D.	Greene	140	U	P	1	4	70	0	No drainage; harvested annually as is.
61	324402087474001	Glover, J.	Hale	100	G	T	7	8	350	3	Drop 1 to 3 feet to seine; possibly drain.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
62	324336087472601	Glover, J.	Hale	150	S	T	1	2	20	0	--
63	324243087455901	McCray, H.	Hale	120	S	P	4	4	150	1	Drained to depth of 6 feet every 1 to 5 years.
64	324519087455901	Lawson, C.R.	Hale	180	U	P	4	2	41	1	--
65	324103087440301	Cobb, N.	Hale	130	U	P	1	4	34	0	Partially drained every 2 years.
66	324154087434801	Morrison, L.	Hale	130	U	P	1	5	78	0	Partially drained every 2 years.
67	324023087433901	Seale, B.	Hale	90	U	P	4	6	53.5	1	Drained 5 feet annually.
68	324534087433201	Mohabat, A.	Hale	200	U	P	1	2	18	0	Pond apparently inactive.
69	324025087432701	Wright, Judge G.	Hale	90	U	P	4	20	80	3	Drained every 6 to 8 mos.
70	323940087431101	Barnette, R & S	Hale	100	U	P	4	5	59	1	No drainage (seined)
71	324507087423601	Garrison, J.	Hale	140	H	P	1	1	17	0	Drained to 6 feet every 15 years.
72	324016087422901	Langford, P.	Hale	140	S	P	4	5	34	1	Seine.
73	324130087415901	Turpine, V.	Hale	145	W	P	1	2	48	0	Drained every 2 years.
74	324000087415201	Langry, G.	Hale	150	S	P	4	5	60	1	Seine
75	324204087413901	England, M.	Hale	170	W	T	4	1	10	1	Partially drained annually.
76	324306087412201	Jay, J.C.	Hale	180	H, W	T	4	15	39.5	1	Partially drained annually.
77	324152087411901	Short, W.	Hale	188	S	P	1	4	39	0	Drained every 1 to 2 yrs.
78	324144087411701	Taylor, R.D.	Hale	180	W	P	1	2	32.9	0	Drained every 4 to 5 years--partially drained in between.
79	324425087411001	McCray, H.	Hale	230	H, W	P	4	8	28	1	Partially drained annually.
80	324232087410801	Coleman, B.W.	Hale	192	F	P	1	2	20	0	Drained annually.
81	323935087405701	Poellnitz, R.	Hale	139	W	P	1	1	27	1	Partially drained every 2 years.
82	324210087401601	Durham, J.	Hale	190	W	P	1	1	18.5	0	Drained every 3 years.
83	324235087392001	Clements, A.	Hale	210	S, W	P	4	4	12	1	Drained every 3 years.
84	324229087383901	Hall, L.	Hale	210	H, W	T	4	5	29.5	1	Partially drained annually.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
85	324259087382601	May, T.	Hale	220	W	T	4	1	10	0	Partially drained every 1 to 2 years.
86	324325087380301	Arrington, J.	Hale	230	S	T	4	3	14	0	Drained annually
87	324041087375901	Langford, P.	Hale	170	U	P	4	2	6.2	1	Drained every 3 years.
88	324210087375701	Tidmore, C.	Hale	187	W	T	4	4	40	1	Drained every 1 to 2 yrs.
89	324302087375001	Jay, L.	Hale	220	W	P	4	17	67	1	Drained annually
90	324012087371501	Hall, D.	Hale	190	U	T	4	7	95	1	Drained annually to harvest.
91	324451087365201	Washburn, J.	Hale	230	U	T	7	5	32	1	Drained annually to harvest.
92	323912087362001	Drury, B.	Hale	180	F	P	7	22	280	5	Drained annually to harvest.
93	324326087354101	Harrow, M.	Hale	210	U	T	5	1	16.2	0	No drainage; harvested by nets annually.
94	324126087351201	Hall, L.	Hale	250	U	P	5	2	20	0	No drainage; harvested by nets annually.
95	323946087334301	Kyser, B.	Hale	220	F	P	4	5	115	2	--
96	324528087333601	Glover, J.	Hale	180	F	T	7	17	240	3	No drainage; harvested by seine.
97	324053087331801	Hamilton, J.L.	Hale	250	S	P	1	3	11	0	--
98	324409087322201	Montz, L.	Hale	225	U	P	4	3	23.5	3	--
99	324527087305201	Montz, L.	Hale	220	U	P	6	13	50	3	Drained annually.
100	323623087183001	Cook, F.	Perry	260	U	P	1	1	9.5	0	Drained annually.
101	323431087183201	Barnette, R.	Perry	240	U	P	4	3	19.5	1	Drained annually.
102	323334087183301	Barnette, R.	Perry	220	U	P	5	4	64	0	Drained annually.
103	323333087201601	Good, J.	Perry	220	U	P	4	6	98	1	Drained annually.
104	323446087202501	Clark, D.	Perry	230	U	P	1	2	30	0	Drained annually.
105	323359087232601	Hinton, A.L.	Perry	225	U	P	1	2	20	0	Drained annually.
106	323541087221401	Lakeland Farms	Perry	230	U	P	1	34	461.9	1	Drained annually.
107	323901087225101	Smith, R.S.	Perry	315	U	P	1	2	9	1	No drainage; filled as needed.
