WATER USE IN SOUTH CAROLINA, 1985

By Whitney J. Stringfield and Susan C. Lambert

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ABSTRACT

Approximately 6,720 million gallons per day of freshwater were withdrawn in 1985 from South Carolina's streams, rivers, lakes, and aquifers for public supply, irrigation, industry, and thermoelectric power generation. This compares to 5,790 million gallons per day withdrawn during 1980, or an increase of 16 percent. Surface water was the source for 98 percent of all freshwater withdrawals and ground water was the source for the remaining 2 percent. Thermoelectric power generation accounted for 77 percent of the total withdrawal; industry, 17 percent; public supply, 5 percent; and agricultural use, 1 percent. An additional withdrawal of 118 million gallons per day was estimated for miscellaneous uses such as domestic, commercial, livestock, and mining. Instream or nonwithdrawal use of water for hydroelectric power generation accounted for 42,100 million gallons per day, which is six times greater than the total of all withdrawal uses.

INTRODUCTION

Increasing diversions, withdrawals, and use of water places stress on the quantity and quality of existing supplies and presents problems in the management and allocation of the resource. Water-use information is a necessity for the water manager and can be used to identify present and potential problems related to water needs. Water-use data are a prerequisite for quantative ground-water studies and many other water-resource investigations.

This report presents water-use data that were collected through the Water Use Reporting Program under the authority of The South Carolina Water Use Reporting and Coordination Act of 1982. These data represent quantities of water withdrawn from ground- and surface-water sources for use in South Carolina during 1985. Section 282 of the Water Use Reporting and Coordination Act requires the centralized collection of water-use information by the South Carolina Water Resources Commission (SCWRC) and that all users withdrawing more than 100,000 gallons per day report their use to the South Carolina Water Resources Commission.

The U.S. Geological Survey has compiled water-use data for South Carolina, as well as the other 49 states, Puerto Rico and the Virgin Islands in the national assessment of water use, published every fifth year since 1950 (MacKichan, 1951, 1957; MacKichan and Kammerer, 1961; Murray, 1969; and Murray and Reeves, 1972, 1977; Solley and others 1983, 1988). The South Carolina Water Resources Commission has published the following five reports on water use from 1971 to 1985: SCWRC Report Number 103, 127, 138, 140, and 148.

In South Carolina, as elsewhere, water use is classified as withdrawal use or nonwithdrawal use, depending on whether water is removed from the source of supply. Four categories of withdrawal use are discussed: public supply, industry, thermoelectric power generation, and irrigation. One category of nonwithdrawal use, hydroelectric power generation, also is discussed. An additional withdrawal of 118 Mgal/d (million gallons per day) was estimated for miscellaneous uses such as domestic, commercial, livestock, and mining.

Terminology

Water-use terms used in this and in other water-use reports published by the Geological Survey have specific definitions that relate to and limit the manner in which water-use data are collected and aggregated. Definitions of some of the more commonly used water-use terms are given below.

Commercial water use: Water used by motels, hotels, restaurants, office buildings, commercial facilities, and institutions, both civilian and military.

Cooling water: Water used for cooling purposes, such as for condensers and nuclear reactors.

Domestic water use: Water use for normal household purposes, such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and watering lawns and gardens.

Freshwater: Water that contains less than 1,000 mg/L (milligrams per liter) of dissolved solids; generally, more than 500 mg/L is considered undesirable for drinking and many industrial uses.

Ground water: Generally all subsurface water as distinct from surface water; specifically, that part of the subsurface water that occurs in the saturated zone.

Hydroelectric power generation water use: The use of water to drive turbines to generate electric power.

Industrial water use: Water used in industrial processes such as the manufacture of steel, the processing of chemical and allied products, mining, and the production of paper and allied products, textiles, and weapons.

Irrigation water use: Application of water on lands to assist in growing crops, commercial plants, and pastures or in maintaining recreational lands such as parks and golf courses.

Nonwithdrawal use: Water use taking place within the stream channel for purposes such as hydrolectric power generation, navigation, water-quality improvement, fish propagation, and recreation. Sometimes referred to as instream use.

Public supply: Water withdrawn by public and private water suppliers and delivered to users that do not supply their own water. Water suppliers provide water for a variety of uses such as domestic, commercial, industrial, and public water use.

Public water use: Water supplied from a public supply and used for firefighting, street washing, and municipal parks and swimming pools.

Saline water: Water that contains more than 1,000 mg/L of dissolved solids. Also called saltwater.

Self-supplied water: Water withdrawn from a surface- or ground-water source by a user and not obtained from a public supply.

Surface water: An open body of water such as a stream or a lake.

Thermoelectric power generation water use: Water used to make and condense steam for generation of electrical power using fossil-fuel (coal, oil, or natural gas), or nuclear energy.

Withdrawal use: Water removed from the ground or diverted from a surface-water source for use. Sometimes referred to as offstream use.

Present Investigation

The U.S. Geological Survey entered into a cooperative agreement with the South Carolina Water Resources Commission in 1979 to collect, compile, and store statewide water-use data. The South Carolina Water Resources Commission acquires and stores the water-use data and the U.S. Geological Survey provides direction and funding to meet the needs of the National Water Use Program for South Carolina water use data. The data collected and presented in this report are the result of the SCWRC inventory of water use in 1985. For use of the reader, a map showing the locations of counties in South Carolina is shown in figure 1 and locations of the physiographic provinces in the State are shown in figure 2. Water use data are presented for the following categories of withdrawal use: (1) public supply (2) industry (3) irrigation (4) thermoelectric power generation. Water use in each of these categories is presented by source, surface water or ground water. Nonwithdrawal use for hydroelectric power also is presented.

Water-use data in this report are compiled from various sources and vary in accuracy. Industrial water use and thermoelectric and hydroelectric power generation water-use data are reported on a quarterly basis to the South Carolina Water Resources Commission, while agricultural irrigation water use is reported annually. Water-use data for public supply are based on monthly reports submitted to the South Carolina Department of Health and Environmental Control.

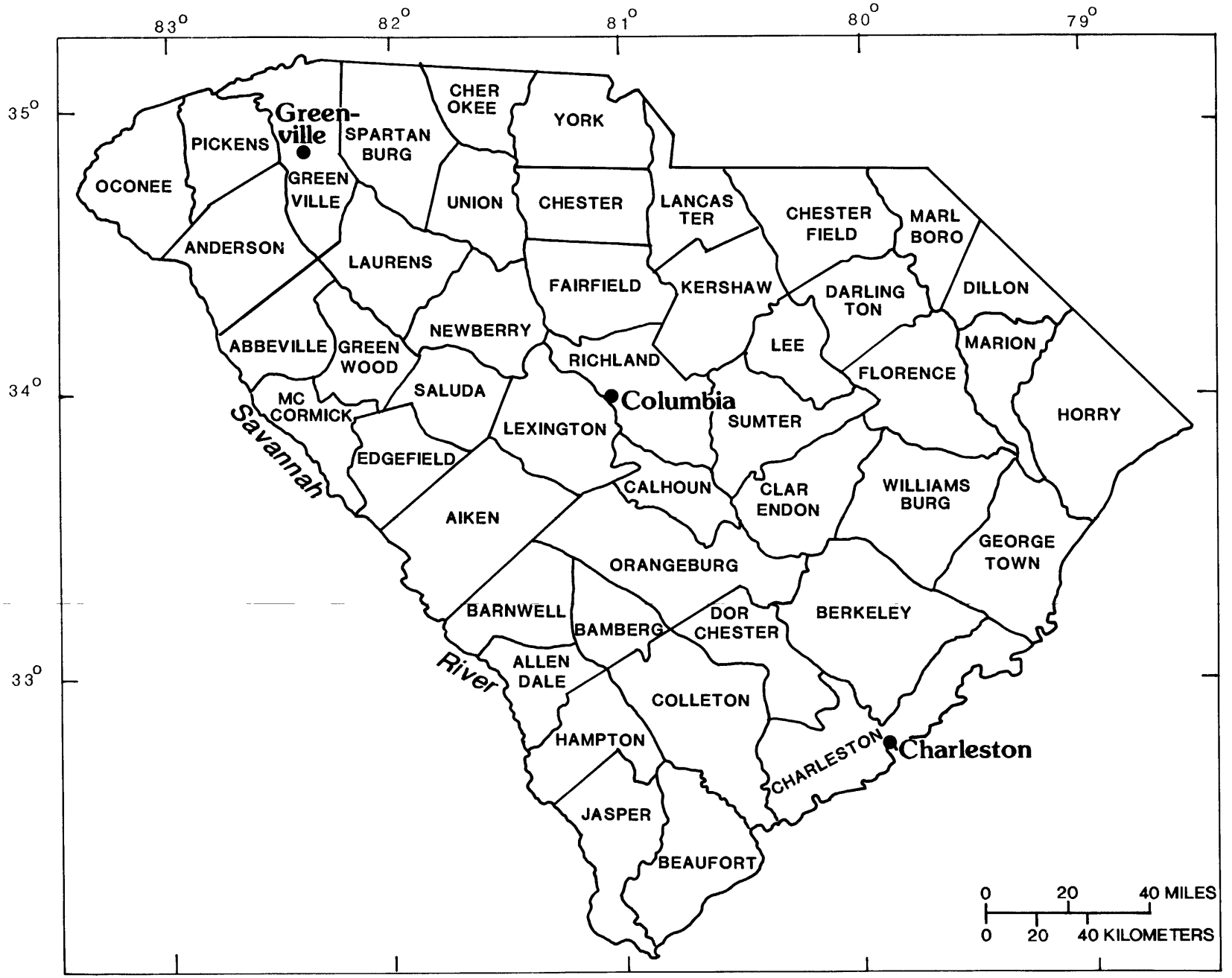

Figure 1.--Counties in South Carolina.

