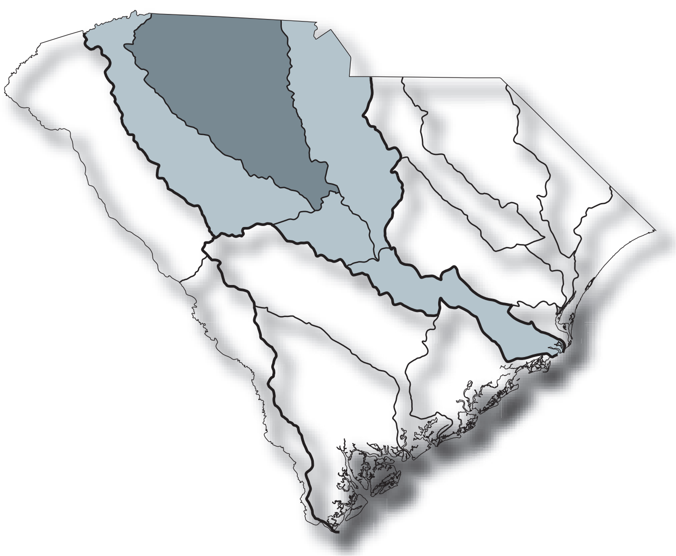
WATERSHED CONDITIONS: SANTEE RIVER BASIN

BROAD RIVER SUBBASIN



BROAD RIVER SUBBASIN

The Broad River subbasin dominates the central Piedmont of South Carolina. Sharing a long northern border with North Carolina, the basin tapers in a southeasterly direction and terminates at its confluence with the Saluda River near Columbia. The subbasin encompasses all or parts of 11 South Carolina counties, including all of Cherokee, Spartanburg, and Union Counties and portions of Chester, Fairfield, Greenville, Laurens, Lexington, Newberry, Richland, and York Counties (Figure 6-1). This is the largest subbasin in the State, representing 12.2 percent of its area and encompassing 3,800 square miles.

DEMOGRAPHICS

This is the most populated subbasin in the State, with an estimated 2000 population of 700,300, or 17.5 percent of the State's total population. The largest population increases are expected to occur in Greenville and Spartanburg Counties, while the slowest growth is expected in Chester County.

The northern part of the subbasin contains the major urban centers, with the cities of Spartanburg and Greenville composing part of the industrialized Interstate-85 corridor. A rural population and agricultural economy predominate in the subbasin south of the Interstate-85 corridor.

The largest population centers are Spartanburg (about 150,000 in the metropolitan area), Gaffney (12,968), and York (6,985) in the north; Laurens (9,916) and Clinton (8,091) in Laurens County near the western boundary; and Union (8,793) in the heart of the subbasin. The northwest corner and south end of the subbasin encompass parts of the Greenville and Columbia metropolitan areas.

Per capita income in the subbasin ranged from $22,651 in Cherokee County to $30,399 in Greenville County in 2005. Per capita income in Greenville, Lexington, Richland, and York Counties ranked third, fourth, fifth, and seventh, respectively, among South Carolina counties. The 1999 median household income ranged from $31,441 in Union County to $44,659 in Lexington County. Median household incomes in five counties were above the State average of $37,082.

During 2000, the counties of the subbasin had combined annual average employment of non-agricultural wage and salary workers of 750,000. Labor distribution in the subbasin counties included management, professional, and technical services, 31 percent; sales and office, 26 percent; production, transportation, and materials moving, 18 percent; service, 13 percent; construction, extraction, and maintenance, 10 percent; and farming, fishing, and forestry, 1 percent.

The sector of manufacturing, mining, and public utilities had an annual product value of $30 billion in 2000. Greenville and Spartanburg Counties accounted for 56 percent of manufacturing output of the subbasin's 11 counties. Manufacturing dominated the economic output of the region, but crop, livestock, and timber-related production were nonetheless substantial. In 2001, crop and livestock value approached $340 million, and delivered-timber value was nearly $190 million (South Carolina Budget and Control Board, 2005).

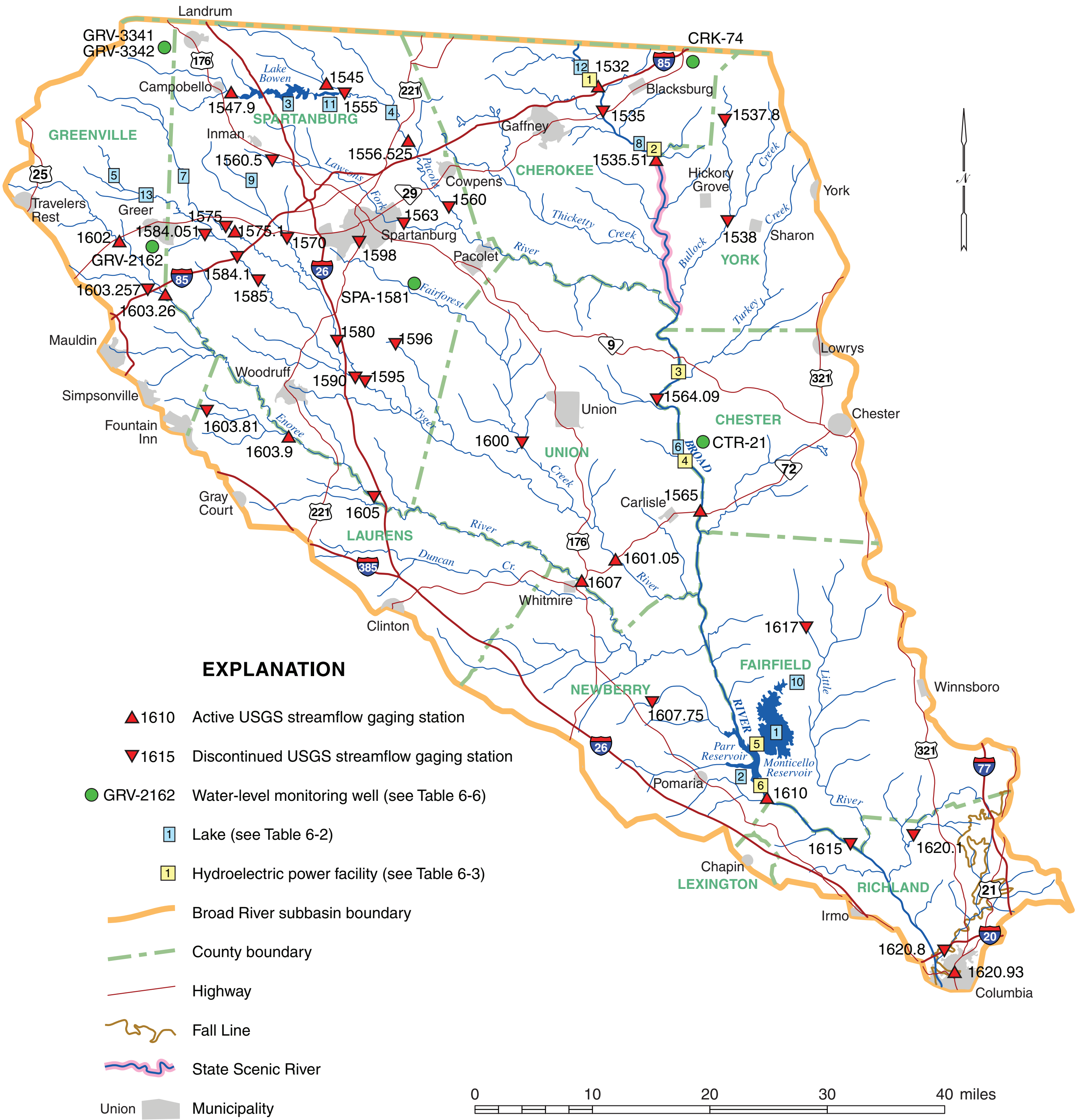


Figure 6-1. Map of the Broad River subbasin.

SURFACE WATER

Hydrology

The Broad River, with its headwaters originating in North Carolina, constitutes the main stem of this large drainage system. Three major tributaries—the Pacolet, Tyger, and Enoree Rivers—originate primarily in South Carolina and discharge into the main stem. Smaller tributaries include Lawsons Fork Creek, Fairforest Creek, Bullock Creek, Turkey Creek, Sandy River, Little River, and Cedar Creek. Several urban areas, including Spartanburg, Columbia, Greer, Gaffney, Union, York, and Winnsboro, utilize these streams. The entire drainage is in the Piedmont physiographic province, except for the extreme headwaters of the Pacolet and Tyger Rivers, which rise in the Blue Ridge, and the southeast edge of the subbasin, which is in the Coastal Plain.

In May of 1991, a 15-mile stretch of the Broad River from Ninety-Nine Islands Dam to the confluence with the Pacolet River was officially designated by the South Carolina General Assembly as a State Scenic River. (See the *River Conservation* section of Chapter 9, *Special Topics*.)

Many U.S. Geological Survey (USGS) streamflow-gaging stations have been established or discontinued in this subbasin since the publication of the *State Water Assessment* in 1983. Streamflow is presently monitored at 14 gaging stations: four on the Broad River, four on the Enoree River, one each on the Pacolet, North Pacolet, South Pacolet, Tyger, and Middle Tyger Rivers and one on Smith Branch in Columbia (Figure 6-1). Streamflow statistics from active and discontinued gaging stations are presented in Table 6-1. Streamflow data for the Broad River near Boiling Springs, N.C., are also presented.

Table 6-1. Selected streamflow characteristics at USGS gaging stations in the Broad River subbasin

Gaging station name, location, station number	Period of record	Drainage area (mi^2)	Average flow (cfs)	Average flow (cfsm)	90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
Broad River near Boiling Springs, N.C. 1515	1925 to 2007*	875	1,473	1.68	552	83 2002	63,900 1928	73,300 1928
Broad River near Blacksburg 1532	1997 to 2007*	1,290	1,738	1.35	504	41 2002	48,000 2004	– – –
Broad River near Gaffney 1535	1938-71 and 1985-90	1,490	2,461	1.65	954	224 1954	80,600 1940	119,000 1940
Broad River below Cherokee Falls 1535.51	1998 to 2007*	1,550	1,983	1.28	518	138 2002	60,000 2004	– – –
Clarks Fork Creek near Smyrna 1537.8	1980 to 2002	24.1	20.7	0.86	3.3	0.0 2002	1,000 1985	2,100 1995
Bullock Creek near Sharon 1538	2000 to 2003	84.3	87.8	1.04	0.0	0.0 2001	2,820 2003	7,160 2003
North Pacolet River at Fingerville 1545	1930 to 2007*	116	203	1.75	79	14 2002	8,110 1964	12,500 1940
South Pacolet River near Campobello 1547.9	1989 to 2007*	55.4	96.6	1.74	33	7.8 2002	3,500 1995	5,170 1995
Pacolet River near Fingerville 1555	1929 to 2006	212	329	1.55	106	26 2002	13,500 1940	22,800 1940
Pacolet River near Cowpens 1556.525	1993 to 2007*	273	345	1.26	78	44 2002	11,800 2003	14,300 2004
Pacolet River near Clinton 1560	1939 to 1971	320	488	1.53	178	17 1941	18,200 1940	26,800 1940

Table 6-1. Continued

Gaging station name, location, station number	Period of record	Drainage area (mi²)	Average flow		90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
			(cfs)	(cfsm)				
Lawsons Fork Creek near Inman 1560.5	1979 to 2006	6.46	9.3	1.44	3.3	0.37 2002	420 2003	564 2003
Lawsons Fork Creek at Spartanburg 1563	1966 to 1970	74.7	107	1.43	49	28 1970	2,010 1969	7,650 1969
Broad River near Lockhart 1564.09	1992 to 1999	2,720	3,852	1.42	1,410	200 1999	57,600 1995	59,300 1995
Broad River near Carlisle 1565	1938 to 2007*	2,790	3,885	1.39	1,270	44 1956	114,000 1976	123,000 1976
North Tyger River near Fairmont 1570	1950 to 1988	44.4	63.9	1.44	22	4.6 1988	2,130 1959	3,610 1959
Middle Tyger River at Lyman 1575	1937 to 1967	68.3	103	1.51	36	5.0 1955	3,110 1940	4,800 1940
Middle Tyger River near Lyman 1575.1	2000 to 2007*	69.0	82.9	1.20	14	0.66 2002	2,880 2005	– – –
North Tyger River near Moore 1580	1933 to 1967	162	233	1.44	76	16 1954	9,340 1940	12,300 1940
Maple Creek near Duncan 1584.051	1993 to 1994	10.2	13.3	1.31	7.1	5.5 1993	235 1994	– – –
South Tyger River below Lyman 1584.1	1993 to 1995	96.3	160	1.66	59	15 1993	1,020 1994	1,120 1994
South Tyger River near Reidville 1585	1934 to 1937	106	160	1.51	20	5.5 1941	3,850 1949	6,420 1949
South Tyger River near Woodruff 1590	1933 to 1971	174	236	1.36	69	12 1955	7,480 1936	9,510 1936
Tyger River near Woodruff 1595	1929 to 1956	351	465	1.32	146	29 1954	18,000 1929	28,000 1929
Dutchman Creek near Pauline 1596	1966 to 1969	8.9	11.7	1.31	6.0	3.8 1966	242 1968	4,500 1968
Fairforest Creek at Spartanburg 1598	1966 to 1970	17.0	29.9	1.76	11	0.0 1966	567 1967	– – –
Fairforest Creek near Union 1600	1940 to 1971	183	212	1.16	51	5.0 1954	6,740 1964	7,720 1964
Tyger River near Delta 1601.05	1973 to 2007*	759	986	1.30	272	28 2002	26,000 1979	37,500 1976