108	323704087234801	Edwards, R.	Perry	250	U	P	1	3	12	0	Drained annually.
109	323623087235501	Curtis, L.	Perry	230	U	P	1	1	25	0	Drained annually.
110	323449087242501	G & H Farms	Perry	230	U	P	1	5	71	0	Drained annually.
111	323532087250301	Ioka Farms	Perry	240	U	P	1	3	47	0	Drained annually.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
112	323346087250601	Johnson, J.	Perry	230	U	p	1	2	22	0	Drained annually.
113	323528087264801	Hinton, A.C.	Perry	240	U	P	1	3	30	0	Drained annually.
114	323606087265101	Wheeler, J.A.	Perry	230	U	P	1	6	67	0	Drained annually.
115	323330087265201	Wheeler, J.A.	Perry	250	U	P	1	3	31	0	Drained annually.
116	323515087305301	Bailey, W.	Perry	170	S	P	1	1	10	0	Partially drained to seine.
117	323346087305501	Broussard, C.	Perry	190	U	P	1	7	100	0	Seine.
118	323551087312301	Broussard, C.	Hale and Perry	170	U	P	1	3	30	0	Seine.
119	323417087313201	Eicher, N.	Hale and Perry	140	U	P	1	10	108	0	Partially drained to seine.
120	323411087321001	Keyser, B.	Hale	140	U	P	1	4	40	1	Drained every 5 to 10 yrs.
121	323318087321601	Broussard, C.	Hale	180	U	P	4	10	70	1	Drained annually.
122	323621087323001	Washburn, J.	Hale	155	U	T	7	1	25	1	Partially drained to seine.
123	323610087323501	Dornbhart Farms	Hale	150	U	P	1	5	92	1	No drainage; seine
124	323545087323801	Stoddard, D.	Hale	150	U	T	1	5	55	0	Partially drained and filled annually to seine.
125	323304087323801	Washburn, J.	Hale	130	G	T	5	4	95	0	Seine
126	323500087330301	Turner, D.	Hale	120	U	P	4	26	229	4	Drained annually.
127	323352087332501	Benner, G.	Hale	130	U	P	1	1	20	0	No drainage; seine.
128	323821087333201	Broussard, D.	Hale	195	F	P	1	6	50	1	No drainage; harvested by nets annually.
129	323828087333901	Morrison Bros.	Hale	190	F	P	4	16	177	0	No drainage; harvested by nets annually.
130	323701087335201	Morrison Bros.	Hale	170	U	P	1	4	70	0	No drainage.
131	323744087341201	Kyser, B.	Hale	180	U	P	4	24	155	5	Drained annually excluding four hatcheries
132	323536087341801	Acker, J.	Hale	170	U	P	1	8	96	2	Drained annually.
133	323437087342701	Acker, J.	Hale	150	U	P	1	3	84	1	Drained annually.
134	323341087345601	Benner, G.	Hale	140	U	P	1	2	30	0	Partially drained; seine occasioually.
135	323619087351001	Weeks, S.	Hale	180	U	P	4	6	67	2	Drained and filled annually.
136	323322087354001	Harless, R.	Hale	130	U	P	4	4	39	1	Drained every 4 to 5 yrs.
137	323644087355401	Smelley, G.	Hale	160	U	P	4	5	100	1	--
138	323529087360101	Hollingsworth, R.	Hale	170	U	P	1	12	96	2	Partial seine annually
139	323415087361101	Cole, R.	Hale	150	F	P	1	7	118	0	Two levy ponds drained annually.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
140	323343087361101	Causey, K.	Hale	140	F	P	1	2	20	0	Seine annually.
141	323603087361301	Keyser, B.	Hale	160	U	P	4	6	83	1	40 acre pond drained every 2 years; others drained every 5 to 10 yrs.
142	323248087364201	Hollingsworth, R.	Hale	120	U	P	4	15	282	2	Filling every year
143	323336087370801	Henry, C.	Hale	140	U	P	1	7	20	0	Partially drained annually to harvest.
144	323251087371601	Garris, D.	Hale	130	U	P	4	6	60	1	Partially drained for each seine.
145	323658087371901	Drury, B.	Hale	130	F	T	1	9	200	2	Drained annually to harvest.
146	323343087380401	Hall, F.	Hale	160	U	P	4	3	25	1	--
147	323311087381201	Garris, D.	Hale	130	U	P	1	2	10	0	Drained and harvested annually.
148	323423087382501	Smelley, C.	Hale	160	U	P	1	1	20	0	Drained and filled every 5 years.
149	323403087385201	Horn, H.	Hale	130	U	P	4	4	90.5	1	No drainage; harvested every 18 months as is.
150	323706087392701	Blaylock, J.	Hale	150	U	P	4	7	74.5	1	Drained 2 to 3 feet for harvest approximately every 3 months; refilled with rain and well water.
151	323623087393601	Morrison Bros.	Hale	150	U	P	1	3	79	1	Drained 5 feet annually.