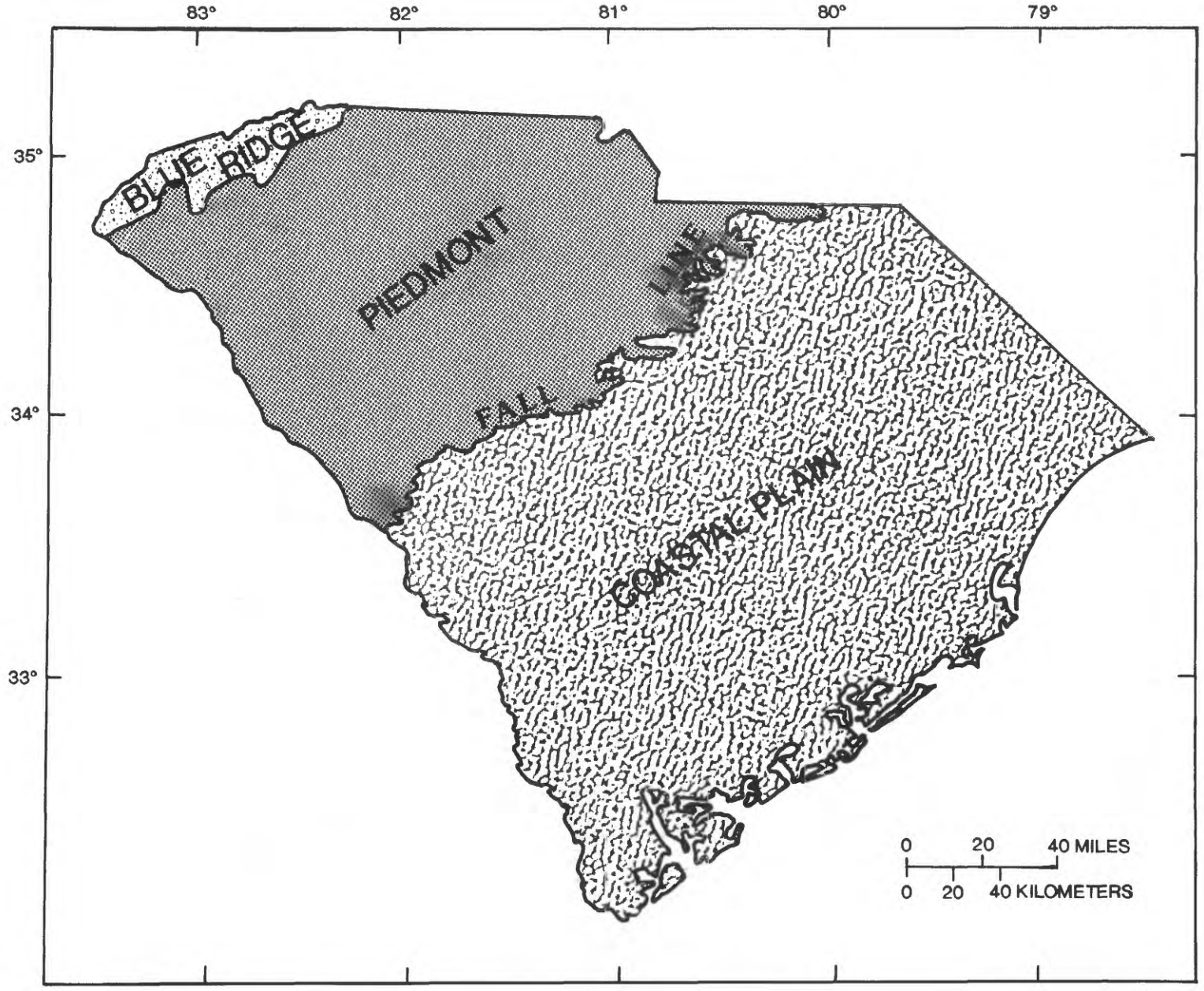

Figure 2.--Physiographic regions.

WITHDRAWAL AND NONWITHDRAWAL USE

The average daily withdrawal of water in South Carolina during 1985 was approximately 6,720 Mgal/d compared with 5,790 Mgal/d in 1980, an increase of 16 percent. Thermoelectric power plants used 77 percent of this total for the production of electricity. An additional withdrawal of 118 Mgal/d was estimated for miscellaneous uses such as domestic, commercial livestock, and mining. Industry withdrew about 17 percent; public supply, 5 percent; and irrigation users, 1 percent (fig. 3). Surface-water sources provided 98 percent of the total withdrawal, and ground water the remainding 2 percent. Fifty-five percent of the total withdrawal of freshwater within the State was made at three facilities; the Oconee and Robinson nuclear thermoelectric power plants, and the Savannah River nuclear weapons facility.

The surface- and ground-water use by county is displayed in figures 4 and 5. The total water use by county is shown in table 1 and in figure 6.

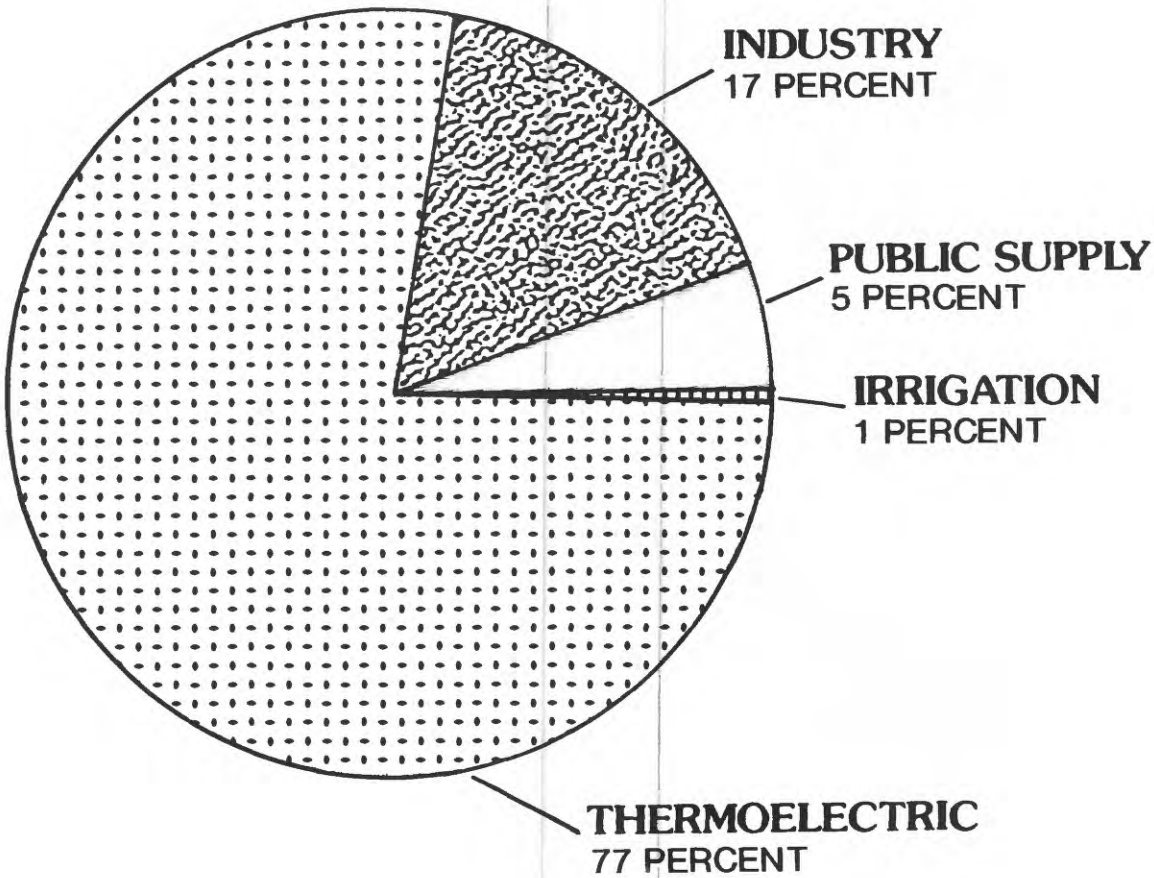

Figure 3.--Withdrawal use by category in 1985.

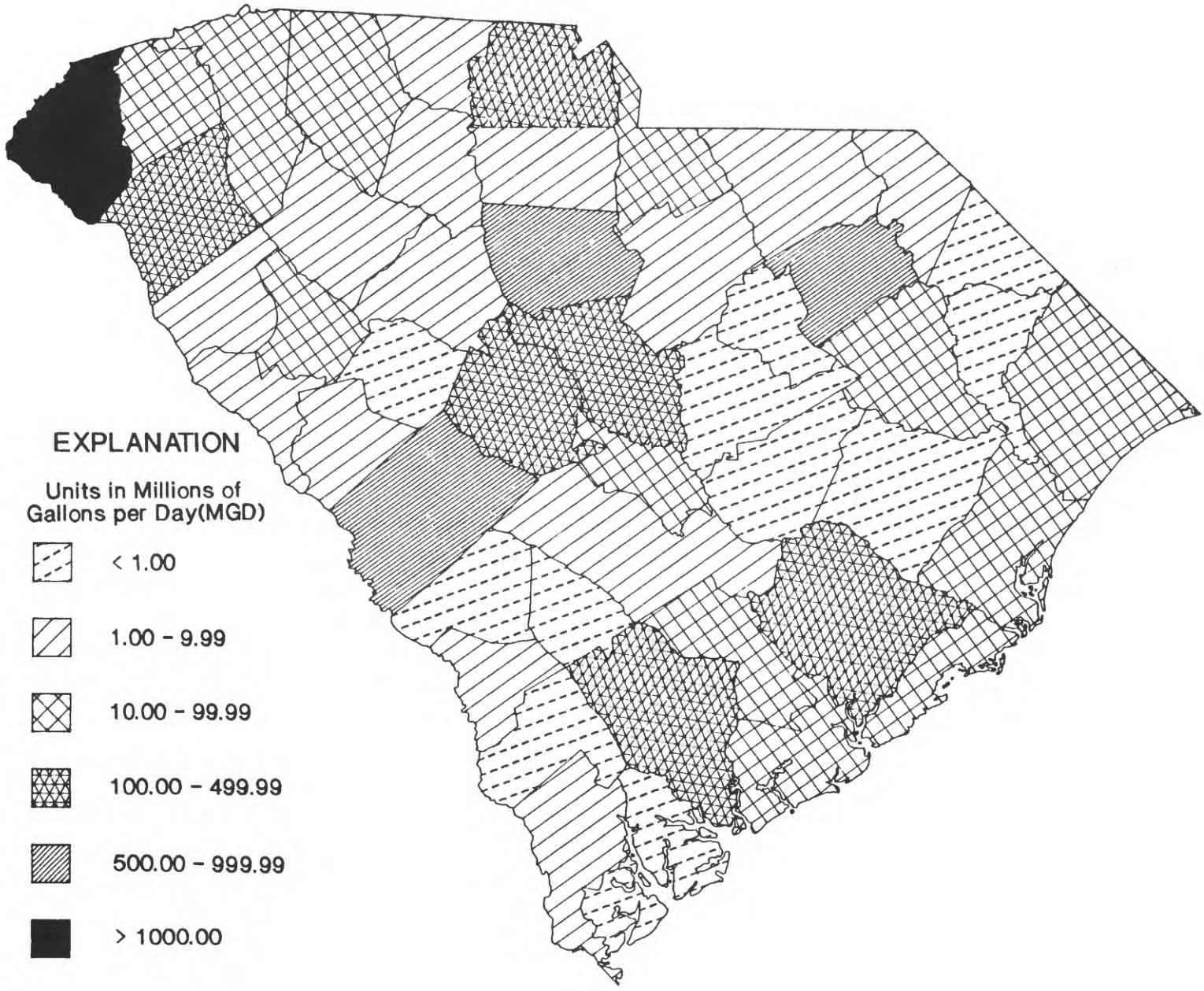

Figure 4.--Surface-water use by county, 1985.