Table 6-1. Continued

Gaging station name, location, station number	Period of record	Drainage area (mi²)	Average flow (cfs)	Average flow (cfsm)	90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
Enoree River at Taylors 1602	1998 to 2007*	49.7	71.4	1.47	18	2.3 2002	2,000 2003	5,600 2003
Brushy Creek near Pelham 1603.257	1995 to 1997	13.8	26.4	1.91	10	3.9 1997	414 1996	1,150 1996
Enoree River at Pelham 1603.26	1993 to 2007*	84.2	153	1.82	50	16 1999	8,500 1995	11,300 1995
Durbin Creek above Fountain Inn 1603.81	1994 to 2006	14.0	15.9	1.14	4.4	0.15 2002	800 1995	– – –
Enoree River near Woodruff 1603.9	1993 to 2007*	249	362	1.46	116	34 2002	20,000 1995	52,200 1995
Enoree River near Enoree 1605	1929 to 1977	307	432	1.41	136	20 1954	18,300 1929	30,000 1929
Enoree River at Whitmire 1607	1973 to 2007*	444	543	1.22	161	30 2002	22,700 1995	31,200 1995
Hellers Creek near Pomaria 1607.75	1980 to 1994	8.16	7.1	0.87	1.4	0.42 1988	360 1992	888 1992
Broad River at Alston 1610	1896-1907 and 1980-2007*	4,790	5,524	1.15	1,330	48 2002	130,000 1903	140,000 1903
Broad River at Richtex 1615	1925 to 1983	4,850	6,158	1.27	1,890	149 1935, 1937	211,000 1929	228,000 1929
West Fork Little River near Salems Crossroad 1617	1980 to 1997	25.5	25.8	1.01	1.4	0.0 1982	1,810 1991	5,470 1991
Cedar Creek near Blythewood 1620.1	1966 to 1996	48.9	43.3	0.89	3.3	0.07 1986	2,910 1994	4,870 1968
Crane Creek at Columbia 1620.8	1968 to 1974	66.5	64.3	0.97	5.0	0.1 1970	1,500 1968	– – –
Smith Branch at N. Main St. at Columbia 1620.93	1976 to 2007*	5.67	9.1	1.61	1.7	0.74 2001	335 1995	2,180 2004

mi², square miles; cfs, cubic feet per second; cfsm, cubic feet per second per square mile of drainage area
90% exceeds flow: the discharge that has been exceeded 90 percent of the time during the period of record for that gaging station
** 2007 is the most recent year for which published data were available when this table was prepared*

Average annual flow of the Broad River ranges from about 1,500 cfs (cubic feet per second) near the North Carolina border to more than 6,000 cfs at the confluence with the Saluda River at Columbia. This main-stem river reflects streamflow characteristics typical of Piedmont streams that depend primarily on precipitation and surface runoff to support flow (Figure 6-2). In the upper portion of this river, near Gaffney, where annual rainfall is higher and ground-water discharges are more significant, flows are well sustained and moderately variable. With distance downstream, flow becomes progressively more variable as rainfall and ground-water support in this lower portion of the subbasin decrease.

Low flows of record for the Broad River occurred during the mid-1950's and in 2002, with average daily flows less than 50 cfs measured at the Blacksburg (1532), Carlisle (1565), and Alston (1610) gaging stations. The highest recorded flow—228,000 cfs—was measured at the Richtex (1615) gage north of Columbia in 1929.

The Broad River typically receives from several hundred to about 1,000 cfs from each of its three main tributaries, the Pacolet, Tyger, and Enoree Rivers. At their most-downstream gages, these rivers have average annual streamflows of 488 cfs on the Pacolet River near Clinton (discontinued gage 1560), 986 cfs on the Tyger River near Delta (1601.05), and 543 cfs on the Enoree River at Whitmire (1607). Ninety percent of the time, flows at these sites equal or exceed 178 cfs, 272 cfs, and 161 cfs, respectively, while the highest flow recorded at each of these sites exceeded 20,000 cfs (Table 6-1).

Streamflow characteristics in the tributary streams are similar to those of the main stem (Figure 6-2). Flow is least variable in streams that drain the upper portion of the subbasin where rainfall and ground-water support are greatest. Flow in streams that drain the lower portion of the subbasin near Columbia shows the greatest variability.

The lowest flows of record for tributary streams occurred primarily during the droughts of 1954–56 and 1998–2002, especially in 2002. Flood flows of record are attributed primarily to major storm events occurring in 1929, 1940, and 1976. Storm events producing peak flows appear to impact limited areas of the subbasin.

Several small water-supply and hydropower reservoirs on the Broad, Pacolet, and Enoree Rivers generally have little effect on streamflow except during low-flow conditions. These developments were built prior to streamflow monitoring.

The Broad River provides reliable quantities of surface water along its entire length, although low flows are best sustained in the upper reaches. Reliable sources of surface-water supplies also exist in tributary streams in the upper portion of the subbasin, such as the Pacolet, Tyger, and Enoree Rivers. Streams that originate in the lower portion of the subbasin near Columbia, such as Little River and Cedar Creek, require storage to provide reliable year-round water supplies.

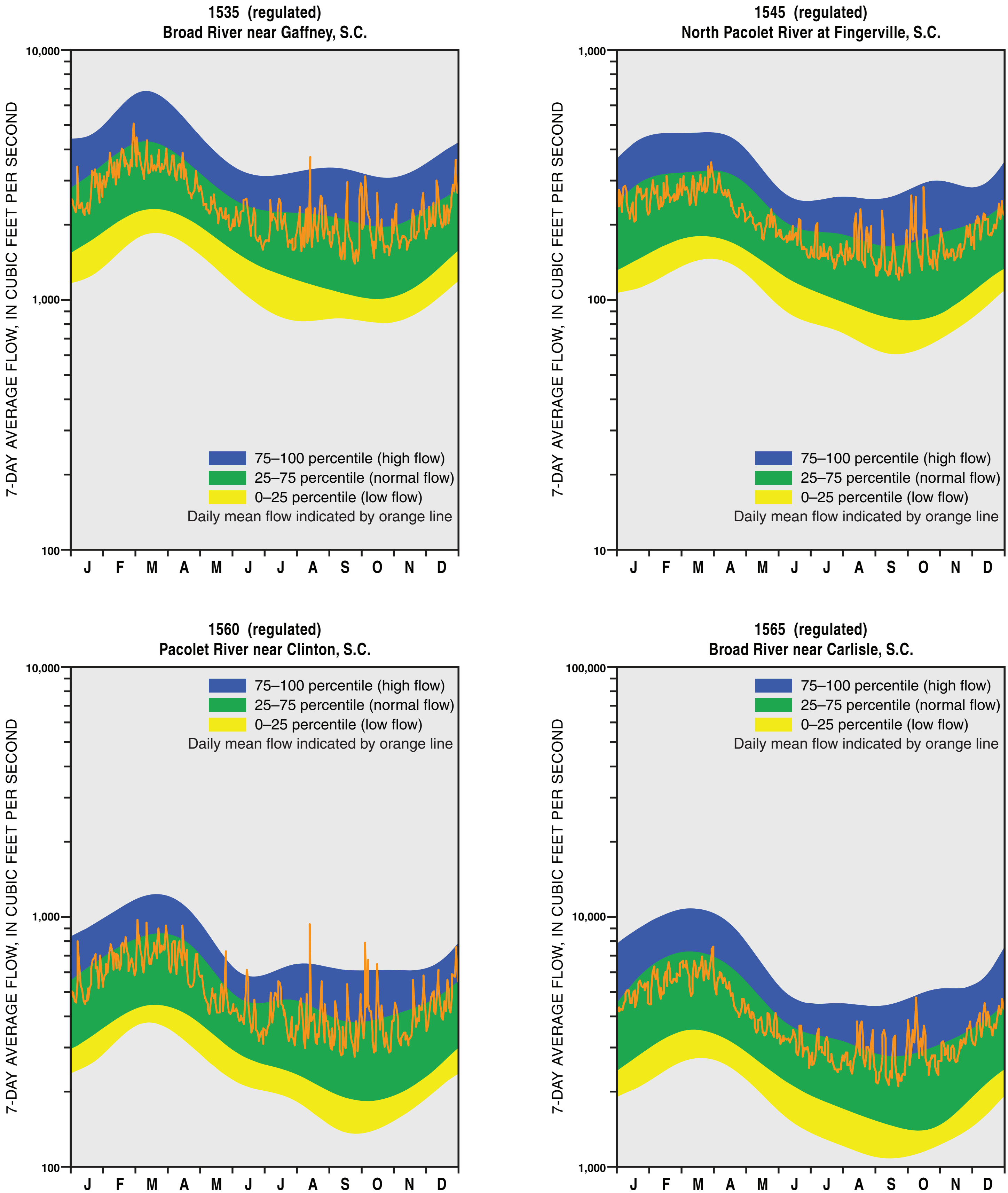


Figure 6-2. Duration hydrographs for selected gaging stations in the Broad River subbasin.

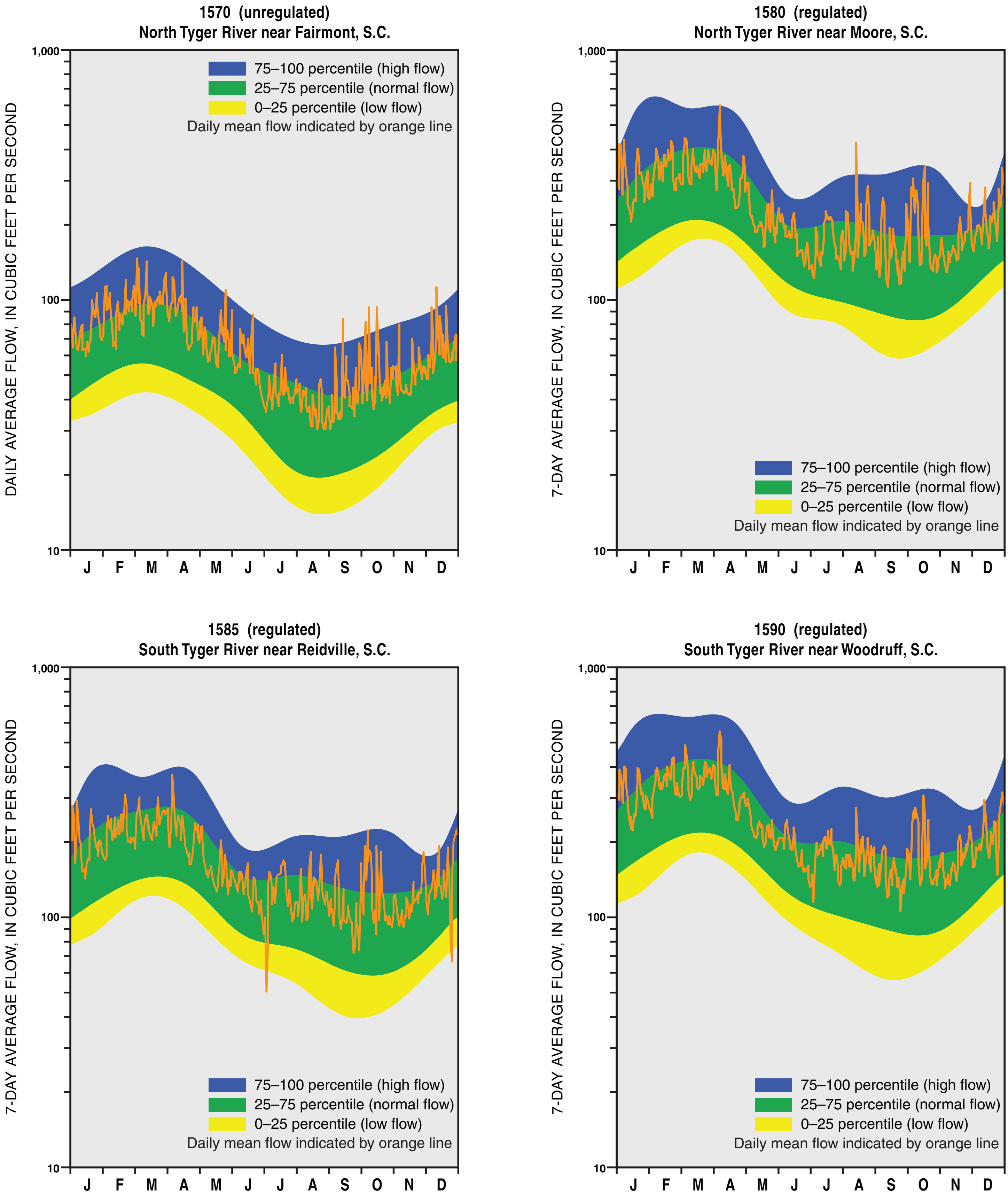


Figure 6-2. Duration hydrographs for selected gaging stations in the Broad River subbasin (continued).