152	323657087394501	Mitchell, C.L.	Hale	150	U	P	1	1	10.6	0	Drained 1.5 ft to seine to past, but hopes to use larger 9 ft net in future and have no drainage.
153	323748087400301	Alexander, R.	Hale	135	S	P	5	6	90	0	Seine.
154	323723087400701	Bonds, H.B.	Hale	120	U	P	1	4	41	0	Drained 2 ft annually; need to drain every 4 to 5 years to clean bottom, but not done.
155	323446087400701	Miller, D.	Hale	130	U	P	4	15	170	2	No drainage; need to drain completely every 8 to 10 years to clean.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
156	323540087401701	Doman, W.	Hale	150	U	P	4	5	57	1	Drained dry annually.
157	323514087402501	Jackson, L.	Hale	140	U	P	4	2	20	1	Drained annually.
158	323559087403101	Jackson, D.	Hale	130	U	P	1	2	20	0	No drainage in past 4 yrs; may need to drain complete and clean in 2 years.
159	323709087403301	Mitchell, C.	Hale	100	U	P	1	2	13	0	No drainage; harvested annually as is.
160	323713087404001	Mitchell, D.	Hale	120	F	P	1	1	13	0	No drainage; harvested annually as is.
161	323328087404901	Garris, D.	Hale	120	U	P	1	3	11.5	0	Drained annually.
162	323427087405301	Horn, H.	Hale	100	U	P	1	1	12.5	0	Drained 6 feet every 18 months.
163	323735087410201	Ensz, Roger	Hale	110	F	P	1	3	30	0	No drainage.
164	323524087410201	Hampton, D.	Hale	120	U	P	4	5	30	1	9 acre pond is drained 2 to 3 feet; no drainage at others.
165	323558087410501	Miller, D.	Hale	100	U	P	4	12	134	1	No drainage in approximately 8 to 10 years, need to drain and clean.
166	323627087410701	Mitchell, H.	Hale	100	U	P	4	2	23.8	1	No drainage; 4th year in production; needs to be drained.
167	323300087412801	Crawford, A.	Hale	100	U	P	1	6	50	0	Drained every 4 to 6 yrs for cleaning; harvested twice a year as is.
168	323829087414301	State Cattle Ranch	Hale	125	U	P	4	33	327	1	Fingerling ponds drained annually; larger ponds partially drained 1 to 2 years.
169	323807087425101	Drummond, E.A.	Hale	115	U	P	1	3	67	0	Partially drained every 1 to 2 years.
170	323258087425101	Perry, J.A.	Hale	100	U	P	4	3	68	2	No drainage; harvested annually as is; filled from flowing wells and runoff.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
171	323321087435601	Perry, J.A.	Hale	80	U	P	1	3	50	0	45 acre pond drained 7 ft to harvest; 3 and 2 acre ponds drained 4 ft to harvest. Harvested every 1.5 years.
172	323645088095401	Pruitt, D.	Sumter	200	U	P	1	1	4	0	--
173	323701088104301	Pruitt, D.	Sumter	200	U	P	1	1	8	0	--
174	323158087461901	Diller, K.	Hale	100	U	P	5	5	43	0	No drainage; harvested twice a year as is.
175	322641087445501	Allen, C.	Marengo	220	U	P	1	5	90	0	--
176	323143087435101	Warren, P.	Hale	140	U	P	1	1	15	0	Drained every 1.5 years for harvest.
177	323210087432801	Amsouth Bank	Hale	140	U	P	1	1	10	0	New pond.
178	323043087432301	Jones, M.	Hale	170	U	P	4	1	10	1	Drained annually for harvest.
179	322630087430501	Allen, J.D.	Marengo	185	U	P	1	1	7	0	Seine.
180	323121087425001	Crawford, A.	Hale	100	U	P	1	1	35	0	Drained every 1 to 1.5 yrs for harvest.
181	322831087424201	Spencer, W.M.	Marengo	190	U	P	1	3	38	1	Harvested by seine annually.
182	323214087422601	Griffin, J.	Hale	100	U	P	1	1	15	0	Harvested annually.
183	323146087421901	Copeman, D.	Hale	120	U	P	1	1	7.5	0	Drained 2 ft for harvest..
184	322746087414901	Lewis, N.	Marengo	160	F	P	1	1	20	0	--
185	323041087414401	Hall, F.	Hale	130	U	P	1	1	3	0	--
186	323212087411601	Perry, J.A.	Hale	90	F	P	3	2	47	0	No drainage; harvested annually as is.
187	323037087400901	Hall, F.	Hale	130	U	P	1	1	2	0	--
188	323027087400201	Morrison Bros.	Hale	140	U	P	1	3	37	0	10 acre pond not drained; 15 and 12 acre ponds drained 5 feet; harvested annually.
189	322934087370201	Williamson Cattle	Hale	140	G	P	4	1	260	2	Drained annually.
190	323029087364201	Hollingsworth, R.	Hale	160	F	P	1	1	20	0	Seine annually.
191	322628087364001	Sims, A.	Marengo	230	U	P	1	5	60	0	Drained annually.
192	322912087354801	Bates, J.	Hale	140	G	P	4	8	114	2	Drained annually.