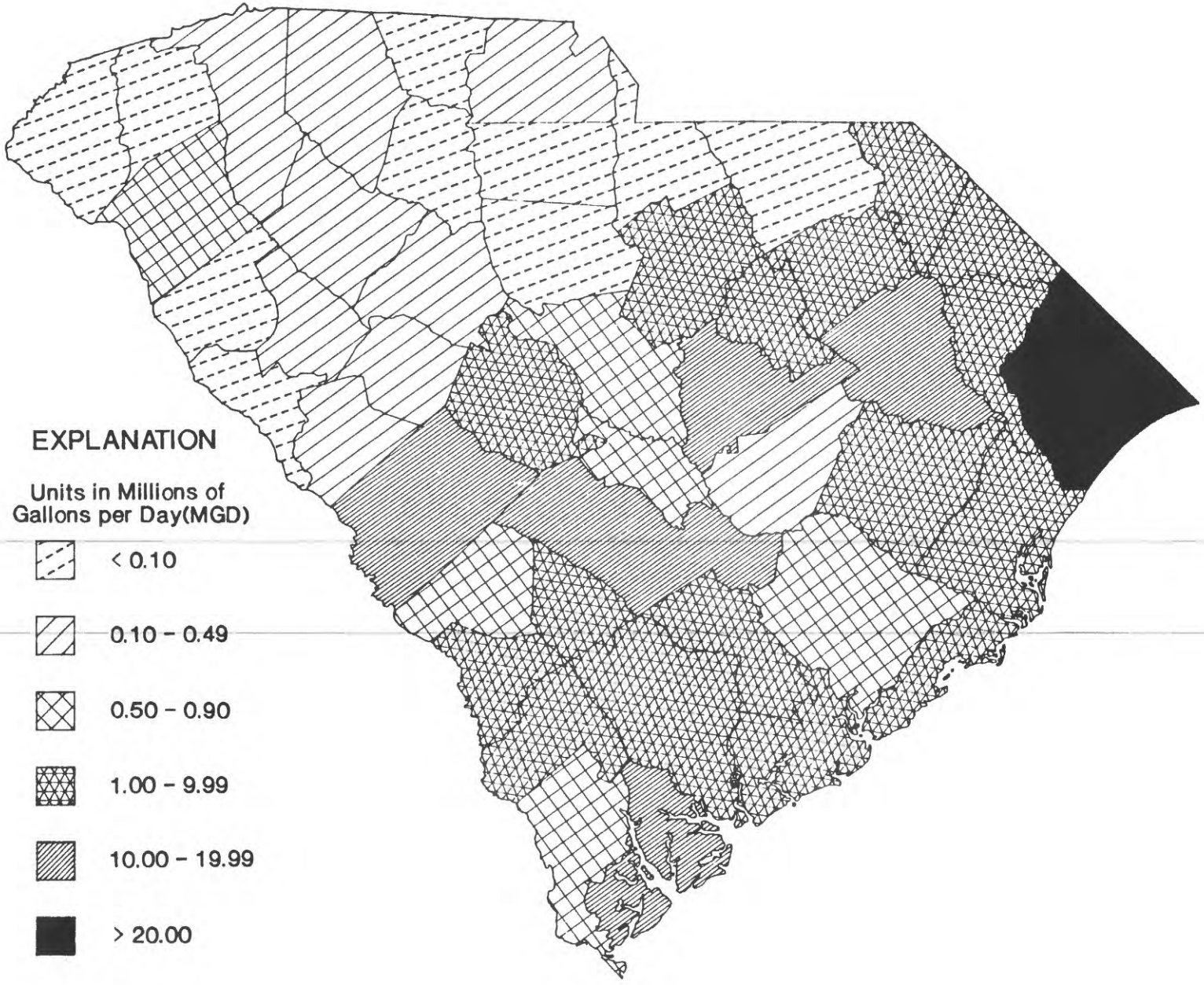

Figure 5.--Ground-water use by county, 1985.

Table 1.--Summary of freshwater withdrawals, by source, for water-use categories inventoried for South Carolina, 1985

[dashes indicate minimal amount; Mgal/d, million gallons per day]

County	Population (in thousands)	Total withdrawals			Public supply		Industry		Irrigation		Thermoelectric	
		Ground water (Mgal/d)	Surface water (Mgal/d)	Total (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)
Abbeville	22.70	--	3.1	3.1	--	2.4	--	.6	--	--	--	--
Aiken	116.00	14.4	911.0	925.0	3.1	5.7	11.3	779.5	--	--	--	125.3
Allendale	10.40	7.5	2.5	10.0	--	--	1.5	--	5.7	2.7	--	--
Anderson	139.60	.5	107.0	108.0	.2	15.2	.3	.6	--	--	--	90.4
Bamberg	18.40	1.3	.3	1.6	--	--	--	--	.4	.4	--	--
Barnwell	20.50	.6	.1	.7	.3	--	.1	--	.3	--	--	--
Beaufort	83.80	15.4	.3	15.7	11.5	5.4	.5	--	1.6	--	--	--
Berkeley	119.50	.8	482.0	483.0	.4	--	.4	7.0	--	--	.4	475.4
Calhoun	11.90	.8	64.4	65.2	.2	--	--	63.5	.6	.9	--	--
Charleston	289.40	3.2	38.6	41.8	1.1	65.0	.1	32.3	.1	--	--	6.4
Cherokee	41.10	--	9.1	9.1	--	6.4	--	2.6	--	.1	--	--
Chester	30.60	--	3.4	3.4	--	3.1	--	.5	--	--	--	--
Chesterfield	38.70	--	4.7	4.7	--	19.3	--	.4	--	--	--	--
Clarendon	28.00	.3	--	.3	.3	--	--	--	--	.1	--	--
Colleton	34.10	3.3	117.0	120.0	3.1	--	--	--	--	--	--	116.5
Darlington	64.40	5.0	758.0	763.0	2.0	--	1.7	3.5	.1	.3	.9	754.4
Dillon	32.30	2.3	--	2.3	.6	--	.7	--	--	--	--	--
Dorchester	72.90	2.7	66.1	68.8	1.9	.7	.6	.4	--	--	--	--
Edgefield	18.00	.1	2.7	2.8	--	1.7	--	--	--	--	--	--
Fairfield	21.00	--	739.0	739.0	--	.8	--	--	--	--	--	737.8
Florence	115.20	10.0	16.8	26.8	3.1	--	2.3	16.7	.1	--	--	--
Georgetown	46.30	4.8	36.7	41.5	4.6	1.5	.1	28.4	--	--	--	6.7
Greenville	302.90	.3	51.1	51.4	--	50.1	.3	.7	--	--	--	--
Greenwood	60.00	.2	11.0	11.2	--	7.5	.1	2.8	.1	--	--	--
Hampton	18.80	2.5	--	2.5	--	--	1.1	--	.7	--	--	--

Table 1.--Summary of freshwater withdrawals, by source, for water-use categories inventoried for South Carolina, 1985--Continued

[dashes indicate minimal amount; Mgal/d, million gallons per day]

County	Population (in thousands)	Total withdrawals			Public supply		Industry		Irrigation		Thermoelectric	
		Ground water (Mgal/d)	Surface water (Mgal/d)	Total (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)	Ground water (Mgal/d)	Surface water (Mgal/d)
Horry	126.70	24.6	94.7	119.0	18.4	--	.1	--	--	--	.2	94.4
Jasper	14.70	.9	5.4	6.3	.6	--	--	--	.3	--	--	--
Kershaw	42.20	3.8	9.5	13.3	1.2	2.8	2.6	6.7	--	--	--	--
Lancaster	55.40	--	15.2	15.2	--	2.1	--	13.1	--	--	--	--
Laurens	53.20	.3	5.0	5.3	--	4.6	.3	.4	--	--	--	--
Lee	18.70	1.3	--	1.3	1.1	--	--	--	.2	--	--	--
Lexington	160.40	1.8	183.0	185.0	.1	6.7	1.6	34.7	.2	.3	--	141.2
McCormick	7.20	--	1.1	1.1	--	1.0	--	--	--	--	--	--
Marion	35.00	1.1	--	1.1	--	--	--	--	.1	--	--	--
Marlboro	32.00	2.7	6.0	8.7	.4	--	--	3.3	.2	.3	--	--
Newberry	32.00	.1	3.6	3.7	--	3.6	--	--	.1	--	--	--
Oconee	51.60	--	2,230.0	2,230.0	--	5.7	--	2.5	--	--	--	2,217.2
Orangeburg	86.20	11.8	8.2	20.0	--	5.5	8.1	.8	3.8	2.0	--	--
Pickens	85.50	--	11.0	11.0	--	8.9	--	2.0	--	--	--	--
Richland	279.10	.7	392.0	393.0	--	34.7	.7	10.1	--	--	--	345.4
Saluda	17.20	.3	.2	.5	.1	--	.2	--	--	.2	--	--
Spartanburg	211.20	.1	32.6	32.7	--	27.3	--	5.0	--	.3	--	--
Sumter	94.60	10.8	.4	11.2	3.6	--	1.1	--	1.2	.5	--	--
Union	30.80	--	6.4	6.4	--	3.5	--	2.9	--	--	--	--
Williamsburg	38.70	2.4	--	2.4	.2	--	2.3	--	--	--	--	--
York	118.40	.2	147.0	147.0	--	7.2	.1	30.7	--	--	--	71.8
Total	3,347.50	139.0	6,580.0	6,720.0	58.1	298.4	38.2	1,051.7	15.8	8.1	1.5	5,182.9