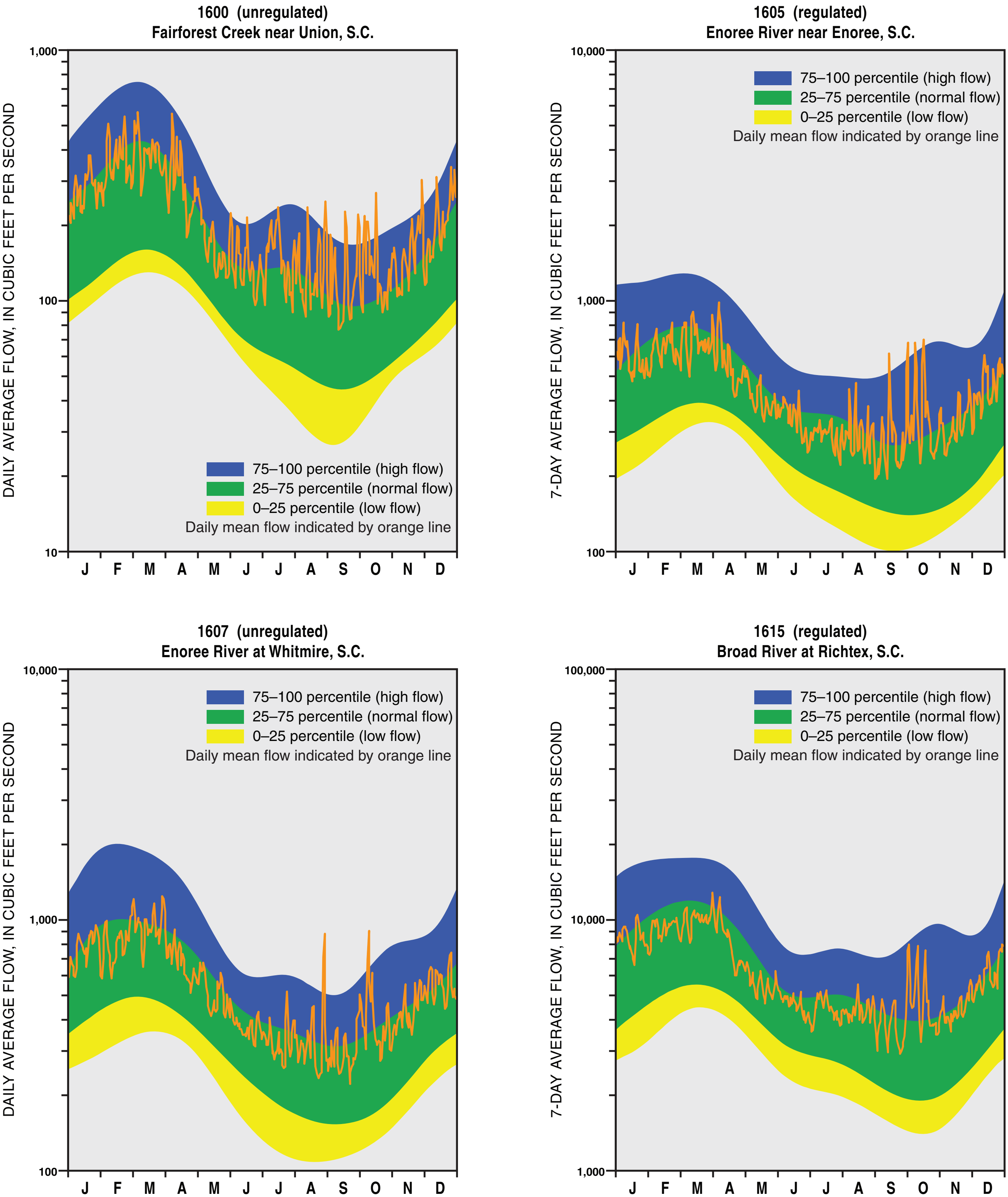


Figure 6-2. Duration hydrographs for selected gaging stations in the Broad River subbasin (continued).

Development

Surface-water development has been extensive in the Broad River subbasin. Most of this development has been for the production of hydroelectric power, although several large reservoirs have been built to provide municipal water supplies (Table 6-2). The larger hydropower facilities located within the subbasin are summarized in Table 6-3 and shown on Figure 6-1. Hundreds of small dams, most privately owned, create small impoundments on many tributaries of the Broad River, particularly in the upper reaches of the subbasin. The three major reservoirs in the subbasin are Lake Monticello, Parr Shoals Reservoir, and Lake William C. Bowen.

Lake Monticello and Parr Shoals Reservoir are 26 miles northwest of Columbia, on Frees Creek and Broad River, respectively. Parr Reservoir, constructed in 1914 for hydroelectric power, has a surface area of 4,400 acres. The lake provides cooling water for steam-electric generating facilities and provided cooling water to the experimental Parr Nuclear Power Plant during the 1960's. In 1976, the dam was heightened 9 feet for conjunctive use with Lake Monticello and provides water for the Fairfield pumped-storage facility on Lower Frees Creek.

Lake Monticello has a surface area of 6,800 acres and a volume of 431,000 acre-ft. The lake was built in 1977 to

Table 6-2. Lakes 200 acres or more in the Broad River subbasin (shown on Figure 6-1)

Number on map	Name	Stream	Surface area (acres)	Storage capacity (acre-feet)	Purpose
1	Monticello Reservoir	Frees Creek	6,800[a]	431,000[a]	Power and recreation
2	Parr Shoals Reservoir	Broad River	4,400[a]	32,500[a]	Power and recreation
3	Lake William C. Bowen	South Pacolet River	1,534[e]	22,700[d]	Recreation and water supply
4	Lake H. Taylor Blalock	Pacolet River	1,100[c]	16,000[c]	Recreation and water supply
5	Lake John A. Robinson	Barton Creek	800[a]	14,000[a]	Recreation and water supply
6	Neal Shoals Reservoir	Broad River	575[f]	1,492[d]	Power
7	Lyman Lake	Middle Tyger River	500[a]	6,200[a]	Industry, recreation, and water supply
8	Ninety-Nine Islands Lake	Broad River	388[b]	undetermined	Power and recreation
9	Lake Cooley	Jordan Creek	330[a]	1,320[a]	Recreation and flood control
10	Monticello Recreation Lake	Frees Creek	300[a]	6,000[a]	Power and recreation
11	Spartanburg Municipal Reservoir #1	South Pacolet River	271[c]	3,388[d]	Recreation and water supply
12	Gaston Shoals Lake	Broad River	251[b]	2,500	Power, recreation, and water supply
13	Lake Cunningham	South Tyger River	250[a]	2,200[a]	Recreation and water supply

Sources: (a) U.S. Army Corps of Engineers (1991)
(b) Duke Energy website http://www.duke-energy.com/lakes/facts-and-maps.asp (2008)
(c) Spartanburg Water System
(d) U.S. Geological Survey (2008)
(e) Journey and Abrahamsen (2008)
(f) South Carolina Electric & Gas Company (2005)

Table 6-3. Major hydroelectric power generating facilities in the Broad River subbasin (shown on Figure 6-1)

Number on map	Facility name and operator	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
1	Gaston Shoals Duke Energy	Broad River	Gaston Shoals Lake	6.7	213,600
2	Ninety-Nine Islands Duke Energy	Broad River	Ninety-Nine Islands Lake	18	32,949
3	Lockhart Lockhart Power Co.	Broad River	Lockhart Canal	18	583
4	Neal Shoals SCE&G	Broad River	Neal Shoals Reservoir	5.2	326,592
5	Fairfield Pumped Storage SCE&G	Frees Creek	Monticello Reservoir	511.2	1,920,104
6	Parr SCE&G	Broad River	Parr Shoals	14.4	593,019

supply cooling water to the V.C. Summer Nuclear power plant and to serve as the upper-storage reservoir of the Fairfield pumped-storage hydroelectric facility. During periods of peak electrical demand, water is drained through generating turbines from Lake Monticello into Parr Reservoir; during periods when electricity demand is low, part of the V.C. Summer facility's output is used to pump water back into Lake Monticello. Parr Shoals Reservoir and Lake Monticello also serve recreational needs.

Lake William C. Bowen is northwest of Spartanburg on the South Pacolet River. This 1,534-acre lake is one of three reservoirs used by the city of Spartanburg as a water supply and a recreational area.

The inactive Columbia Canal, which takes in water from the Broad River and discharges it into the Congaree River, is the only navigation project in the subbasin. Initially constructed in 1824 to provide a navigable route around rapids at the confluence of the Broad and Saluda Rivers, the Columbia Canal was used by barge traffic into the mid-1800's. A hydroelectric power station constructed at the lower end of the canal in 1891 is still in operation today. The city of Columbia also uses the canal for water supply.

The NRCS (Natural Resources Conservation Service) assisted in the planning and installation of several flood-control projects in the subbasin. Work has been completed on 9 of 12 projects authorized since 1962; three projects have been terminated or have become inactive since their authorizations. Work completed through 2005 included 45 flood-retarding structures, 13 miles of channel improvements, erosion-control treatments, and sediment-damage reduction.

Surface-Water Quality

The Broad River main stem and most of its tributaries are designated as "Freshwater" (Class FW). Class FW encompasses freshwater that is suitable for the survival and propagation of aquatic life, primary- and secondary-contact recreation, drinking-water supply, fishing, and industrial and agricultural uses. Vaughn Creek, in the northeastern corner of Greenville County, is designated as "Outstanding Resource Water" (Class ORW)—freshwater that constitutes an outstanding recreational or ecological resource and is suitable as a drinking-water source with minimal treatment (DHEC, 2001).

Water quality in the Broad River subbasin is characterized as generally good. This basin has shown improvement in water-quality indicators since the mid-1990's, and the major lakes meet the minimum water-quality criteria for recreational uses.

As part of its ongoing Watershed Water-Quality Assessment program, DHEC sampled 179 surface-water sites in the subbasin in the late 1990's in order to assess the water's suitability for aquatic life and recreational use (Figure 6-3). Aquatic-life uses were fully supported at 134 sites, or 75 percent of the water bodies sampled; water at the impaired sites exhibited poor macroinvertebrate-community structure, high metals concentrations, pH excursions, or low dissolved-oxygen levels. In the Enoree River, contaminated ground water from an industrial site point-source has been identified as the cause of excessive zinc concentrations. Recreational use was fully supported in 19 percent of the sampled water bodies; the water bodies that did not support recreational use exhibited high levels of fecal-coliform bacteria (DHEC, 2001). Water-quality impairments in the subbasin are listed in Table 6-4.