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
193	323030087353101	Sims, H.	Hale	160	U	P	1	2	20	0	No drainage; pond is 1 year old.
194	322758087334901	Enze, G.	Marengo	160	G	P	1	5	71	0	Drained annually.
195	323139087331801	James, P.	Hale	130	U	P	1	11	183	1	Partially drained every 2 years; drained every 5 years.
196	322951087324401	Watson, B.	Hale	180	G	P	4	9	200	2	Drained approximately annually.
197	322941087315801	Cole, R.	Hale	200	U	P	1	2	22	0	Drained annually.
198	322813087311701	Harms, D.	Perry	220	U	P	1	1	20	0	Drained annually.
199	323030087310801	Belcher, T.	Perry	220	U	P	1	2	19	0	Drained annually.
200	323217087302701	Morrisette	Perry	160	G	P	4	24	391	3	--
201	323137087292101	Broussard, D.	Perry	250	U	P	1	3	45	0	Drained annually.
202	322809087292001	Johnson, F.	Perry	200	U	P	1	5	56	0	Drained annually.
203	322749087283901	Harms, D.	Perry	190	G	P	1	2	28	0	Drained annually.
204	322815087283601	Barton, A.	Perry	190	U	P	1	1	14	0	Drained annually.
205	323048087271001	Diller, J.	Perry	200	U	P	1	1	19	0	Drained annually.
206	322654087255301	Williams, W.	Perry	180	U	P	1	1	3.5	0	Drained annually.
207	322749087234001	Johnson, H.	Dallas	210	U	P	1	2	17	0	Drained annually.
208	322548087214601	Nichols, R.	Dallas	160	U	P	2	2	31	1	Drained annually.
209	323219087203301	Wheeler, B.	Perry	210	U	P	1	2	25	0	Drained annually.
210	322550087142701	Cogle, T.	Dallas	190	W	P	1	1	17.5	0	Drained annually.
211	322552087125001	Miller, J.	Dallas	210	U	P	4	1	35	1	Drained annually.
212	322643087123501	Moore, R.	Dallas	160	U	P	1	1	8	0	Drained annually.
213	322546087121501	Miller, J.	Dallas	185	U	P	4	9	67	1	Drained annually.
214	322453087145501	Cogle, T.	Dallas	180	U	P	1	1	25.5	0	Drained annually.
215	322405087222001	Pearce, D.	Dallas	165	U	P	4	26	750	2	Drained annually.
216	322302087224901	Dixon, B.	Dallas	200	U	P	1	2	8.5	0	Drained annually.
217	321933087232701	Givham, S.	Dallas	220	U	P	1	1	20	0	Drained every 3 to 4 yrs.
218	322314087234501	Wilson, B.	Dallas	200	U	P	1	1	12	0	Drained annually.
219	322449087245601	Wilson, B.	Dallas	190	U	P	4	5	60	1	Drained annually.
220	322319087252401	Williams, W.	Perry	240	U	P	1	2	35	0	Drained annually.
221	322429087254101	McKenzie, J.	Perry	230	U	P	1	3	72	0	Drained annually.
222	322524087260501	McKenzie, J.	Perry	200	U	P	1	1	15	0	Drained annually