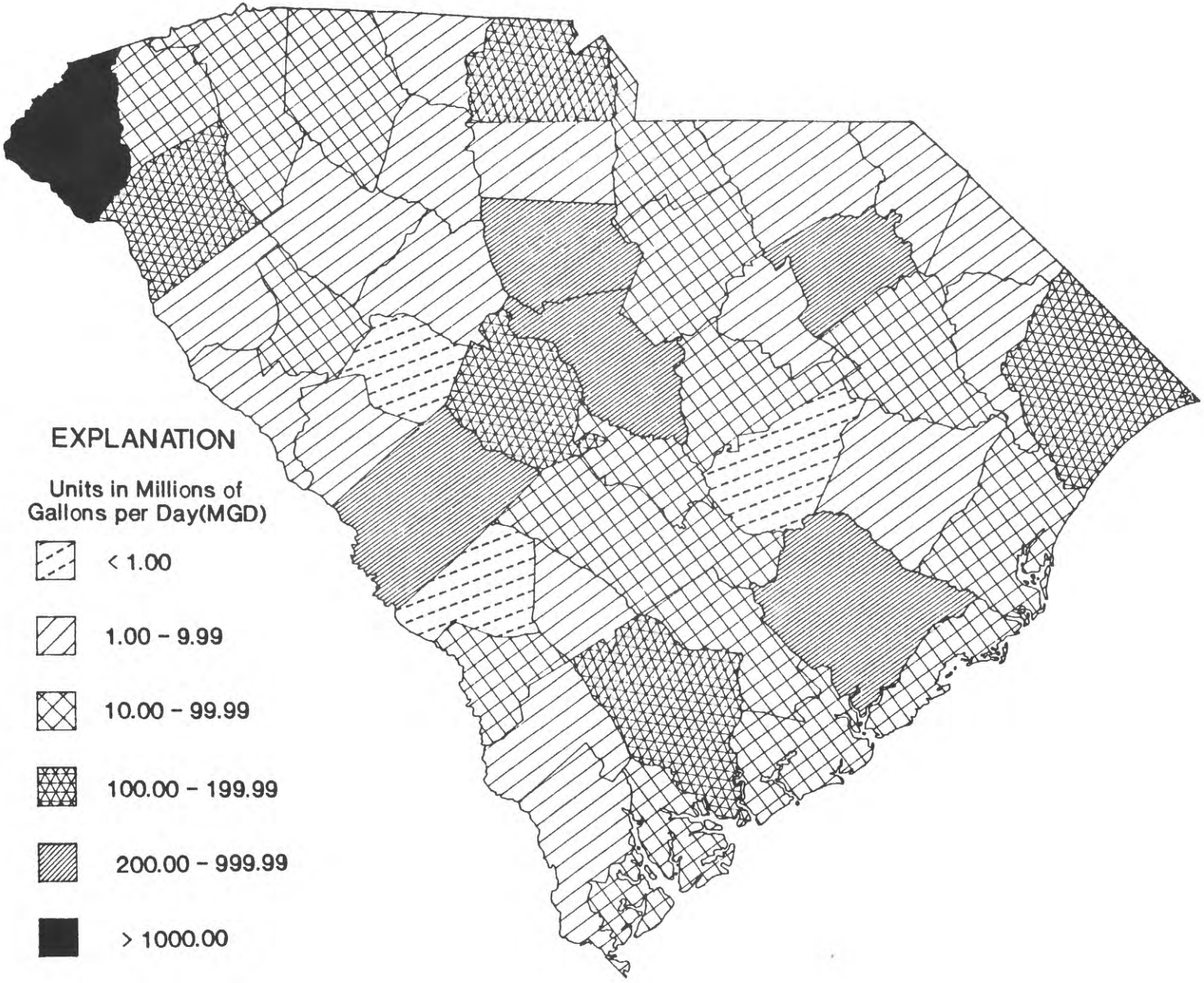

Figure 6.--Total water use by county, 1985.

Public Supply

Public-supply systems provide water to domestic, commercial, industrial, and public water users. In South Carolina these systems served about 75 percent of the State's population or 2.5 million people during 1985. Total water withdrawn for public supply from surface- and ground-water sources during 1985 was estimated at 359 Mgal/d, or 5 percent of the total withdrawals compared with 270 Mgal/d or 6 percent of the 1980 withdrawals. Per capita water use for public supply in South Carolina averages approximately 190 gal per person per day. This represents a 36 percent increase in per capita use since 1980.

Surface-water withdrawals totaled 283 Mgal/d during 1985, representing 79 percent of the public supply withdrawals in the Piedmont region and the more populated areas of the Coastal Plain, compared with 270 Mgal/d representing 77 percent of the withdrawals for 1980. The city of Charleston, which operates the largest public supply facility in the State, withdraws most of its surface-water from neighboring Dorchester County. The total public-supply surface-water use is shown in figure 7. Consumptive water-use totals are not available for public-supply water use.

Public supply withdrawals from ground-water sources during 1985 totaled 76 Mgal/d compared with 78 Mgal/d in 1980. All of the large ground-water withdrawals for public supply occur in the Coastal Plain (fig. 8). Many of the formations of the Coastal Plain are excellent aquifers capable of storing and transmitting large quantities of water. The counties with the largest amounts of ground water withdrawn for public supply in 1985 were Horry (18 Mgal/d), Beaufort (11 Mgal/d), Sumter (9 Mgal/d), and Florence (8 Mgal/d). Ground-water withdrawals for public supply in Horry County probably have decreased since 1988 when the city of Myrtle Beach shifted to a surface-water source. The total public-supply use for 1985 is shown in figure 9.

Industry

Industrial water use in South Carolina is the second largest water-use category in the State. Industrial water use totaled about 1,220 Mgal/d in 1985, which represented a 24-percent increase from the 982 Mgal/d used in 1980. Total industrial water use by county is shown in figure 10. Manufacturing of chemical and allied products dominate industrial water use. Self-supplied industrial systems withdrew 1,090 Mgal/d of surface water and 40 Mgal/d of ground water. In addition, industry purchased 86 Mgal/d from public suppliers. Consumptive water use was 183 Mgal/d in 1985 and 47 Mgal/d for 1980.

Surface-water withdrawals by industry are distributed evenly throughout the State (fig. 11). The Savannah River Plant in Aiken County is the largest user withdrawing approximately 70 percent of the total surface water used by industry in 1985. Ground-water use by industry is greatest in the Coastal Plain, with Orangeburg and Aiken Counties having the largest withdrawals (fig. 12).

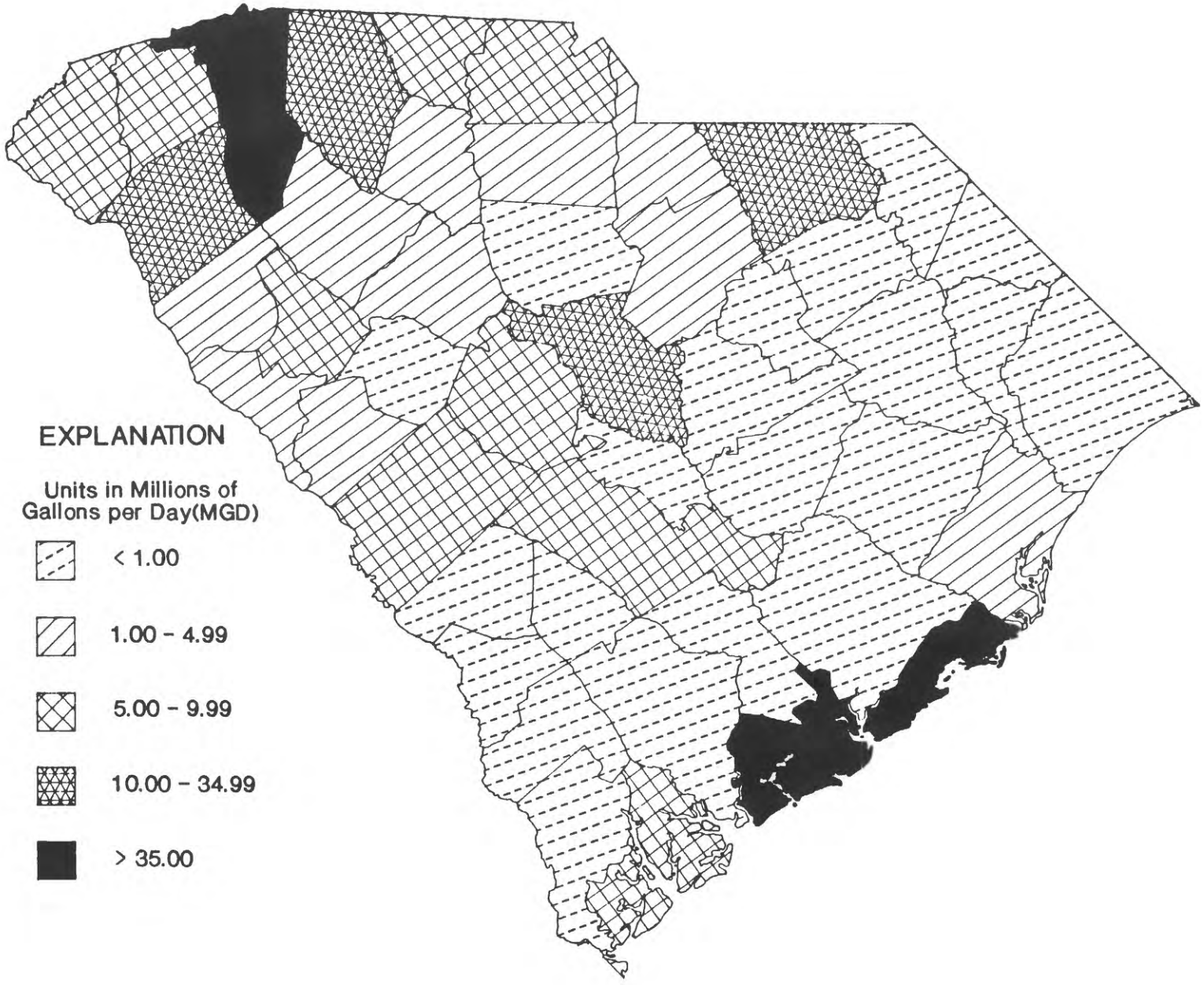

Figure 7.--Total public-supply surface-water use by county, 1985.