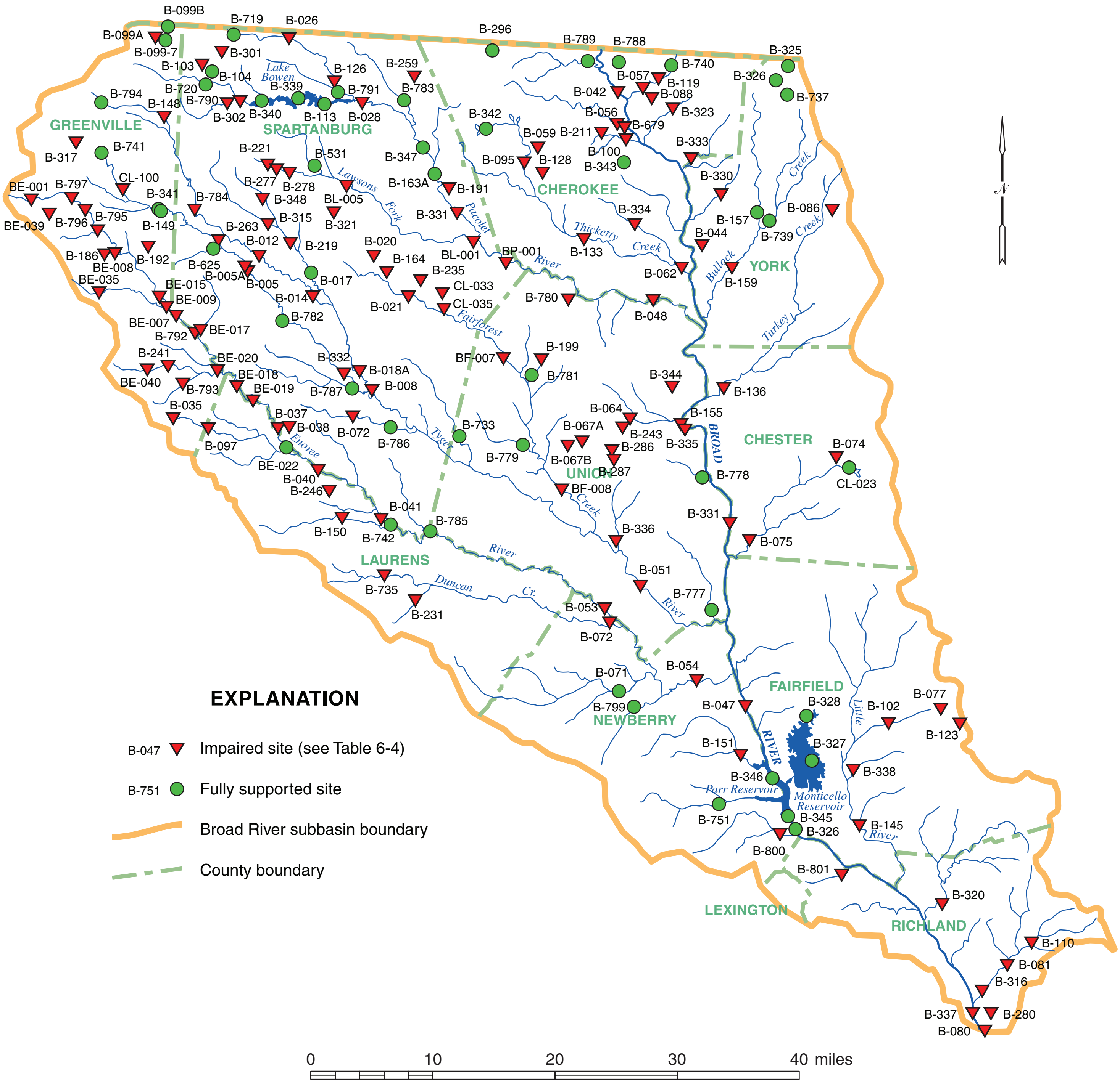


Figure 6-3. Surface-water-quality monitoring sites evaluated by DHEC for suitability for aquatic life and recreational uses. Impaired sites are listed in Table 6-4 (DHEC, 2001).

Table 6-4. Water-quality impairments in the Broad River subbasin (DHEC, 2001)

Water-body name	Station number	Use	Status	Water-quality indicator
Beaverdam Creek	BE-039	Recreation	Nonsupporting	Fecal coliform
Beaverdam Creek	B-769	Aquatic life	Partially supporting	Macroinvertebrates
Buckhorn Creek	B-795	Aquatic life	Partially supporting	Macroinvertebrates
Mountain Creek	B-186	Recreation	Nonsupporting	Fecal coliform
Mountain Creek	BE-008	Aquatic life	Partially supporting	Macroinvertebrates
Princess Creek	B-192	Aquatic life	Nonsupporting	Zinc
Princess Creek	B-192	Recreation	Nonsupporting	Fecal coliform
Brushy Creek	BE-035	Aquatic life	Partially supporting	Macroinvertebrates
Brushy Creek	BE-035	Recreation	Nonsupporting	Fecal coliform
Brushy Creek	BE-009	Aquatic life	Partially supporting	Macroinvertebrates
Brushy Creek	BE-009	Recreation	Nonsupporting	Fecal coliform
Rocky Creek	BE-007	Aquatic life	Partially supporting	Macroinvertebrates
Rocky Creek	BE-007	Recreation	Nonsupporting	Fecal coliform
Abner Creek	B-792	Aquatic life	Partially supporting	Macroinvertebrates
Horsepen Creek	B-793	Aquatic life	Partially supporting	Macroinvertebrates
Gilder Creek	BE-040	Recreation	Nonsupporting	Fecal coliform
Gilder Creek	B-241	Recreation	Nonsupporting	Fecal coliform
Gilder Creek	BE-020	Aquatic life	Partially supporting	Macroinvertebrates
Gilder Creek	BE-020	Recreation	Nonsupporting	Fecal coliform
Lick Creek	B-038	Recreation	Nonsupporting	Fecal coliform
Durbin Creek	B-035	Recreation	Nonsupporting	Fecal coliform
Enoree River	B-097	Recreation	Nonsupporting	Fecal coliform
Enoree River	BE-001	Aquatic life	Nonsupporting	Zinc
Enoree River	BE-001	Recreation	Nonsupporting	Fecal coliform
Enoree River	B-797	Aquatic life	Partially supporting	Macroinvertebrates
Enoree River	BE-015	Recreation	Nonsupporting	Fecal coliform
Enoree River	BE-017	Aquatic life	Nonsupporting	Copper
Enoree River	BE-017	Recreation	Nonsupporting	Fecal coliform
Enoree River	BE-018	Aquatic life	Partially supporting	Macroinvertebrates
Enoree River	BE-018	Recreation	Nonsupporting	Fecal coliform
Enoree River	BE-019	Aquatic life	Partially supporting	Macroinvertebrates
Enoree River	B-037	Recreation	Nonsupporting	Fecal coliform
Enoree River	B-040	Recreation	Partially supporting	Fecal coliform
Enoree River	B-041	Aquatic life	Nonsupporting	Zinc
Enoree River	B-041	Recreation	Partially supporting	Fecal coliform
Enoree River	B-053	Recreation	Nonsupporting	Fecal coliform
Beaverdam Creek	B-246	Recreation	Nonsupporting	Fecal coliform
Warrior Creek	B-150	Recreation	Nonsupporting	Fecal coliform
Beards Fork Creek	B-231	Aquatic life	Nonsupporting	Dissolved oxygen
Duncan Creek Reservoir	B-735	Aquatic life	Partially supporting	pH
Duncan Creek	B-072	Recreation	Nonsupporting	Fecal coliform
Enoree River	B-054	Aquatic life	Nonsupporting	Chromium
Enoree River	B-054	Recreation	Nonsupporting	Fecal coliform

Table 6-4. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Mush Creek	B-317	Recreation	Nonsupporting	Fecal coliform
Lake Robinson	CL-100	Aquatic life	Partially supporting	pH
South Tyger River	B-263	Recreation	Partially supporting	Fecal coliform
	B-005A	Aquatic life	Partially supporting	Macroinvertebrates
	B-005	Recreation	Nonsupporting	Fecal coliform
	B-332	Recreation	Partially supporting	Fecal coliform
Lake Cooley	B-348	Aquatic life	Partially supporting	pH
North Tyger River tributary	B-315	Recreation	Nonsupporting	Fecal coliform
North Tyger River	B-219	Aquatic life	Nonsupporting	Zinc
		Recreation	Nonsupporting	Fecal coliform
North Tyger River	B-018A	Recreation	Nonsupporting	Fecal coliform
Beaverdam Creek	B-784	Aquatic life	Partially supporting	Macroinvertebrates
Middle Tyger River	B-148	Recreation	Nonsupporting	Fecal coliform
	B-012	Recreation	Nonsupporting	Fecal coliform
	B-014	Recreation	Nonsupporting	Fecal coliform
Tyger River	B-008	Recreation	Nonsupporting	Fecal coliform
	B-051	Recreation	Nonsupporting	Fecal coliform
Jimmies Creek	B-072	Recreation	Nonsupporting	Fecal coliform
Fairforest Creek	B-020	Recreation	Nonsupporting	Fecal coliform
	B-164	Recreation	Nonsupporting	Fecal coliform
	B-021	Aquatic life	Nonsupporting	Macroinvertebrates, chromium, zinc, copper
		Recreation	Nonsupporting	Fecal coliform
	BF-007	Recreation	Nonsupporting	Fecal coliform
	BF-008	Recreation	Nonsupporting	Fecal coliform
Fairforest Creek tributary	B-321	Aquatic life	Nonsupporting	Chromium, zinc, copper
		Recreation	Nonsupporting	Fecal coliform
Kelsey Creek	B-235	Recreation	Nonsupporting	Fecal coliform
Lake Johnson	CL-035	Aquatic life	Nonsupporting	pH
Lake Craig	CL-033	Aquatic life	Partially supporting	pH
Mitchell Creek	B-199	Recreation	Nonsupporting	Fecal coliform
Toschs Creek	B-067A	Recreation	Nonsupporting	Fecal coliform
	B-067B	Recreation	Nonsupporting	Fecal coliform
Tinkers Creek	B-286	Recreation	Nonsupporting	Fecal coliform
	B-287	Recreation	Nonsupporting	Fecal coliform
	B-336	Recreation	Nonsupporting	Fecal coliform
Canoe Creek	B-088	Aquatic life	Partially supporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Peoples Creek	B-211	Recreation	Nonsupporting	Fecal coliform
Furnace Creek	B-100	Recreation	Nonsupporting	Fecal coliform
Doolittle Creek	B323	Recreation	Nonsupporting	Fecal coliform
Guyonmoore Creek	B-330	Recreation	Partially supporting	Fecal coliform

Table 6-4. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Broad River	B-042	Recreation	Partially supporting	Fecal coliform
	B-044	Recreation	Partially supporting	Fecal coliform
Buffalo Creek	B-119	Recreation	Nonsupporting	Fecal coliform
	B-057	Aquatic life	Partially supporting	Copper
		Recreation	Nonsupporting	Fecal coliform
Cherokee Creek	B-056	Aquatic life	Partially supporting	Macroinvertebrates
	B-679	Recreation	Nonsupporting	Fecal coliform
Kings Creek	B-333	Recreation	Partially supporting	Fecal coliform
Irene Creek	B-059	Recreation	Nonsupporting	Fecal coliform
Limestone Creek	B-128	Recreation	Nonsupporting	Fecal coliform
Gilkey Creek	B-334	Recreation	Nonsupporting	Fecal coliform
Thicketty Creek	B-095	Recreation	Nonsupporting	Fecal coliform
	B-133	Recreation	Nonsupporting	Fecal coliform
	B-062	Recreation	Nonsupporting	Fecal coliform
Bullock Creek	B-159	Recreation	Nonsupporting	Fecal coliform
Lake Lanier	B-099A	Recreation	Partially supporting	Fecal coliform
Page Creek	B-301	Recreation	Nonsupporting	Fecal coliform
North Pacolet River	B-026	Recreation	Nonsupporting	Fecal coliform
	B-126	Recreation	Nonsupporting	Fecal coliform
Spivey Creek	B-103	Recreation	Partially supporting	Fecal coliform
Motlow Creek	B-790	Aquatic life	Partially supporting	Macroinvertebrates
South Pacolet River	B-302	Recreation	Nonsupporting	Fecal coliform
Little Buck Creek	B-259	Recreation	Nonsupporting	Fecal coliform
Potter Branch	B-191	Recreation	Nonsupporting	Fecal coliform
Pacolet River	B-028	Recreation	Nonsupporting	Fecal coliform
	B-331	Recreation	Partially supporting	Fecal coliform
Lawsons Fork Creek	B-221	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
	B-277	Recreation	Nonsupporting	Fecal coliform
	B-278	Recreation	Nonsupporting	Fecal coliform
	BL-005	Recreation	Nonsupporting	Fecal coliform
	BL-001	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
Mill Creek	B-780	Aquatic life	Partially supporting	Macroinvertebrates
Pacolet River	BP-001	Recreation	Nonsupporting	Fecal coliform
	B-048	Recreation	Nonsupporting	Fecal coliform
John D. Long Lake	B-344	Aquatic life	Nonsupporting	pH
Broad River	B-331	Recreation	Partially supporting	Fecal coliform
Ross Branch	B-086	Recreation	Nonsupporting	Fecal coliform
Turkey Creek	B-136	Recreation	Partially supporting	Fecal coliform
Meng Creek tributary	B-243	Recreation	Nonsupporting	Fecal coliform
Meng Creek	B-064	Recreation	Nonsupporting	Fecal coliform

Table 6-4. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Browns Creek	B-155	Recreation	Partially supporting	Fecal coliform
Gregorys Creek	B-335	Recreation	Nonsupporting	Fecal coliform
Dry Fork	B-074	Recreation	Nonsupporting	Fecal coliform
Sandy River	B-075	Recreation	Nonsupporting	Fecal coliform
Broad River	B-047	Recreation	Partially supporting	Fecal coliform
Hellers Creek	B-151	Aquatic life	Partially supporting	Macroinvertebrates
Crims Creek	B-800	Aquatic life	Partially supporting	Macroinvertebrates
Wateree Creek	B-801	Aquatic life	Partially supporting	Macroinvertebrates
Elizabeth Lake	B-110	Recreation	Partially supporting	Fecal coliform
Cranes Creek	B-081	Aquatic life	Partially supporting	Macroinvertebrates
	B-316	Aquatic life	Nonsupporting	Zinc
		Recreation	Partially supporting	Fecal coliform
Smith Branch	B-280	Aquatic life	Nonsupporting	Macroinvertebrates, zinc
		Recreation	Nonsupporting	Fecal coliform
Broad River	B-337	Recreation	Partially supporting	Fecal coliform
	B-080	Aquatic life	Nonsupporting	Copper
		Recreation	Partially supporting	Fecal coliform
Little River	B-145	Recreation	Nonsupporting	Fecal coliform
Winnsboro Branch	B-123	Recreation	Nonsupporting	Fecal coliform
	B-077	Aquatic life	Nonsupporting	Copper, zinc
		Recreation	Nonsupporting	Fecal coliform
Jackson Creek	B-102	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Partially supporting	Fecal coliform
Mill Creek	B-338	Recreation	Nonsupporting	Fecal coliform
Big Cedar Creek	B-320	Recreation	Partially supporting	Fecal coliform

Water-quality conditions can change significantly from year to year, and water bodies are reassessed every 2 years for compliance with State water-quality standards. DHEC publishes the most recent impairments and water-quality trends online in their 303(d) listings and 305(b) reports.