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
223	322050087272001	Miller Bros.	Perry	220	U	P, T	1	0	223	0	Drained every 3 to 4 yrs; harvested as is.
224	322000087280601	Miller Bros.	Perry	200	U	P, T	1	13	156	0	Drained every 3 to 4 yrs.
225	322444087311001	Barton, R.	Perry	250	U	P	1	6	95	0	Drained annually.
226	322455087311401	Broussard, C.	Perry	220	U	P	1	4	43	0	Drained annually.
227	322458087322001	Mackey, B.	Marengo	250	U	P	1	3	35	0	Drained annually.
228	322502087342501	Brackin, B.	Marengo	250	U	P	4	5	39.7	1	Drained annually.
229	322358087425201	Mosely, Jr., J.	Marengo	140	F	P	3	2	50	0	Seine.
230	321535087475201	Tucker, J.	Marengo	140	U	P, T	1	2	21.5	0	Drained approximately annually to harvest.
231	321736087464901	Seaman, D.	Marengo	140	F	P	1	1	10	0	Drained approximately annually to harvest; filled with runoff.
232	321723087461001	Baugh, B.J.	Marengo	140	U	P	1	1	5.9	0	Drained annually to harvest.
233	321637087450401	Hale, M.	Marengo	120	U	P	1	1	15	0	Drained approximately annually to harvest.
234	321816087273501	Miller Bros.	Dallas	200	U	T	1	1	5	0	Drained every 3 to 4 yrs; harvested as is.
235	321610087263001	Miller Bros.	Dallas	170	U	P	1	7	87	0	Drained every 3 to 4 yrs; harvested as is.
236	321746087253601	Miller Bros.	Dallas	190	U	P	1	2	30	0	Drained every 3 to 4 yrs; harvested as is.
237	321803087225901	Miller, S. & H.	Dallas	200	U	P	1	2	20	0	Drained every 2 to 3 yrs.
238	321633087215501	Miller Bros.	Dallas	200	U	P	1	1	15	0	Drained every 3 to 4 yrs; ponds not lowered to harvest.
239	321636087204401	Pierce, D.	Dallas	180	U	P	1	3	30	0	Drained every 3 years.
240	321558087204201	Bell, J.	Dallas	190	U	P	1	1	10	0	No drainage; pond inactive.
241	321606087194201	Pierce, D.	Dallas	200	U	P	4	1	28	1	Drained every 3 years.
242	321442087184701	Jones, L.	Wilcox	150	S	P	1	1	23	0	--
243	321711087184101	Pierce, D.	Dallas	120	F	T	4	11	98	2	Drained every 2 to 3 yrs; wells flow completely.
244	321326087180301	Caine, P.	Wilcox	150	F	P	1	4	18	0	--