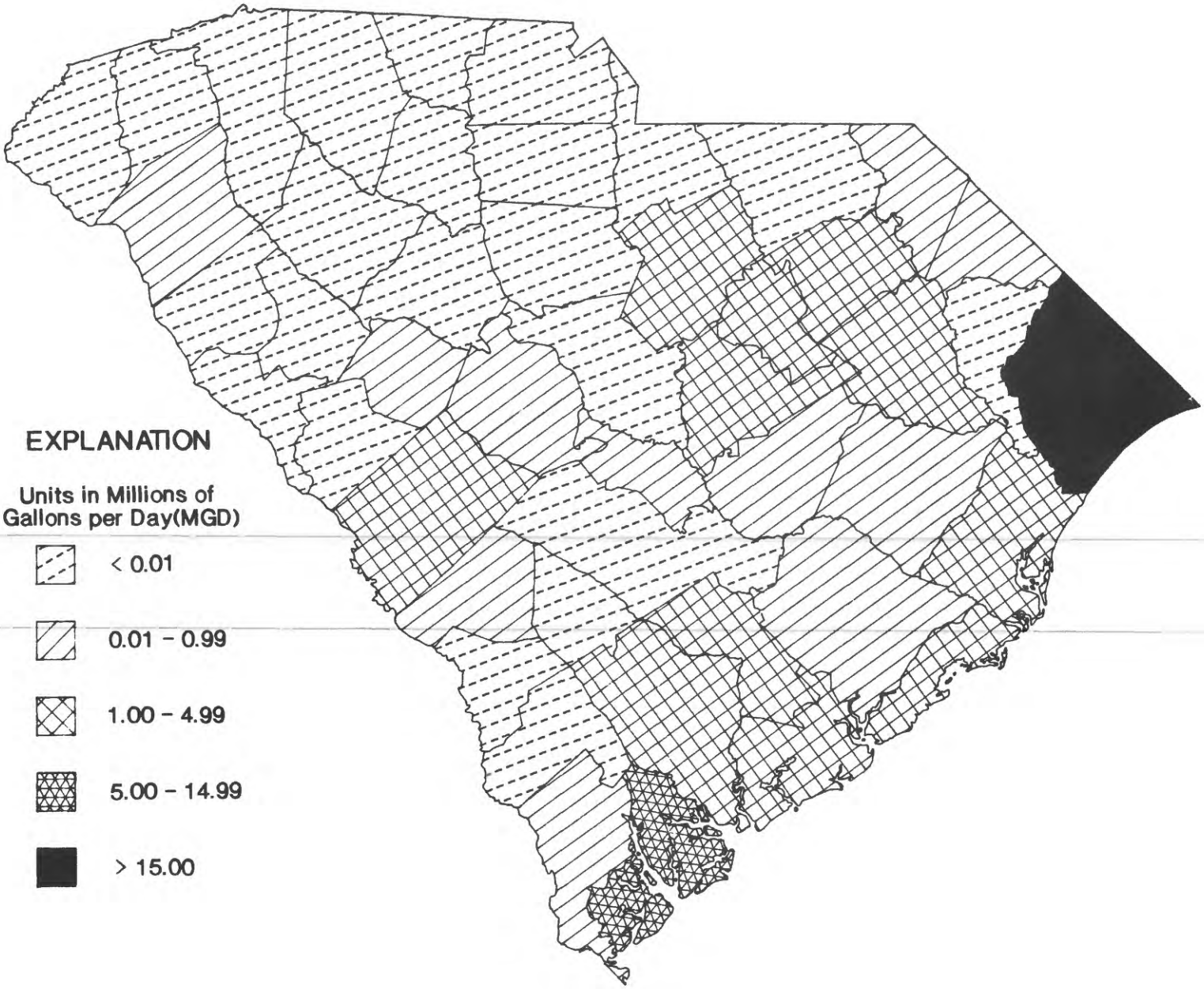

Figure 8.--Total public-supply ground-water use by county, 1985.

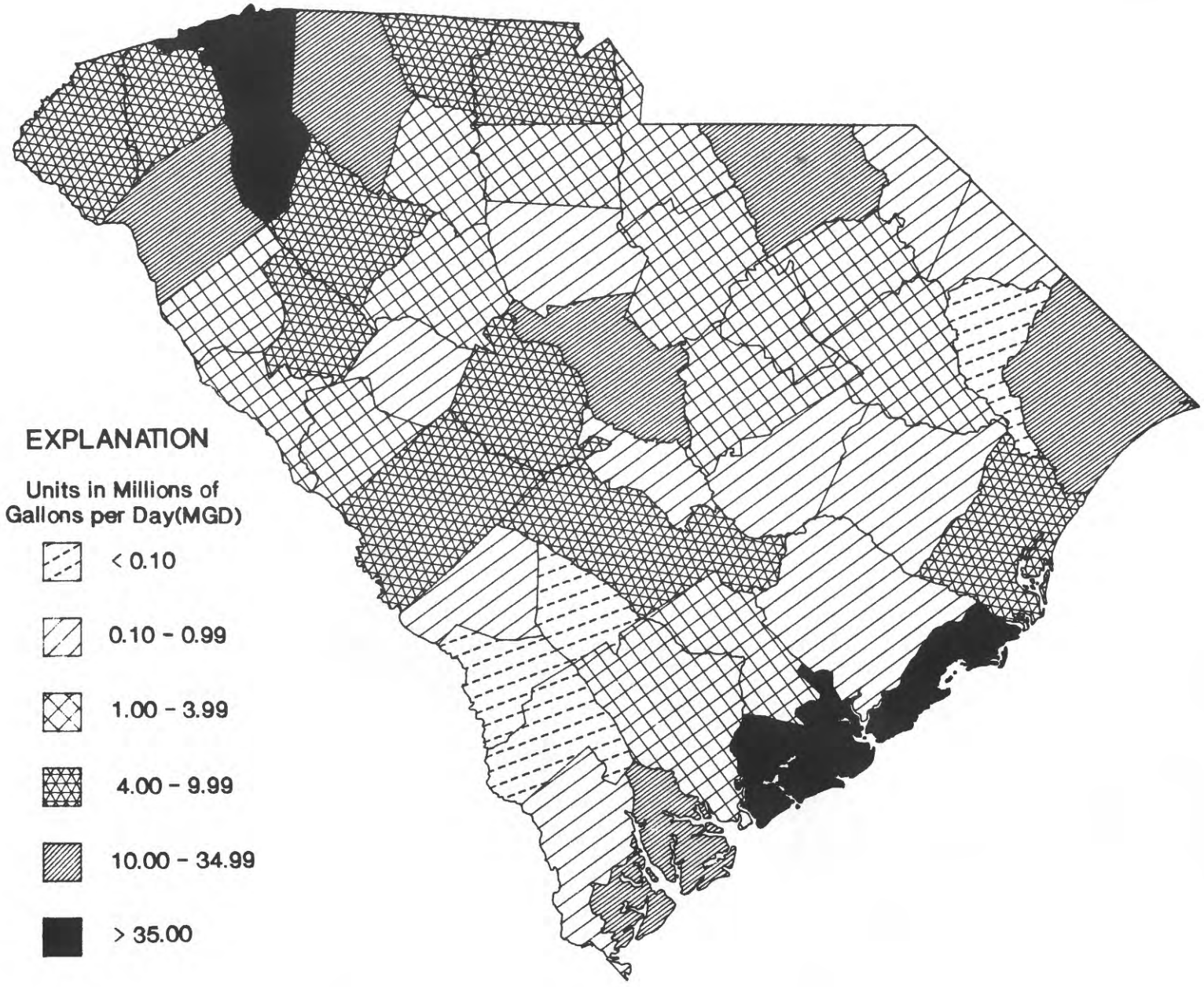

Figure 9.-- Total public-supply water use by county, 1985.

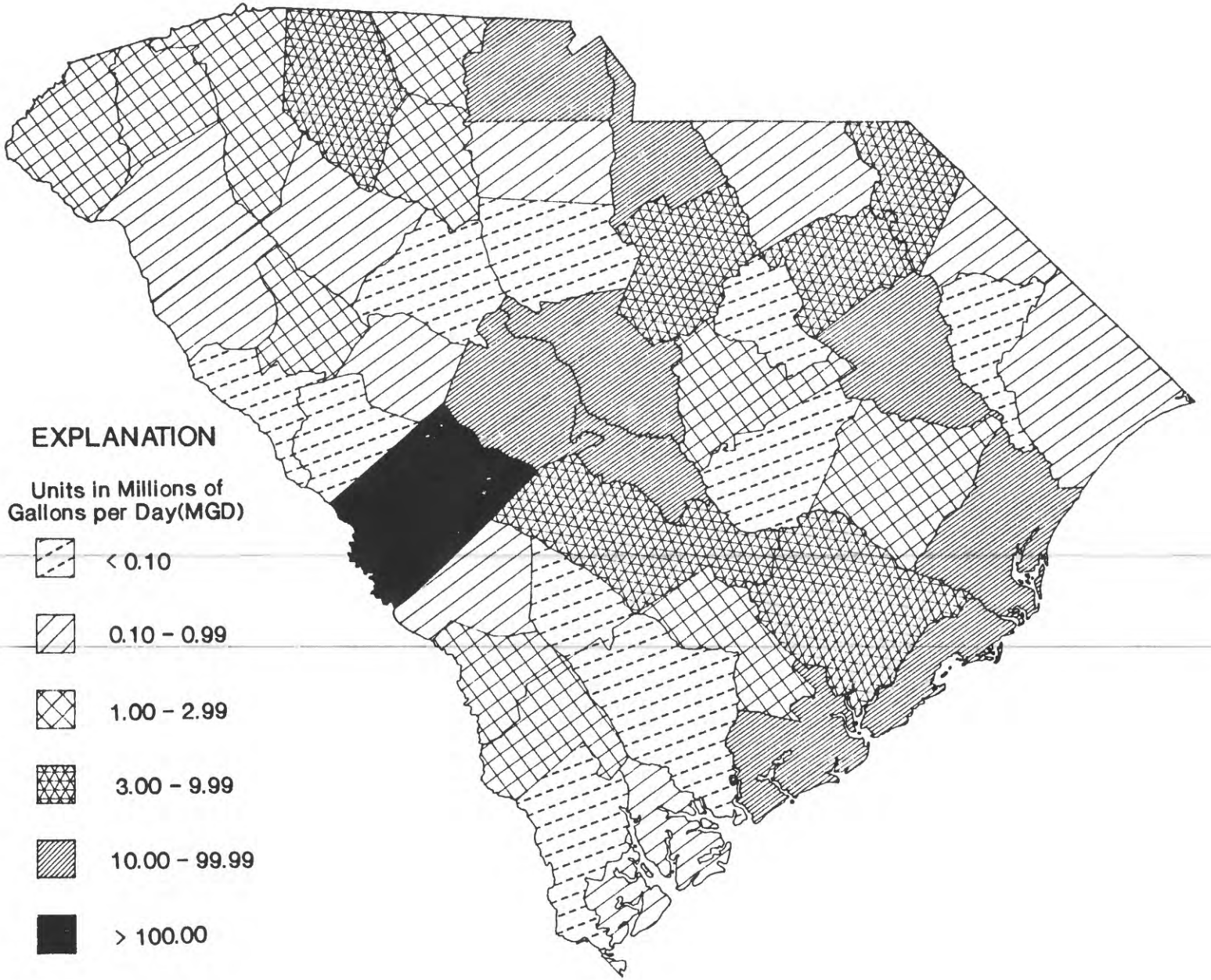

Figure 10.--Total industrial water use by county, 1985.