GROUND WATER

Hydrogeology

The Broad River subbasin is almost entirely in the Piedmont physiographic province, where ground water occurs principally in bedrock fractures formed by fault-and-joint systems and in the saprolite. Cretaceous-age Coastal Plain sediments occupy the extreme southern reach of the subbasin and constitute a shallow, sandy aquifer.

The subbasin includes six geologic units of the Piedmont geologic province trending northeast-southwest. From north to south, these are the extreme eastern edge of the Walhalla thrust sheet (Greenville County), the Sixmile thrust sheet (Greenville, Spartanburg, and Cherokee Counties), and the Laurens thrust sheet (Greenville, Spartanburg, and Cherokee Counties). To the southeast, separated by the Cross Anchor fault and the Kings Mountain shear zone, lie the Kings Mountain terrane (Spartanburg, Union, Cherokee, and York Counties), the Charlotte terrane (Laurens, Spartanburg, Union, Cherokee, York, Chester, Fairfield, and Newberry Counties), and the Carolina terrane (Newberry, Fairfield, and Richland Counties). Some gabbro and granite intrusions exist in the subbasin; an especially large granite pluton occurs in northeastern Union County and southern Cherokee County.

Saprolite is as thick as 150 feet and serves as a medium for the collection of rainfall and subsequent recharge to fractures in the underlying crystalline rocks. The number and size of fractures usually diminish with depth, and crystalline-rock composition appears to have little effect on well yields. The water supply from wells penetrating these rocks is reliable but limited, and well yields are usually less than 50 gpm (gallons per minute).

Topography also impacts wells yields. Valleys provide basins that capture recharge water and commonly are areas of rock weakness and more numerous fractures. Wells in valleys tend to have larger yields than wells in topographically high areas.

The full ground-water potential of the region is not known, and specific aquifer or hydrogeologic units are not well delineated. Generally, ground water in the subbasin is somewhat limited but typically is present in quantities adequate for domestic use. Average well yields are about 18 gpm; however, wells that are carefully sited with regard to topography and geology can produce much more than the average. About 70 percent of reported wells are 300 feet deep or less, although a few are deeper than 1,000 feet. The available data indicate that 100 to 250 feet are optimum depths for maximum yields. Wells drilled in crystalline-rock fracture zones can produce 100 to 300 gpm, whereas wells near the fringes of fracture zones produce 2 to 50 gpm. Two geologic-core holes in Fairfield County were drilled deeper than even the deepest water-supply wells: the first well was deeper than 3,500 feet and produced more than 1,100 gpm, and the second well exceeded 3,900 feet and produced about 600 gpm. The average and maximum well depths and well yields in the subbasin sections of each county are listed in Table 6-5. The table data indicate there generally is little difference in the depths required of drilled bedrock wells if only modest well yields are needed.

Table 6-5. Well depths and yields for drilled bedrock wells in the Broad River subbasin

County	Well depth (feet)		Well yield (gpm)	
	Average	Maximum	Average	Maximum
Cherokee	236	1,185	15	200
Chester	213	585	17	360
Fairfield	251	610	21	200
Greenville	265	1,085	17	200
Laurens	273	905	16	150
Lexington	274	325	26	40
Newberry	234	880	15	250
Richland	292	884	24	200
Spartanburg	278	1,200	20	370
Union	276	1,000	14	100
York	220	745	16	300

Bored wells represent about 11 percent of all water-producing wells in the Broad River subbasin. They commonly have a 24-inch diameter but range from 12 inches to 60 inches. The wells are generally shallow, do not penetrate bedrock, and draw water from the saprolite. Old hand-dug wells range from 8 feet to 100 feet in depth and average 47 feet in depth. Yields are rarely reported by drillers, but sustained yields are believed to be less than 5 gpm.

The northwestern area of Richland County in the Broad River subbasin is underlain mostly by argillite of the Carolina slate belt, but near the southeast edge of the subbasin the bedrock is overlain by about 50 feet of unconsolidated Middendorf sand, gravel, and clay. Rock-well depths range from 100 to 884 feet deep, and yields are 2 to 50 gpm.

Ground-Water Quality

Chemical quality of the ground water in the Broad River subbasin is generally good, although in some areas the water is rather hard. Water from acidic rocks such as granite, granite-gneiss, and mica-schist is soft, slightly acidic, and contains low concentrations of TDS (total dissolved solids). Water from hornblende, gneiss or schist, diorite, gabbro, and diabase is slightly alkaline, fairly hard, and relatively high in dissolved solids. This water also can contain high amounts of dissolved iron. Ground water in the subbasin has TDS concentrations ranging from 8 to 658 mg/L (milligrams per liter); pH ranges from 5.1 to 9.1, with a median of 6.8. The higher pH values (above 7.5) are generally in the Charlotte belt in Union County and in the Kings Mountain belt in Cherokee County. Alkalinity ranges from 0.5 to 300 mg/L (National Uranium Resource Evaluation program, 1997).

DHEC has found that Ra-226 and Pb-214 (radioactive isotopes of radium and lead) are present in two wells in Jenkinsville (southern Fairfield County) and that concentrations exceed acceptable drinking-water standards. These wells are completed in rocks of the Charlotte belt.

Water-Level Conditions

Ground-water levels are routinely monitored by DNR and USGS in six wells in the Broad River subbasin to help assess trends or changes in hydrologic conditions (Table 6-6). Water levels in these wells are often indicative of local hydrologic conditions that impact the surface-water systems to which the ground water is connected. Changes in observed water levels are almost always a reflection of changes in above-ground hydrologic conditions.

Table 6-6. Water-level monitoring wells in the Broad River subbasin

Well number	Monitoring agency*	Latitude Longitude (deg min sec)	Aquifer	Well location	Land surface elevation (feet)	Depth (feet) to screen top, bottom; or open interval
CRK-74	USGS	35 09 18 81 26 34	Crystalline rock	4 miles northeast of Blacksburg	825	99–265
CTR-21	USGS	34 40 27 81 24 55	Crystalline rock	6 miles north-north-east of Carlisle	665	40–93
GRV-2162	DNR	34 54 16 82 15 49	Crystalline rock	East Riverside Park, Greer	875	83–169
GRV-3341	DNR	35 09 38 82 13 29	Shallow	Oak Grove Road Fire Station, Gowansville	1,030	70–80
GRV-3342	DNR	35 09 38 82 13 29	Crystalline rock	Oak Grove Road Fire Station, Gowansville	1,030	132–334
SPA-1581	USGS	34 51 45 80 50 29	Crystalline rock	Croft State Park	605	54–225

* *DNR, South Carolina Department of Natural Resources; USGS, United States Geological Survey*

Because ground-water use in this subbasin is very limited, no areas within the subbasin are experiencing significant water-level declines caused by overpumping.

WATER USE

Water-withdrawal information presented here is derived from water-use data for the year 2006 that were collected and compiled by DHEC (Butler, 2007) and represents only withdrawals reported to DHEC for that year. Water-use categories and water-withdrawal reporting criteria are described in more detail in the *Water Use* chapter of this publication.

Water use in the Broad River subbasin, exclusive of hydroelectric power production, is summarized in Table 6-7 and Figure 6-4. Offstream water use in this subbasin totaled 311,778 million gallons in 2006, ranking it third among the 15 subbasins. Of this amount, more than 99 percent (310,485 million gallons) came from surface-water sources and less than one percent (1,293 million gallons) came from ground-water sources. Thermoelectric power production accounted for 87 percent of this total, and water supply accounted for 12 percent. Relatively small amounts of water were also used for industry, mining, golf courses, irrigation, and aquaculture. Consumptive use in this subbasin is estimated to be 10,913 million gallons, or about 4 percent of the total offstream use.

The Virgil C. Summer Nuclear Station, located on Lake Monticello in Fairfield County, about 26 miles northwest of Columbia, is the only thermoelectric power plant in the subbasin. It is jointly owned by SCE&G and the South Carolina Public Service Authority (Santee Cooper) and is operated by SCE&G. It contains one turbine that has a capacity of 953.9 MW (megawatts). In 2006, the facility used 271,236 million gallons of water for cooling and steam.

Table 6-7. Reported water use in the Broad River subbasin for the year 2006 (modified from Butler, 2007)

Water-use category	Surface water		Ground water		Total water	
	Million gallons	Percentage of total surface-water use	Million gallons	Percentage of total ground-water use	Million gallons	Percentage of total water use
Aquaculture	35	0.0	0	0.0	35	0.0
Golf course	644	0.2	25	1.9	669	0.2
Industry	1,259	0.4	87	6.7	1,346	0.4
Irrigation	137	0.0	5	0.4	143	0.1
Mining	0	0.0	982	76.0	982	0.3
Other	0	0.0	0	0.0	0	0.0
Thermoelectric power	271,236	87.4	0	0.0	271,236	87.0
Water supply	37,173	12.0	194	15.0	37,367	12.0
Total	310,485		1,293		311,778	

Water-supply use in the Broad River subbasin totaled 37,367 million gallons in 2006, which ranked it second behind the Saluda River subbasin. Surface water accounted for 37,173 million gallons (99.5 percent) and ground water for 194 million gallons (0.5 percent). The largest surface-water system was the city of Columbia, which withdrew 12,096 million gallons from the Columbia Canal on Broad River. Columbia's other water-supply facility is in the Saluda subbasin at Lake Murray. The city of Spartanburg withdrew 12,092 million gallons from Lake Bowen, Lake Blalock, and Municipal Reservoir #1. Other systems of note include Greer Commission of Public Works (2,883 million gallons from the South Tyger River), Gaffney Board of Public Works (2,582 million gallons from Lake Welchel and Broad River), and Startex-Jackson-Wellford-Duncan Water District (2,454 million gallons from Lyman Lake on the Middle Tyger River). Despite its limited availability, ground water is used by several smaller water-supply systems. Jenkinsville Water District had the largest ground-water system in the subbasin, with a withdrawal of 49 million gallons from the crystalline rock aquifer.

Industrial water use was 1,346 million gallons in 2006. Of this amount, 1,259 million gallons were from surface-water sources (94 percent) and 87 million were from wells (6 percent). Milliken & Company in Cherokee County and Cone Mills Corp. in Union County were among the largest users in the subbasin, withdrawing 621 and 458 million gallons, respectively.

Mining water use was 982 million gallons in the subbasin, all of it ground water. All of the water was pumped at the Martin Marietta Aggregates quarry in Columbia to dewater the quarry. Golf-course water use was 669 million gallons, ranking it fourth among the 15 subbasins in this category. Most of the water used was surface water (96 percent). Of the seventeen golf courses reporting water use in 2006, the Cliffs at Glassy in Greenville County was the largest user, withdrawing 274 million gallons.

Eight hydroelectric facilities operating in this subbasin reported total instream water use of 3,098,700 million gallons in 2006 (see Table 6-3). The largest water use was by the Fairfield Pumped Storage facility, which is owned and operated by SCE&G and is located at Lake Monticello in Fairfield County off the main stem of the Broad River. Water that is released from the lake to produce hydroelectric power flows into Parr Shoals Reservoir, where it can then be pumped back into Lake Monticello and reused. In 2006, the facility used 1,920,104 million gallons of water, second only to Duke Energy's pumped-storage facility at Lake Jocassee in the Upper Savannah subbasin. Water is also released through turbines at Parr Shoals Reservoir to produce hydroelectric power. The amount of water used at Parr Shoals was 593,019 million gallons. Together, the two facilities operate 14 turbines and have a capacity of about 525 MW. SCE&G also owns and operates the Neal Shoals facility on the Broad River, which contains four turbines and has a capacity of 5.2 MW. It used 326,592 million gallons in 2006.