Table 4.--Records of selected catfish ponds in the Black Belt area of west-central Alabama--Continued

Site number	Location	Owner	County	Altitude of pond surface (feet)	Topo-graphy	Land use	Water source	Number of ponds	Area of pond(s) (acres)	Number of nearby wells	Draining/ filling
245	321505087180001	Jones, L.	Wilcox	140	S	P	1	2	34	0	--
246	321444087175601	Jones, L.	Wilcox	130	S	P	1	2	24	0	--
247	320744087252401	Henderson, J.	Wilcox	140	F	P	1	2	0.7	0	--
248	320728087252501	Henderson, J.	Wilcox	130	W	P	1	1	2.9	0	--
249	320627087253601	Henderson, J.	Wilcox	100	W	P	1	1	46.4	0	--
250	320833087260001	Henderson, J.	Wilcox	150	F	P	1	3	3.7	0	--
251	320715087263801	Henderson, J.	Wilcox	110	S	P	1	2	2.9	0	--
252	320931087265801	Martin, R.	Wilcox	165	F	P	4	10	56.6	1	--

The following assumptions were made when estimating water use for sites that did not have specific water-use data available:

1. A cycle of one drain and fill per year was assumed for ponds without drainage and fill records. Ponds that were reported to be lowered only for harvest were assumed to be lowered 4 feet. A depth of 8 feet was assumed for ponds without depth information.
2. Ponds filled primarily by rainfall runoff, but with some ground water contribution during droughts or other emergencies, were assumed to use 98 percent runoff and 2 percent ground water.
3. Ponds filled primarily with ground water, but with some runoff contribution, were assumed to use 75 percent ground water and 25 percent runoff.
4. Ponds filled with runoff supplemented with either surface water or ground water were assumed to use 75 percent runoff. The remaining 25 percent was from either surface water or ground water.
5. Ponds filled with runoff, ground water, and surface water in undesignated amounts were assumed to use 50 percent runoff, 25 percent ground water, and 25 percent surface water withdrawn from a stream or other water body.
6. Ponds filled with surface water and ground water in undesignated amounts were assumed to use 50 percent surface water and 50 percent ground water.