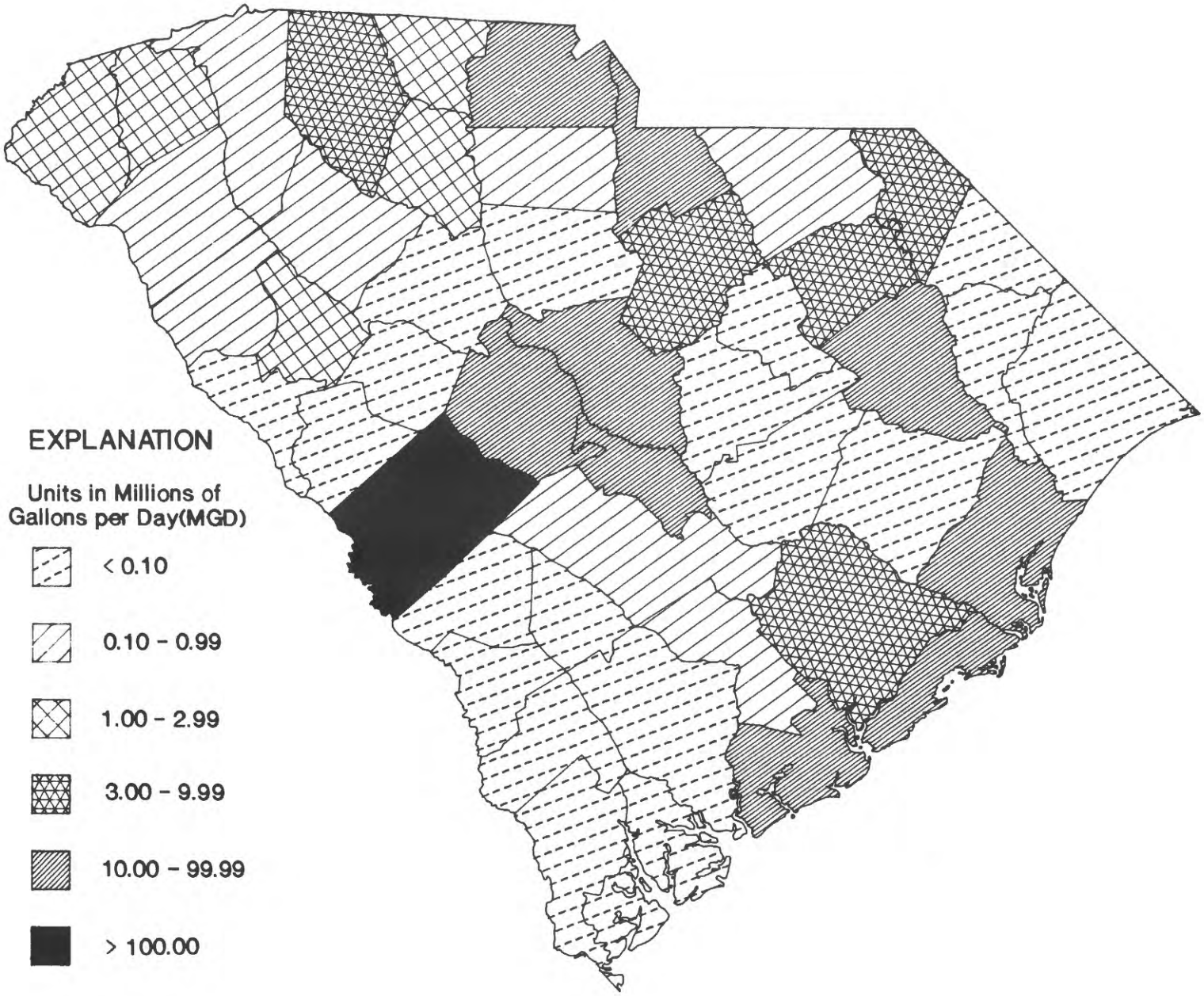

Figure 11.--Total industrial surface-water use by county, 1985.

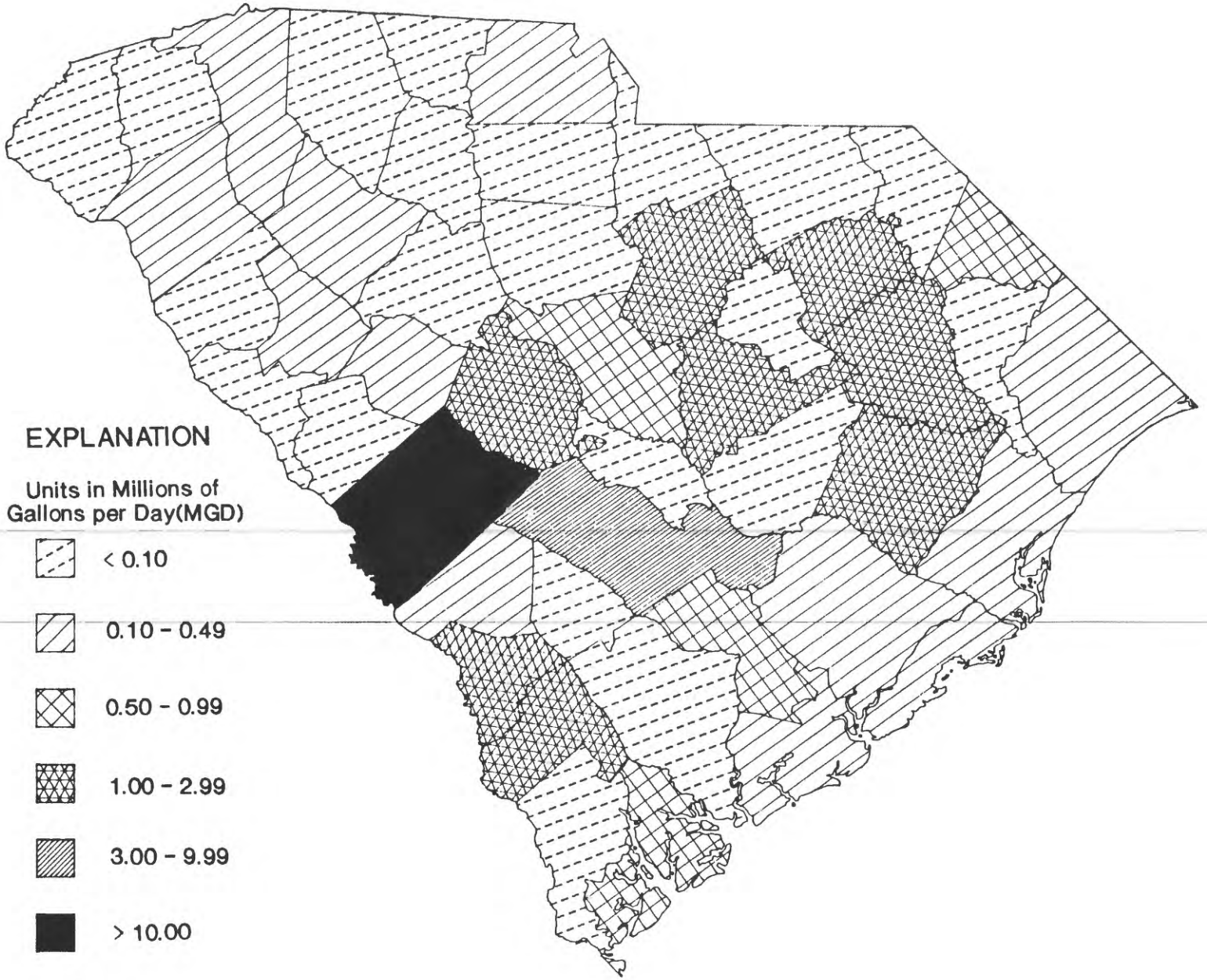

Figure 12.--Total industrial ground-water use by county, 1985.

Irrigation

Irrigation water use includes all water applied to commercial crops on farms, orchards, and nurseries. It also includes water used to irrigate public and private golf courses. Withdrawals for irrigation amounted to 34 Mgal/d or one percent of the total withdrawal during 1985 compared to 54 Mgal/d for 1980.

Agricultural irrigation is seasonal and is most intensive in a band stretching from the southwest to the northeast through the middle of the Coastal Plain region. The band is evident in figure 13, which describes the surface- and ground-water withdrawals for irrigation. The only notable exception to this is the moderate quantities of surface water used to irrigate peaches in the Piedmont region. Ground water was the source of 21 Mgal/d and surface water 13 Mgal/d for all irrigation uses in 1985 as compared with ground-water withdrawals of 17 Mgal/d and surface-water withdrawals of 37 Mgal/d in 1980. The largest withdrawals occured in Allendale (9 Mgal/d) and Orangeburg (6 Mgal/d) Counties. These two counties accounted for 62 percent of the total irrigation withdrawals. Irrigation is considered to be a highly consumptive water use with virtually all of the water applied either being evaporated, retained by the plants or transpired. The total irrigation water use for 1980 and 1985 also are the consumptive totals.

Thermoelectric Power

South Carolina is ranked 12th in the Nation in the withdrawal of water by thermoelectric plants for the production of electricity. Thermoelectric power generation is the largest withdrawal water use in the State, representing 77 percent of all withdrawals. The water is used by 13 fossil-fuel plants and 4 nuclear-power plants. These plants used a total of 5,180 Mgal/d of water for steam and cooling purposes in 1985, which was down slightly from the 5,200 Mgal/d used in 1980. Surface water supplied 99.9 percent of the water during 1985. Consumptive use was 55 Mgal/d in 1985 and 35 Mgal/d in 1980. Total thermoelectric water use by county is shown in figure 14.

Fossil-fuel thermoelectric plants used 1,400 Mgal/d of fresh surface water, 0.2 Mgal/d of ground water, and 6 Mgal/d of saline surface water during 1985, about the same as during 1980. The major user of saline water is the Hagood plant in Charleston County. Water use for fossil-fuel power generation represented 27 percent of the total use for thermoelectric power generation. The distribution of surface-water use by county for thermoelectric fossil-fuel power generation by fossil-fuel facilities in South Carolina is shown in figure 15.