Duke Energy owns and operates the Gaston Shoals and Ninety-Nine Islands hydroelectric facilities located on the Broad River in Cherokee County. Gaston Shoals used 213,600 million gallons and Ninety-Nine Islands used 32,949 million gallons in 2006. The two plants house 10 turbines with a total capacity of 24.7 MW. Lockhart Power Company owns and operates two hydroelectric facilities, the Lockhart plant on the Broad River in Union County, and the Pacolet plant on the Pacolet River in Spartanburg County. The Lockhart plant used 583 million gallons and the Pacolet plant used 35 million gallons. The plants operate seven turbines with a capacity of 18.8 MW. The city of Spartanburg Commissioners of Public Works operates a small 1 MW unit at Lake Bowen in Spartanburg County. It used 11,818 million gallons in 2006.

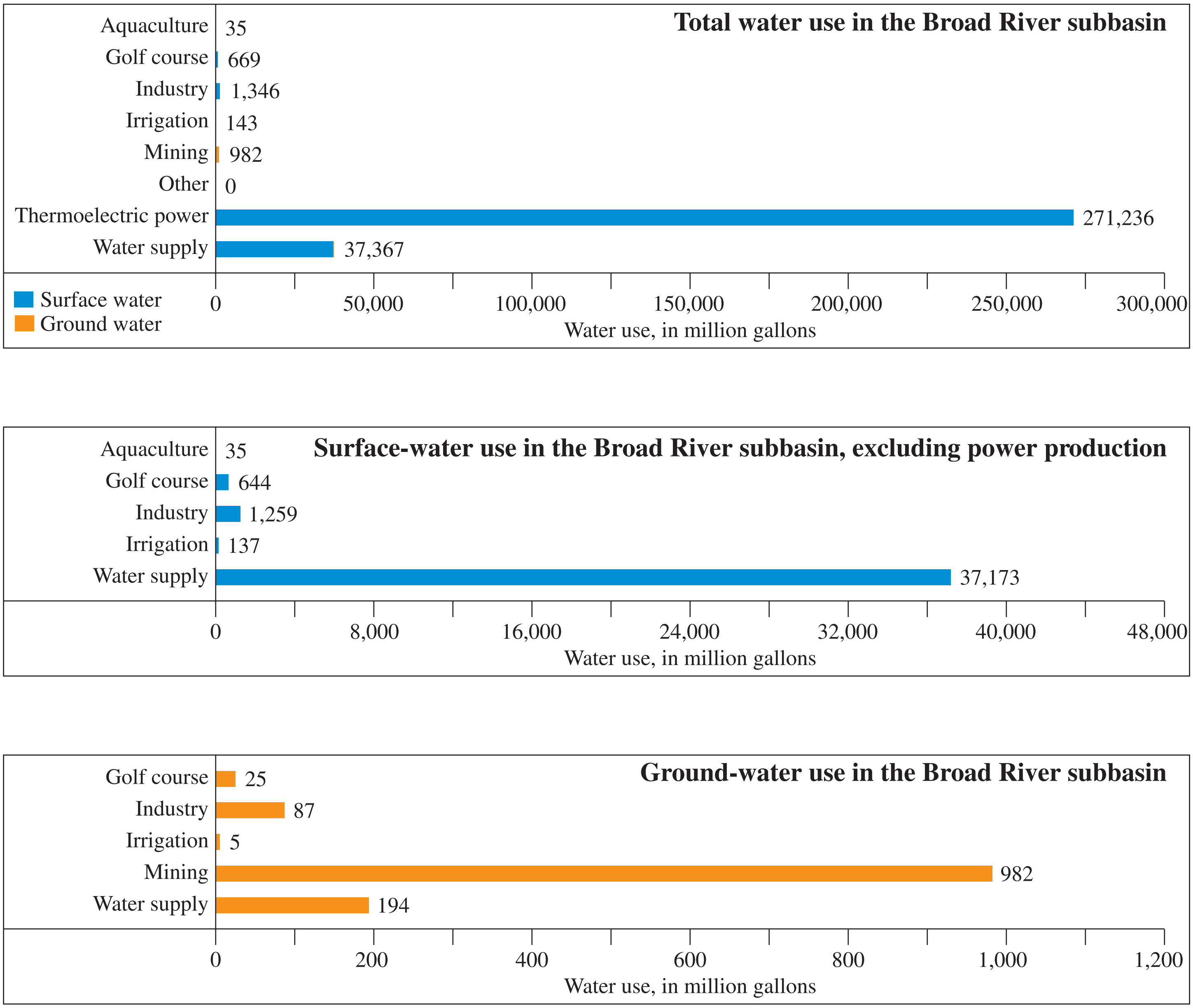


Figure 6-4. Reported water use in the Broad River subbasin for the year 2006 (modified from Butler, 2007).

SALUDA RIVER SUBBASIN

SALUDA RIVER SUBBASIN

The Saluda River subbasin is a long, narrow basin transecting the Blue Ridge and Piedmont of South Carolina and extending southeast to the Fall Line in the central part of the State. With a northwest-southeast orientation, the subbasin shares a common northern boundary with North Carolina on the north and encompasses parts of 12 South Carolina counties, including most of Greenville, Greenwood, Laurens, Newberry, and Saluda Counties, and smaller parts of Abbeville, Aiken, Anderson, Edgefield, Lexington, Pickens, and Richland Counties (Figure 6-5). The subbasin area is approximately 2,505 square miles, 8.1 percent of the State.

DEMOGRAPHICS

The year 2000 population of the subbasin was estimated at 541,600, which was 13.5 percent of the State's total. The greatest population growth by the year 2020 is anticipated in Lexington County (34 percent), Pickens County (28 percent), and Aiken County (25 percent). Aiken, Anderson, Lexington, and Richland Counties are classified as urban, and Saluda County is classified as very rural.

The major cities and population centers include: Greenville (about 300,000 in the urban area), Greenwood (22,071), Easley (17,754), Laurens (9,916), Newberry (10,580), Simpsonville (14,352), and Mauldin (15,224). The major urban center of Columbia is immediately outside the eastern boundary.

There are four subbasin counties with a year-2005 per capita income above the State's average of $28,285: Aiken, Greenville, Lexington, and Richland. The 1999 median household income ranged from $44,659 in Lexington County to $32,635 in Abbeville County. Only four of the subbasin's 12 counties have median household incomes above the State average of $37,082.

During 2000, the counties of the subbasin had combined annual-average employment of non-agricultural wage and salary workers of 275,000. Labor distribution in the subbasin counties included management, professional, and technical services, 30 percent; sales and office, 25 percent; production, transportation, and materials moving, 21 percent; service, 13 percent; construction, extraction, and maintenance, 10 percent; and farming, fishing, and forestry, 1 percent. In the sector of manufacturing and public utilities, the average annual product value of the area was $29.9 billion in 2000.

Agriculture-related production played a relatively modest role in the subbasin's economy. Crop and livestock production generated $414 million, with Lexington and Saluda Counties having product values of $87 million and $67 million, respectively. The delivered value of timber exceeded $270 million in 2001, with Newberry County generating more than $40 million (South Carolina Budget and Control Board, 2005).

SURFACE WATER

Hydrology

The Saluda River is the major watercourse in the subbasin. This stream has its headwaters in the Blue Ridge physiographic province of South Carolina, and it flows southeasterly across the Piedmont before joining the Broad River to form the Congaree River near Columbia. Major tributaries include the Reedy River, Rabon Creek, Little River, Bush River, and Little Saluda River. These streams serve water-use needs for the cities of Greenville, Greenwood, and Laurens.

Figure 6-5. Map of the Saluda River subbasin.

A 5-mile segment of the Middle Saluda River in Greenville County became the first river protected under the Scenic Rivers Program in South Carolina in 1978. In addition, a 10-mile segment of the Saluda River from one mile below the Lake Murray Dam to its confluence with the Broad River was designated as a State Scenic River in 1991.

Streamflow is presently monitored at 13 sites, 6 on the Saluda River and 7 on tributary streams (Figure 6-5). Streamflow statistics for these gaging stations and 9 discontinued stations are presented in Table 6-8. Surface-water data are also available for six crest-stage stations as well as lake-level stations on Lakes Greenwood and Murray. Streamflow in the upper part of the Saluda River has been affected for the entire period of record by two small water-supply reservoirs, Table Rock Reservoir and Poinsett (North Saluda) Reservoir. Controlled releases from Lakes Murray and Greenwood have modified streamflows in the lower portion of the Saluda River since the 1930's.

Table 6-8. Selected streamflow characteristics at USGS gaging stations in the Saluda River subbasin

Gaging station name, location, station number	Period of record	Drainage area (mi^2)	Average flow		90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
			(cfs)	(cfsm)				
South Saluda River near Cleveland 1622.9	2000 to 2005	17.8	28.1	1.57	3.7	1.3 2000	2,730 2004	3,720 2004
Middle Saluda River near Cleveland 1623.5	1980 to 2003	21.0	57.2	2.72	18	6.6 2002	1,160 1994	5,190 1986
Saluda River near Greenville 1625	1941-78 and 1990-2007*	295	623	2.11	231	36 1998	8,580 1949	11,000 1949
Hamilton Creek near Easley 1625.25	1981 to 1986	1.6	3.1	1.91	0.8	0.09 1986	77 1985	– – –
Saluda River near Pelzer 1630	1929 to 1971	405	783	1.93	290	57 1954	– – –	13,600 1949
Saluda River near Williamston 1630.01	1995 to 2007*	414	640	1.55	202	6.3 2000	12,000 1995	– – –
Grove Creek near Piedmont 1630.967	1994 to 2007*	19.1	22.8	1.19	5.5	0.44 2007	1,000 1995	– – –
Saluda River near Ware Shoals 1635	1938 to 2007*	580	975	1.68	313	11.0 1941	16,100 1995	20,900 1995
Reedy River near Greenville 1640	1941-71 and 1987-2007*	48.6	80.8	1.66	24	5.3 1999	4,120 1995	5,830 2004
Reedy River above Fork Shoals 1641.1	1993 to 2007*	104	204	1.96	81	39 2002	6,260 1995	8,200 1995
Reedy River near Ware Shoals 1650	1939 to 2004	236	353	1.50	94	4.8 1973	8,800 1963	11,000 1973
South Rabon Creek near Gray Court 1652	1967-81 and 1990-2007*	29.5	35.4	1.20	9.8	0.20 2007	2,520 1973	4,100 1973
Ninety-Six Creek near Ninety-Six 1669.7	1980 to 2001	17.4	15.6	0.90	0.36	0.0 2002	810 1982	– – –

Table 6-8. Continued

Gaging station name, location, station number	Period of record	Drainage area (mi²)	Average flow (cfs)	Average flow (cfsm)	90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
Saluda River at Chappells 1670	1926 to 2007*	1,360	1,869	1.37	518	8.0 1939	56,700 1929	63,700 1929
Little River near Silverstreet 1674.5	1990 to 2007*	230	178	0.77	27	0.71 2002	5,600 1996	– – –
Saluda River near Silverstreet 1675	1929 to 1966	1,620	2,227	1.37	710	49 1940	– – –	83,800 1929
Bush River near Joanna 1675.57	1995 to 2005	11.1	14.5	1.31	0.73	0.0 2001, 02, 04, 05	730 2003	1,160 1996
Bush River at Newberry 1675.63	1999 to 2007*	62.2	45.3	0.73	4.3	0.0 2002	1,880 2003	– – –
Bush River near Prosperity 1675.82	1990 to 2007*	115	102	0.89	14	3.2 2002	4,330 1995	5,570 1995
Little Saluda River at Saluda 1677.037	1992 to 2001	90	84.1	0.93	0.73	0.0 2001	4,720 1994	6,340 1994
Saluda River below Lake Murray 1685.04	1988 to 2007*	2,386	2,495	1.07	441	155 1989	21,800 1995	22,400 1995
Saluda River near Columbia 1690	1925 to 2007*	2,520	2,762	1.10	426	12.0 1930	62,300 1929	67,000 1929

mi², square miles; cfs, cubic feet per second; cfsm, cubic feet per second per square mile of drainage area
90% exceeds flow: the discharge that has been exceeded 90 percent of the time during the period of record for that gaging station
** 2007 is the most recent year for which published data were available when this table was prepared*

Average-annual streamflow in the Saluda River varies from 623 cfs (cubic feet per second) near Greenville to 2,762 cfs near Columbia. Ninety percent of the time, flow at these sites equals or exceeds 231 cfs and 426 cfs, respectively. Streamflows in the Blue Ridge portion of the subbasin are relatively steady and have well-sustained base flow supported by ground-water discharge from exposed fracture zones. High rainfall and runoff in this region also contribute significantly to flow. Streamflow in the upper reach of the Saluda River is well-sustained throughout the year (Figure 6-6). Streamflow in the Saluda River becomes increasingly more variable in the Piedmont region with distance downstream, because of hydropower facilities and progressively decreasing annual precipitation and ground-water support in watersheds away from the mountains.