Estimates of ground water and surface water used to replace evaporation losses from ponds were calculated by multiplying the surface area of the ponds by 10.17 inches which was the sum of rainfall deficit for May through September 1990 when adjusted pan evaporation exceeded rainfall. A pan coefficient of 0.7 was used to estimate water surface evaporation from the class-A land pan evaporation data for the National Oceanic and Atmospheric Administration (NOAA) site at Demopolis (NOAA, 1991; Veihmeyer, 1964). The amounts of ground water and surface water used for operations and evaporation are listed in table 5.

Total water use for aquaculture in the study area in 1990 was 21.83 Mgal/d; 16.08 Mgal/d from ground-water sources and 5.75 Mgal/d from surface-water sources (table 5). Pond operations (filling) accounted for 10.01 Mgal/d of ground water and 3.53 Mgal/d of surface water. Replacement of evaporation losses accounted for 6.07 Mgal/d ground water and 2.22 Mgal/d surface water. Most of the ground water used was from the Eutaw aquifer.

Table 5.--Estimated average annual water use for aquaculture in the Black Belt area of west-central Alabama in 1990, by county

(Mgal/d, million gallons per day.)

County	Total area of aquaculture ponds (acres)	Estimated operational withdrawals (Mgal/d)			Estimated withdrawals to replace evaporation losses (Mgal/d)			Total estimated withdrawals (Mgal/d)
		Surface water	Ground water	Total	Surface water	Ground water	Total	
Dallas	1,344.5	1.45	3.42	4.87	0.64	0.78	1.42	6.29
Greene	1,861.1	.00	.29	.29	.02	.43	.45	.74
Hale	7,892.4	1.95	5.18	7.13	1.46	3.87	5.33	12.46
Marengo	463.1	.07	.07	.14	.07	.03	.10	.24
Perry	2,854.9	.03	.90	.93	.01	.70	.71	1.64
Sumter	855.5	.03	.12	.15	.02	.22	.24	.39
Wilcox	375.8	.00	.03	.03	.00	.04	.04	.07
Totals	15,647.3	3.53	10.01	13.54	2.22	6.07	8.29	21.83

SUMMARY

Commercial production of catfish in west-central Alabama began about 1970 and by 1990 catfish ponds in the part of the State known as the Black Belt area covered about 16,000 acres. The rapid increase in the number of catfish ponds and the associated demand for ground water prompted State and Federal agencies to initiate a study to define the ground-water resources and water requirements for aquaculture in the area.

Geologic units that crop out in the study area are of sedimentary origin and range in age from Late Cretaceous to Quaternary. The major aquifers in the study area are sand and gravel beds in the Eutaw, Gordo, and Coker Formations. Recharge areas for the major aquifers generally coincide with the outcrops of the Eutaw, Gordo, and Coker Formations along and north of the northern boundary of the study area. The average recharge to the major aquifers, estimated from baseflow analysis, is 11.4 in/yr in the outcrop areas.

Water from the major aquifers generally is of good quality and suitable for most uses, except in central Greene County and in downdip areas in Marengo and Wilcox Counties where water from the Eutaw aquifer has chloride concentrations in excess of 500 mg/L. Water not suitable for human consumption because of elevated chloride concentrations is used for catfish farming in some parts of the study area.

The potentiometric surfaces of the Eutaw, Gordo, and Coker aquifers have steadily declined since the 1950's in some parts of the study area as a result of ground-water withdrawals for municipal supplies and aquaculture. Local depressions in the potentiometric surface of the major aquifers near large pumping centers have been documented by several investigations.

The total water use for aquaculture in the study area in 1990 was estimated to be 21.83 Mgal/d; 16.08 Mgal/d from ground-water sources and 5.75 Mgal/d from surface-water sources. Pond operations accounted for 13.54 Mgal/d ground water and 3.53 Mgal/d surface water. Replacement of evaporation losses accounted for 6.07 Mgal/g ground water and 2.22 Mgal/d surface water.

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