Nuclear powerplants used 3,780 Mgal/d, or 73 percent of the water used for all thermoelectric power generation and 55 percent of the total water used in the State in 1985. This was down slightly from the 3,800 Mgal/d used in 1980. The Oconee Nuclear plant accounted for 43 percent of all thermoelectric power generation water use. The distribution of surface-water use by county for thermoelectric (nuclear) power generation is shown in figure 16.

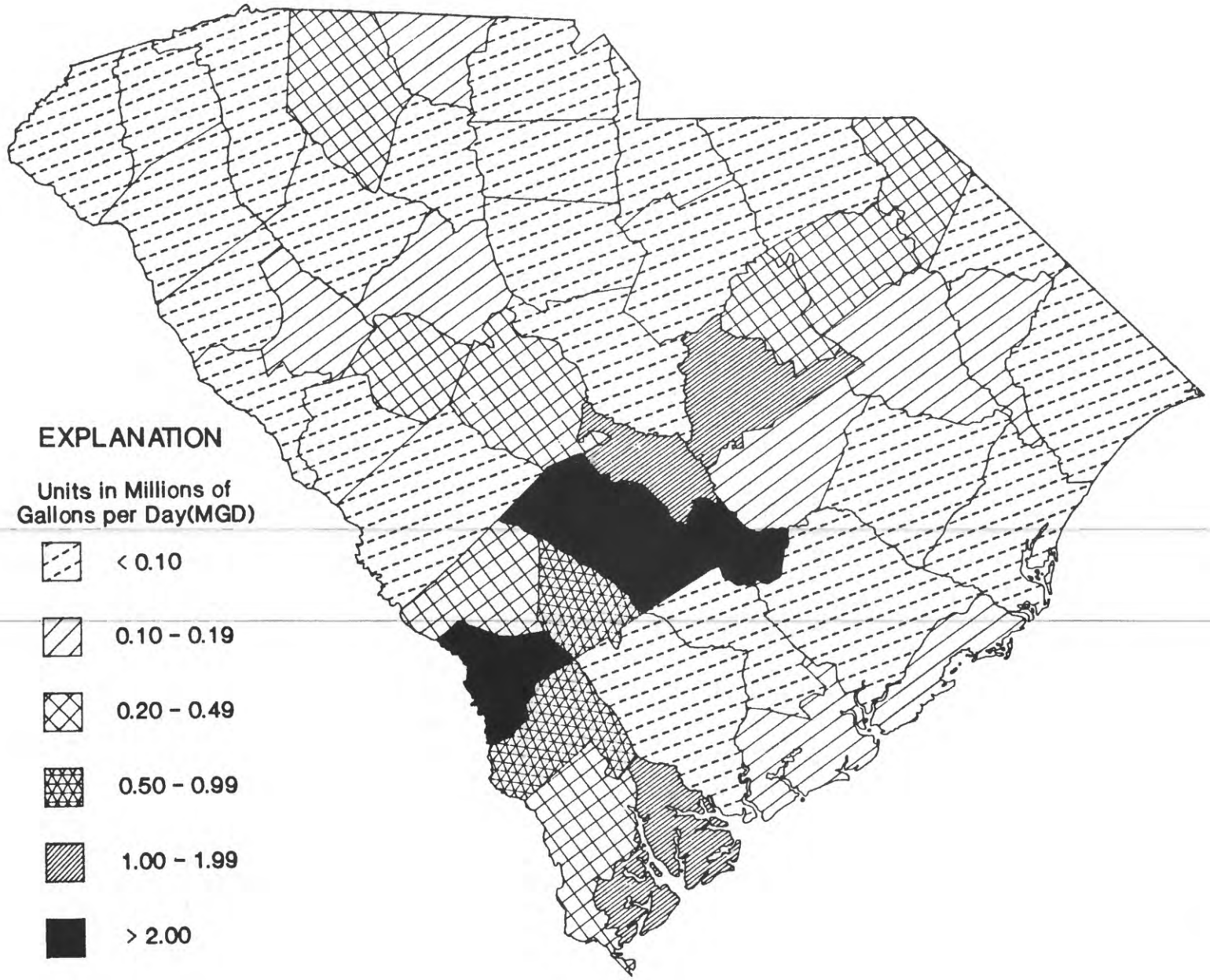

Figure 13.--Total irrigation water use by county, 1985.

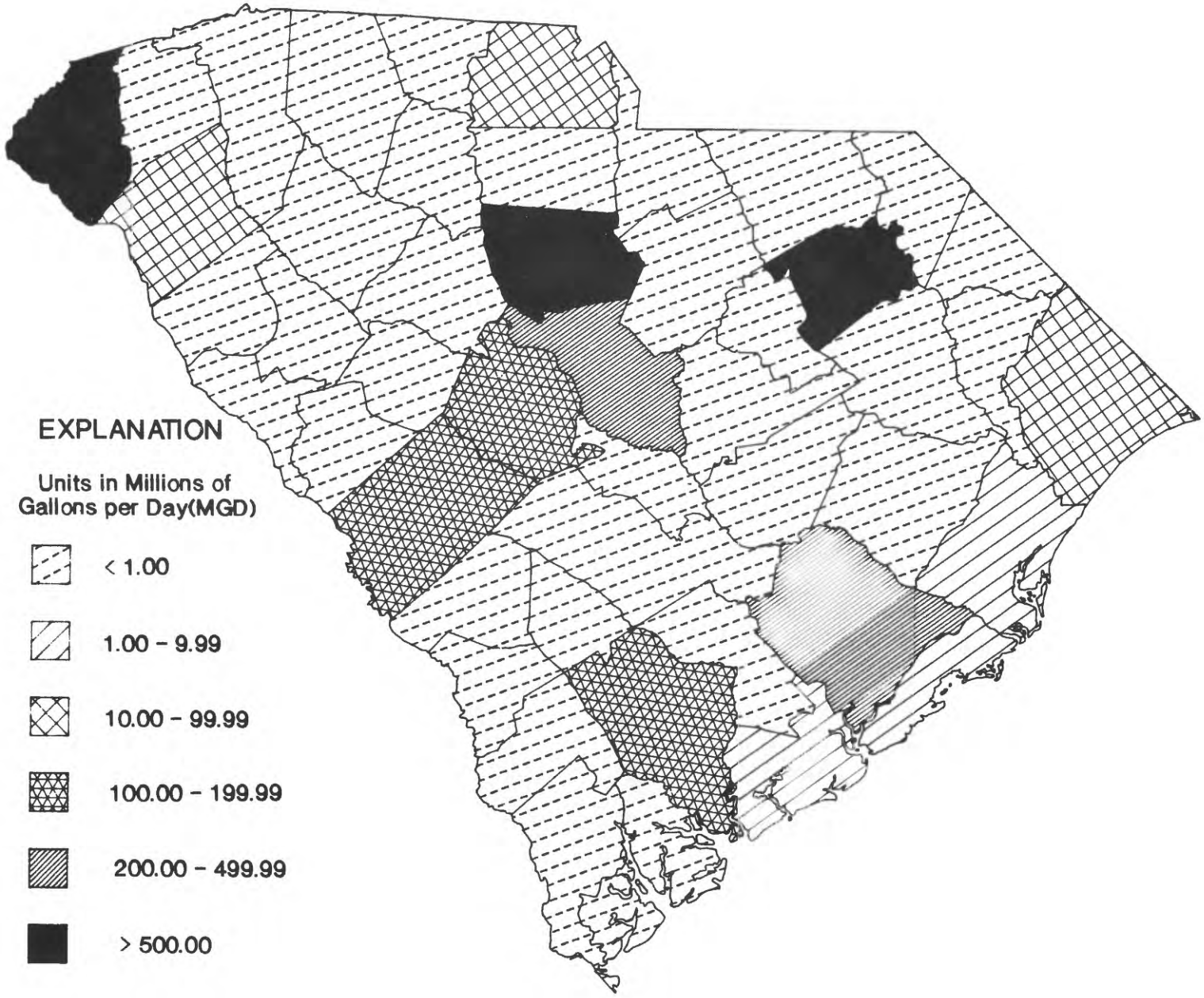

Figure 14.--Total thermoelectric, power generation water use by county, 1985.