The most variable flows in the Saluda River occur immediately below Lake Greenwood, where regulated discharges from the Buzzard's Roost Hydroelectric Plant greatly influence flow. Use of this facility only during periods of peak electric demand results in highly fluctuating flows downstream with frequent periods of extreme low flow. These low-flow conditions limit navigation, fish migration, and suitable fish habitat.

Tributary streams are subject to the same flow-controlling factors as the main stem; however, most tributaries do not benefit from having headwater bodies in regions of high rainfall and ground-water discharge to partially sustain streamflows during periods of low rainfall. Streamflow characteristics of the Reedy River indicate the same main-stem trend of increased flow variability with progression downstream (Figure 6-6). Average annual streamflow in the Reedy River is 80.8 cfs near Greenville and 353 cfs near Ware Shoals. Streamflow at these sites is at least 24 cfs and 94 cfs, respectively, 90 percent of the time.

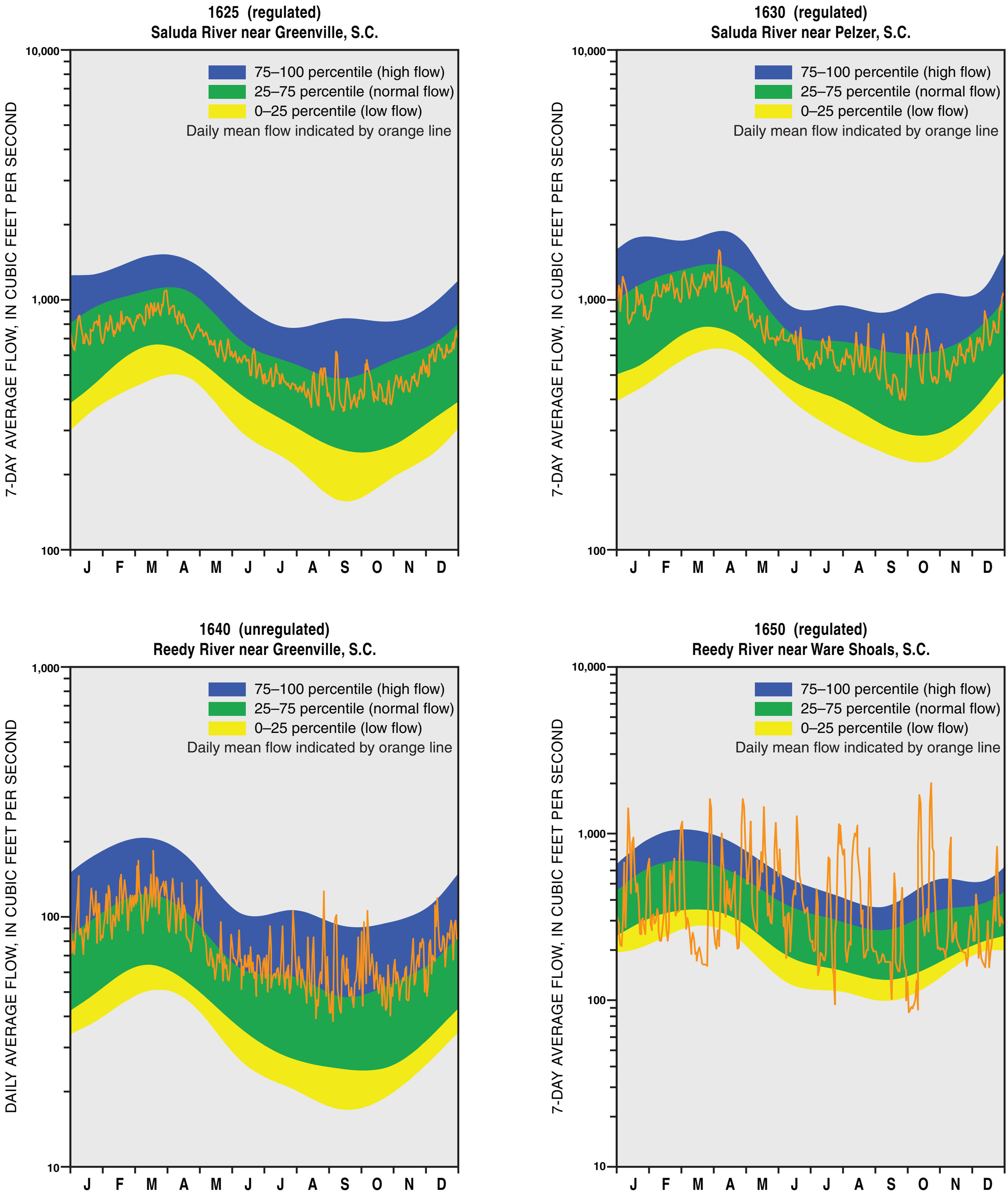


Figure 6-6. Duration hydrographs for selected gaging stations in the Saluda River subbasin.

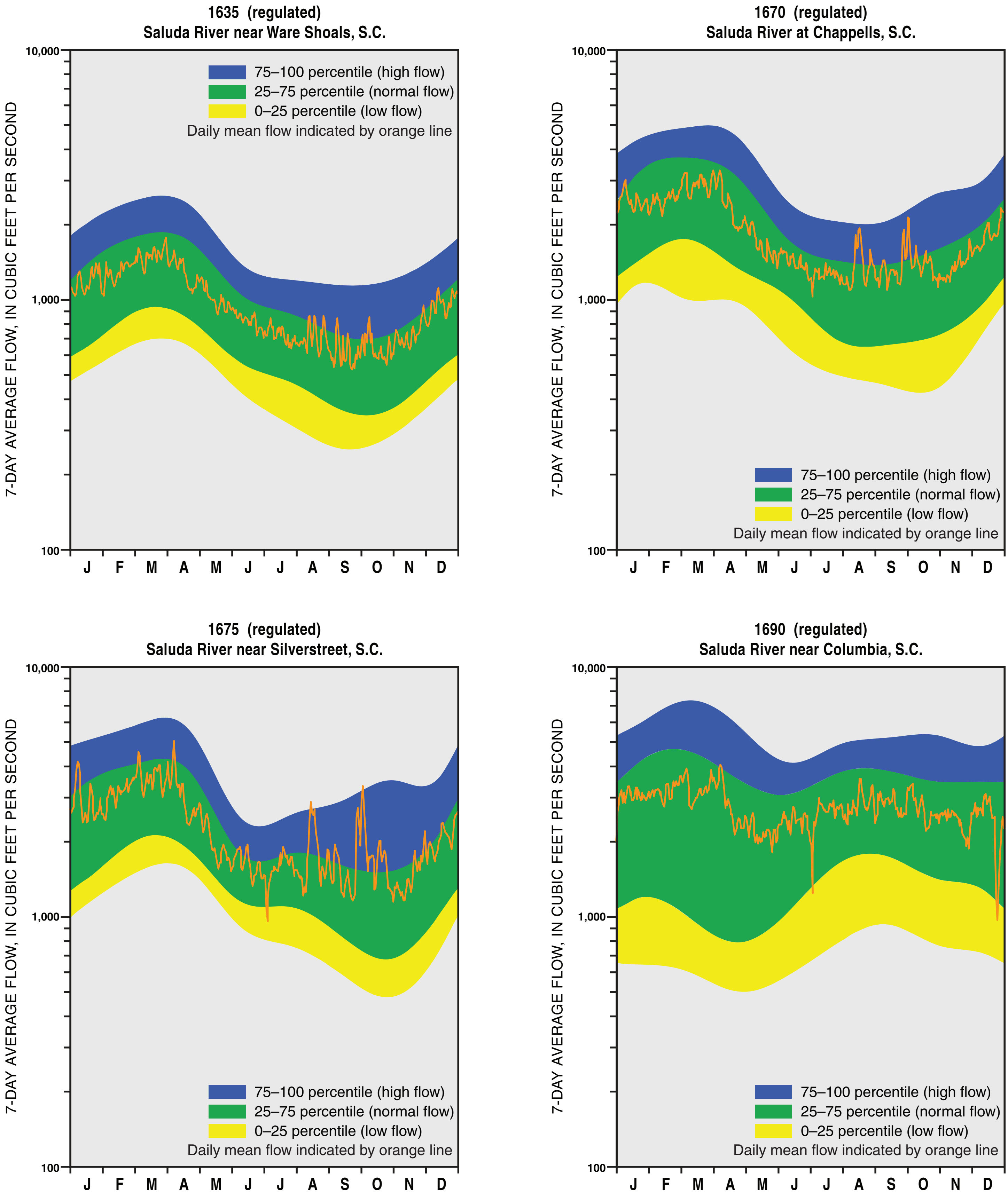


Figure 6-6. Duration hydrographs for selected gaging stations in the Saluda River subbasin (continued).

The lowest recorded flow of the Saluda River is 6.3 cfs (estimated) and occurred in 2000 near Williamston. Record flood flows were primarily because of three storms occurring in 1929, 1949, and 1973. The highest peak flow of the Saluda River (83,800 cfs) was recorded near Silverstreet in 1929.

In general, available streamflows in the upper part of the subbasin are well-sustained and provide a reliable surface-water supply source. While flow is more variable in the lower portion of the Saluda River, minimum flow still provides a substantial supply. Tributaries in the lower part of the subbasin may experience significant low-flow conditions during periods of low rainfall and, if used as a water source, may require storage facilities to ensure a reliable year-round supply.

Development

Extensive surface-water development exists to meet the needs of industry and municipalities in the Saluda River subbasin. There are several large reservoirs on the Saluda River, including Lake Murray, Lake Greenwood, and Poinsett (North Saluda) Reservoir. Just in the upper part of the subbasin that drains into Lake Greenwood, there are more than 150 State- or Federally-regulated dams and more than 2,500 non-regulated dams, most of which are privately owned (Saluda-Reedy Watershed Consortium, 2005a). The aggregate surface area of all lakes larger than 200 acres is approximately 65,000 acres, and the total volume is about 2,500,000 acre-ft (Table 6-9).

Table 6-9. Lakes 200 acres or more in the Saluda River subbasin (shown on Figure 6-5)

Number on map	Name	Stream	Surface area (acres)	Storage capacity (acre-feet)	Purpose
1	Lake Murray	Saluda River	51,000[a]	2,114,000[a]	Power, recreation, and water supply
2	Lake Greenwood	Saluda River	11,400[a]	270,000[a]	Power, recreation, and water supply
3	Poinsett (North Saluda) Reservoir	North Saluda River	1,034[b]	33,000[b]	Water supply
4	Lake Rabon	Rabon Creek	562[b]	6,832[b]	Water supply, flood control, and recreation
5	Table Rock Reservoir	South Saluda River	485[b]	15,000[b]	Water supply
6	Saluda Lake	Saluda River	305[b]	7,228[b]	Power, water supply, and industry
7	Boyd Mill Pond	Reedy River	203[b]	3,000[b]	Power and recreation

Sources: (a) U.S. Army Corps of Engineers (1991)
(b) Saluda-Reedy Watershed Consortium (2005b)

Statewide, Lake Murray ranks fifth in surface area and third in volume, with 51,000 acres and 2,114,000 acre-ft, respectively. Located 11 miles west of Columbia, Lake Murray is owned and operated by South Carolina Electric and Gas Company (SCE&G). The lake was constructed in 1930 for the production of hydroelectric power, but now also provides recreational opportunities and water supply.

Lake Greenwood, 18 miles east of Greenwood, is currently owned by Greenwood County, but Santee Cooper operates the hydroelectric plant (Buzzard's Roost). Constructed in 1940 for the production of hydroelectric power, the lake also serves as a municipal water supply and is used for recreation. With a surface area of 11,400 acres and a volume of 270,000 acre-ft, Lake Greenwood ranks tenth in surface area among the State’s lakes.

Poinsett (North Saluda) Reservoir is owned by the City of Greenville and is used solely as a municipal water supply. It has a surface area of 1,034 acres and a volume of 33,000 acre-ft.

The three largest hydroelectric power plants in the subbasin are listed in Table 6-10 and shown on Figure 6-5. With a generating capacity of 197.5 megawatts, the SCE&G Saluda plant at Lake Murray is the largest. Several other hydroelectric power plants on the Saluda River have capacities of less than 5 megawatts.

The subbasin contains no navigation projects, but the subbasin is the site of some of the earliest flood-control

Table 6-10. Major hydroelectric power generating facilities in the Saluda River subbasin (shown on Figure 6-5)

Number on map	Facility name and operator	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
1	Ware Shoals Chi Energy, Inc.	Saluda River	– – –	6.2	0
2	Buzzard's Roost Santee Cooper	Saluda River	Lake Greenwood	15	93,433
3	Saluda SCE&G	Saluda River	Lake Murray	197.5	149,244

projects in South Carolina. Eighteen flood- and erosion-control projects have been given Federal authorization. Since 1957, eight projects that involved more than 30 miles of channel improvement and 20 flood-retarding structures were completed by the U.S. Army Corps of Engineers (COE) or the Natural Resources Conservation Service (NRCS).