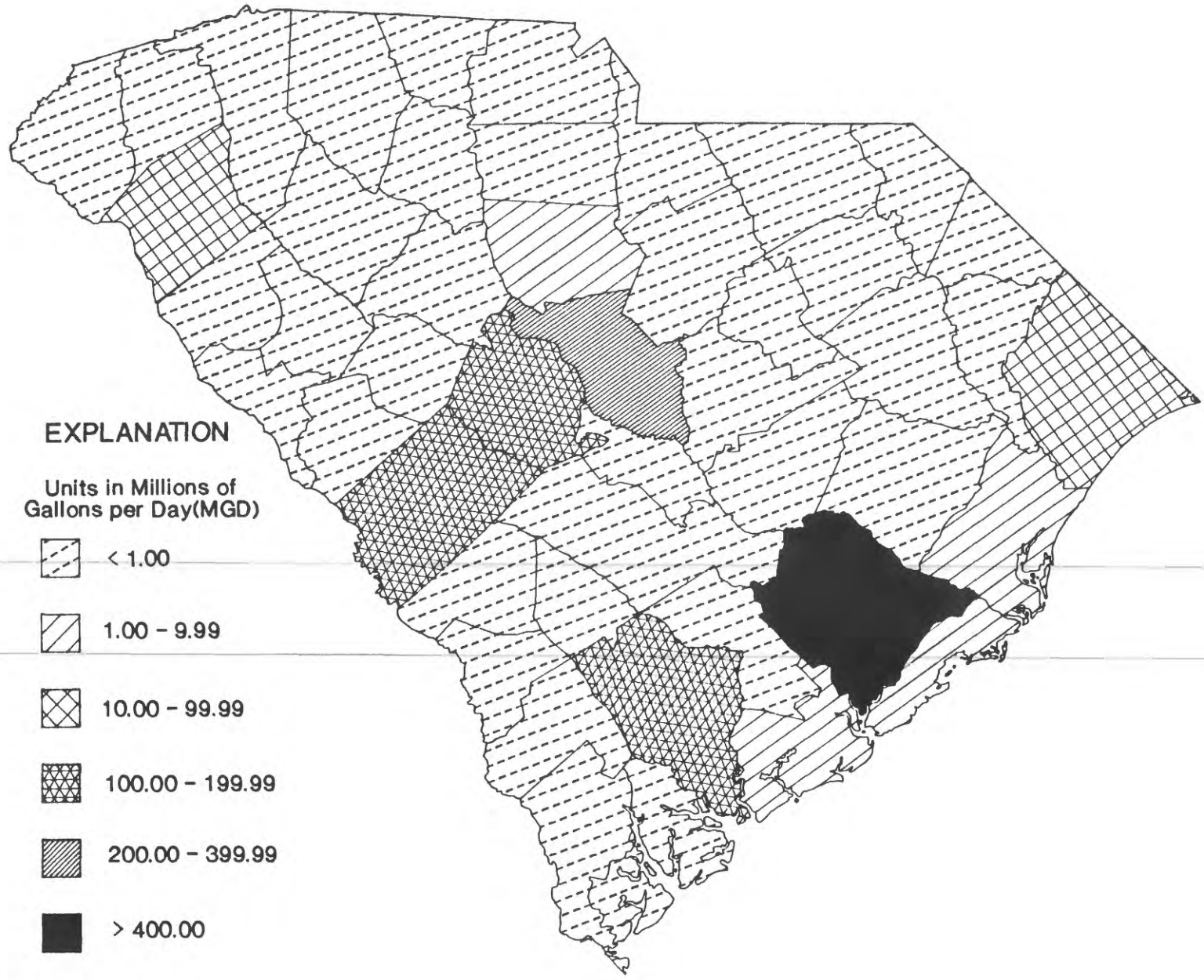

Figure 15.--Total thermoelectric, power generation surface-water use in fossil fuel facilities by county, 1985.

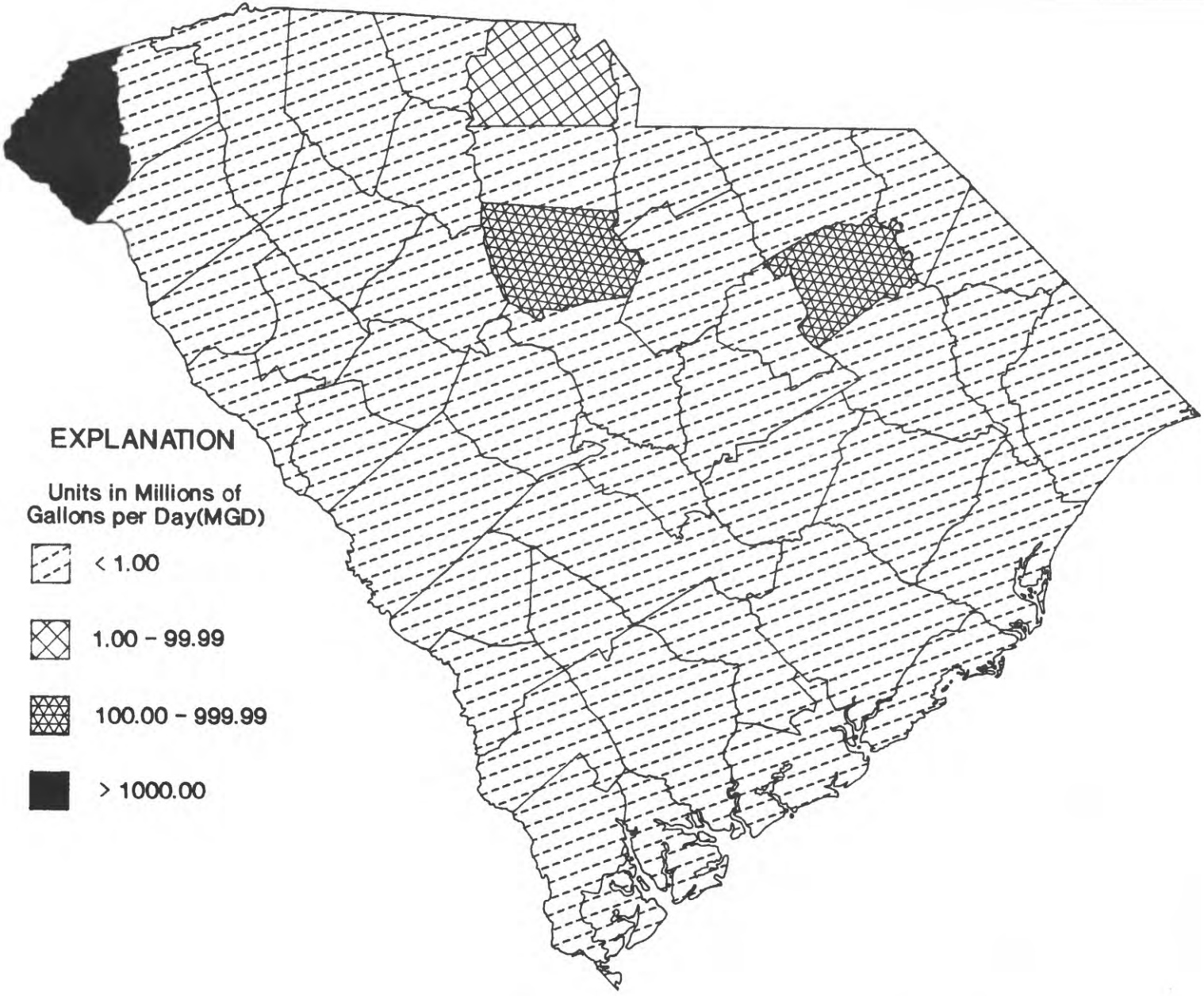

Figure 16.--Total thermoelectric, power generation surface-water use in nuclear-fuel facilities by county, 1985.

Hydroelectric Power

The largest nonwithdrawal water use in South Carolina is for hydroelectric power generation. In 1985 there were 38 hydroelectric power plants that used 42,100 Mgal/d. These power plants used about 41,000 Mgal/d in 1980. Water use by hydroelectric power plants is more than six times the total withdrawal use in the State. However, this use of water is a nonconsumptive use and does not impact water availability downstream of the powerplants. Hydropower is an efficient method of producing electricity and strong efforts to utilize it are being made by the electric power companies. The statewide distribution of this water use for hydroelectric power is shown by county in figure 17.

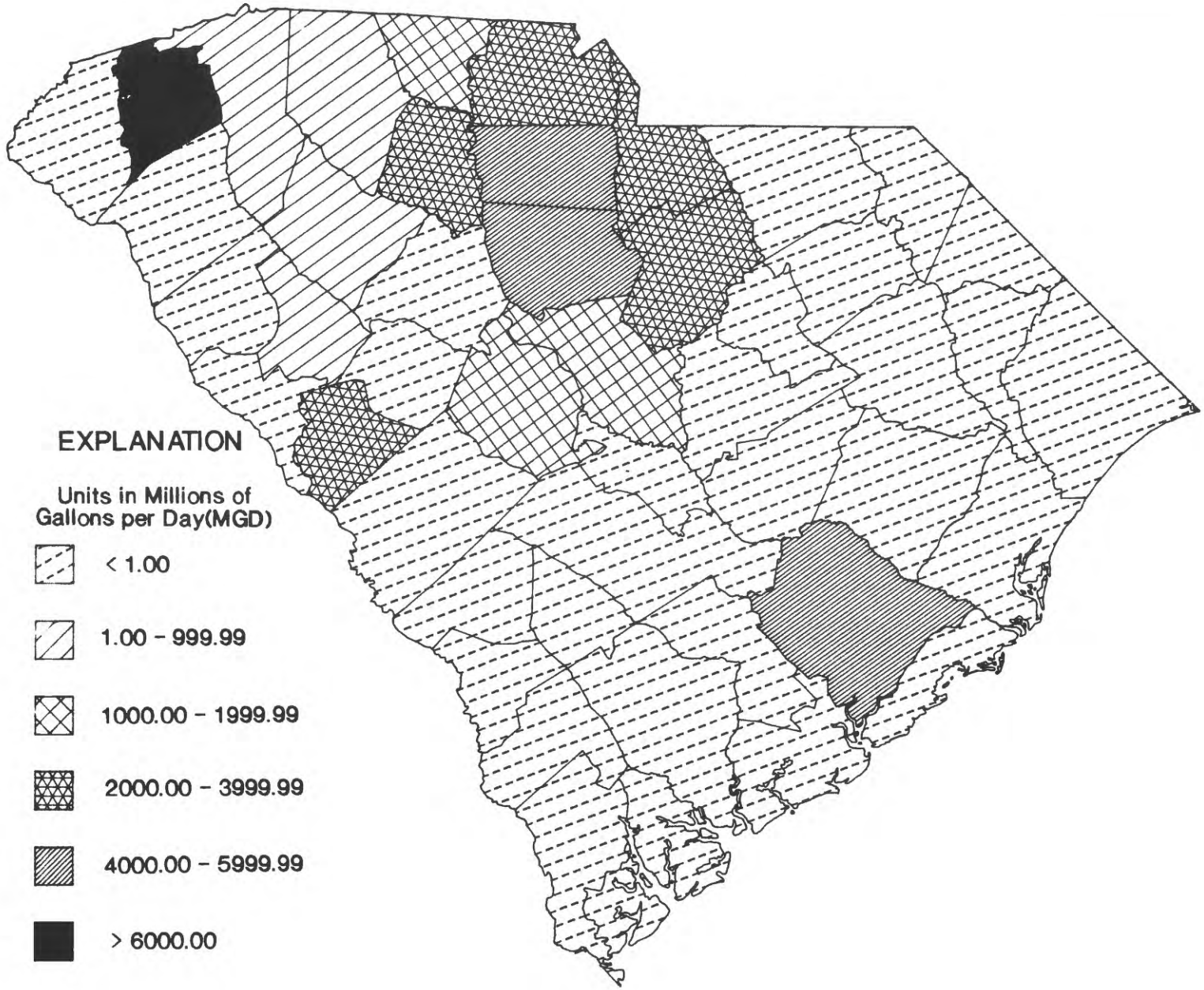

Figure 17.--Total hydroelectric, power generation surface-water use by county, 1985.

SUMMARY

Approximately 6,720 Mgal/d of freshwater were withdrawn in South Carolina during 1985. Surface-water sources provided 98 percent of this volume and ground-water sources the remaining 2 percent. Thermoelectric power generation accounted for 77 percent of the total withdrawal; industry, 17 percent; public supply, 5 percent; and agricultural use, 1 percent. Nonwithdrawal use of water for hydroelectric power generation was six times greater than all withdrawal uses combined.

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