Surface-Water Quality

The Saluda River subbasin contains water bodies with a variety of water-use classifications, but most are designated as "Freshwater" (Class FW). Class FW lakes and streams are suitable for the survival and propagation of aquatic life, primary- and secondary-contact recreation, drinking water, fishing, and industrial and agricultural uses (DHEC, 2004a).

A large number of water bodies in the subbasin are designated as "Outstanding Resource Waters" (Class ORW). These are freshwater bodies that constitute an outstanding recreational or ecological resource and are suitable as a drinking-water source with minimal treatment. Class ORW water bodies in this basin include part of the North Saluda River, with the Poinsett Reservoir, and the South Saluda River including Table Rock Reservoir, Julian Creek, Matthews Creek, Coldstream Branch, Middle Saluda River, Head Foremost Creek, and Oil Camp Creek. Other ORW-designated water bodies are Falls Creek from its headwaters to Lake Trammell; Willis and Emory Creeks from their headwaters to the north boundary of Table Rock Resort property; Green Creek; the Carrick Creek headwater; and Pinnacle Lake.

Several streams are designated as "Trout Natural Waters" (Class TN). These are freshwater bodies suitable for supporting reproducing-trout populations and a cold-water balanced indigenous aquatic community of fauna and flora. Water bodies with this designation include parts of Oil Camp Creek; Lake Trammell, and part of Falls Creek; Gap Creek, Rock Branch, Buck Hollow, and the Middle Saluda River from the end of State land to Oil Camp Swamp.

The South Saluda River from Table Rock Reservoir dam to the crossing of S.C. Highway 8 and the main stem of the Saluda River and Saluda River tributaries from the Lake Murray dam to the confluence with the Broad River are classified as "Trout Put, Grow and Take Waters" (Class TPGT). These are freshwater bodies suitable for supporting the growth of stocked-trout populations and a balanced indigenous aquatic community of fauna and flora.

As part of its ongoing Watershed Water-Quality Assessment program, DHEC sampled 128 surface-water sites between 1997 and 2001 within the subbasin in order to assess the water's suitability for aquatic life and recreational uses (Figure 6-7). Aquatic-life uses were fully supported in 78 sites, or 61 percent of the water bodies sampled. Water was considered partially or fully impaired primarily because of poor macroinvertebrate-community structures or high phosphorus or metals concentrations. Aquatic life is not supported in Mill Creek, near Greenville, because of chromium and copper, and human health standards for chromium are consistently exceeded; these contaminants are transported by ground water from a nearby industrial site. Signs advise the public to avoid swimming, wading, drinking, or other contact with water from this creek, and the public is also advised not to consume fish from Mill Creek. Recreational use was fully supported in 55 percent of the sampled water bodies; water bodies that did not support recreational use exhibited high levels of fecal-coliform bacteria (DHEC, 2004a). Water-quality impairments in the subbasin are summarized in Table 6-11. DHEC publishes the most recently observed impairments and water-quality trends online in their 303(d) listings and 305(b) reports.

In 2008, DHEC issued a fish-consumption advisory for the Saluda River between Lake Greenwood and Lake Murray, and from Lake Murray to the Congaree River. Fish-consumption advisories are issued in areas where fish are contaminated with mercury; the contamination is only in the fish and does not make the water unsafe for swimming or boating.

The Reedy River and Bushy River arms of Lake Murray are listed as two of the most eutrophic lake embayments

Figure 6-7. Surface-water-quality monitoring sites evaluated by DHEC for suitability for aquatic life and recreational uses. Impaired sites are listed in Table 6-11 (DHEC, 2004a).

Table 6-11. Water-quality impairments in the Saluda River subbasin (DHEC, 2004a)

Water-body name	Station number	Use	Status	Water-quality indicator
North Saluda River	S-004	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
	S-773	Aquatic life	Nonsupporting	Macroinvertebrates
South Saluda River	S-087	Recreation	Partially supporting	Fecal coliform
	S-299	Recreation	Partially supporting	Fecal coliform
Middle Saluda River	S-077	Aquatic life	Nonsupporting	Copper
Oolenoy River	S-103	Recreation	Partially supporting	Fecal coliform
Saluda River	S-250	Recreation	Partially supporting	Fecal coliform
	S-007	Recreation	Partially supporting	Fecal coliform
Mill Creek	S-315	Aquatic life	Nonsupporting	Chromium, copper
		Drinking water	Nonsupporting	Chromium
		Recreation	Nonsupporting	Fecal coliform
Saluda River tributary	S-267	Recreation	Partially supporting	Fecal coliform
Grove Creek	S-171	Recreation	Nonsupporting	Fecal coliform
	S-774	Aquatic life	Partially supporting	Macroinvertebrates
Georges Creek	S-300	Recreation	Nonsupporting	Fecal coliform
Georges Creek tributary	S-005	Recreation	Nonsupporting	Fecal coliform
Big Brushy Creek	S-301	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Partially supporting	Fecal coliform
Saluda River	S-125	Recreation	Partially supporting	Fecal coliform
Turkey Creek	S-858	Aquatic life	Partially supporting	Macroinvertebrates
Lake Greenwood	S-024	Aquatic life	Partially supporting	pH
	S-131	Aquatic life	Nonsupporting	Total phosphorus
Cane Creek	S-097	Aquatic life	Nonsupporting	Dissolved oxygen, total phosphorus
Broad Mouth Creek	S-289	Recreation	Nonsupporting	Fecal coliform
	S-010	Recreation	Nonsupporting	Fecal coliform
	S-304	Recreation	Partially supporting	Fecal coliform
Broad Mouth Creek tributary	S-776	Aquatic life	Partially supporting	Macroinvertebrates
Reedy River	S-073	Recreation	Nonsupporting	Fecal coliform
	S-928	Aquatic life	Partially supporting	Macroinvertebrates
	S-319	Recreation	Nonsupporting	Fecal coliform
	S-013	Recreation	Nonsupporting	Fecal coliform
	S-018	Recreation	Nonsupporting	Fecal coliform
	S-323	Aquatic life	Nonsupporting	Copper
		Recreation	Nonsupporting	Fecal coliform
	S-072	Recreation	Partially supporting	Fecal coliform
Langston Creek	S-264	Recreation	Nonsupporting	Fecal coliform
Brushy Creek	S-067	Aquatic life	Partially supporting	Macroinvertebrates
	S-867	Recreation	Nonsupporting	Fecal coliform
Rocky Creek	S-091	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform

Table 6-11. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Huff Creek	S-863	Recreation	Nonsupporting	Fecal coliform
	S-178	Aquatic life	Partially supporting	Macroinvertebrates
Reedy River	S-778	Recreation	Partially supporting	Fecal coliform
	S-070	Aquatic life	Partially supporting	Macroinvertebrates
Boyd Mill Pond	S-311	Aquatic life	Nonsupporting	Total phosphorus, pH
Reedy River arm of Lake Greenwood	S-308	Aquatic life	Nonsupporting	Total phosphorus, pH
	S-022	Aquatic life	Nonsupporting	Total phosphorus, pH
North Rabon Creek	S-321	Recreation	Nonsupporting	Fecal coliform
South Rabon Creek	S-322	Recreation	Nonsupporting	Fecal coliform
Rabon Creek	S-096	Recreation	Partially supporting	Fecal coliform
Rabon Creek arm of Lake Greenwood	S-307	Aquatic life	Partially supporting	pH
Ninety Six Creek	S-856	Aquatic life	Partially supporting	Macroinvertebrates
Coronaca Creek	S-184	Aquatic life	Partially supporting	Macroinvertebrates
	S-092	Aquatic life	Nonsupporting	Dissolved oxygen, pH
Wilson Creek	S-235	Aquatic life	Partially supporting	Macroinvertebrates
Saluda River	S-186	Aquatic life	Partially supporting	Copper
	S-295	Aquatic life	Nonsupporting	Copper
	S-047	Aquatic life	Partially supporting	pH
Saluda River arm of Lake Murray	S-310	Aquatic life	Nonsupporting	pH
	S-223	Aquatic life	Nonsupporting	Total phosphorus, pH
Beaverdam Creek	S-852	Aquatic life	Partially supporting	Macroinvertebrates
Bush River	S-042	Aquatic life	Nonsupporting	Dissolved oxygen
	S-046	Recreation	Partially supporting	Fecal coliform
	RS-01044	Aquatic life	Partially supporting	Macroinvertebrates
	S-102	Recreation	Partially supporting	Fecal coliform
Scott Creek	S-044	Recreation	Nonsupporting	Fecal coliform
Bush River arm of Lake Murray	S-309	Aquatic life	Nonsupporting	Total phosphorus, pH
Little River	S-034	Recreation	Nonsupporting	Fecal coliform
	S-297	Recreation	Nonsupporting	Fecal coliform
	S-305	Aquatic life	Partially supporting	pH
North Creek	S-135	Recreation	Nonsupporting	Fecal coliform
Little Saluda River	S-050	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
	S-123	Aquatic life	Nonsupporting	Dissolved oxygen
Little Saluda River arm of Lake Murray	S-222	Aquatic life	Nonsupporting	Total phosphorus, pH
Clouds Creek	S-255	Aquatic life	Nonsupporting	Dissolved oxygen, pH
	S-324	Aquatic life	Partially supporting	pH
Lake Murray	S-279	Aquatic life	Nonsupporting	Total phosphorus, pH
	S-211	Aquatic life	Partially supporting	pH
	S-212	Aquatic life	Partially supporting	pH
	CL-083	Aquatic life	Partially supporting	pH

Table 6-11. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Camping Creek	S-290	Recreation	Partially supporting	Fecal coliform
Hollow Creek	S-306	Aquatic life	Partially supporting	pH
		Recreation	Nonsupporting	Fecal coliform
Saluda River	S-152	Aquatic life	Partially supporting	Dissolved oxygen, pH
	S-149	Aquatic life	Partially supporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
Rawls Creek	RS-01012	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Partially supporting	Fecal coliform
	S-287	Recreation	Nonsupporting	Fecal coliform
Lorick Branch	S-150	Recreation	Nonsupporting	Fecal coliform
Kinley Creek	S-260	Aquatic life	Partially supporting	Macroinvertebrates, dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Twelvemile Creek	S-294	Recreation	Nonsupporting	Fecal coliform
Fourteenmile Creek	S-848	Aquatic life	Partially supporting	Macroinvertebrates

in the State. These areas have high densities of algae and high phosphorus concentrations. Boyd Mill Pond is one of the most eutrophic small lakes in South Carolina owing to algae and phosphorus concentrations. The upper end of Lake Murray has been classified as one of the most eutrophic sites on a large lake in South Carolina because of a high algae density. Large lakes characterized as having intermediate trophic conditions are Lake Greenwood, the Rabon Creek arm of Lake Greenwood, the Saluda River arm of Lake Murray, and the Little Saluda River arm of Lake Murray. Oolenoy Lake is characterized as one of the least eutrophic small lakes in the State because of its low nutrient concentration and clear water. Saluda Lake also is listed as one of the least eutrophic small lakes, mainly owing to low phosphorus concentrations and high levels of dissolved oxygen. Lake Murray is characterized as one of the least eutrophic large lakes in South Carolina. The lake is a source of public water supply and a major recreation area, and, in 2000, DHEC designated it as a no-discharge lake for marine toilets (DHEC, 2004a).

GROUND WATER

Hydrogeology

The Saluda River subbasin lies almost entirely within the Piedmont province; only the extreme southern portion is in the Coastal Plain province. The extreme northwestern tip of Greenville County and the extreme northeastern tip of Pickens County are in the Chauga belt, which is the northwest-most belt of the Piedmont province. The subbasin is crossed by five more geologic units trending northeast to southwest. From north to south, these are the Walhalla thrust sheet (Pickens and Greenville Counties), the Sixmile thrust sheet (Anderson, Pickens, and Greenville Counties), the Laurens thrust sheet (Anderson, Greenville, Abbeville, Laurens, and Greenwood Counties), the Charlotte terrane (Greenwood, Laurens, and Newberry Counties) and the Carolina terrane (Greenwood, Newberry, Saluda, Lexington, and Richland Counties). To the south is the Modoc Shear zone (Saluda and Lexington Counties), which separates the metamorphic and igneous rocks of the Piedmont from the sediments of the Coastal Plain to the south. Another shear zone, the Lowndesville, partially separates the Charlotte and the Carolina terranes in Greenwood and Laurens Counties. Scattered gabbro and granite intrusions occur in the subbasin as well.

Ground-water availability in the subbasin is generally limited to zones of substantial fracturing. Well records for the subbasin counties range from numerous in the northwestern part of the subbasin, especially in Greenville County, to sparse in the southeastern part. Reported well depths range from 29 to 1,103 feet, with the majority of wells less than 350 feet deep. Yields generally are 20 gpm (gallons per minute) or less but can be as much as 400 gpm. Table 6-12 summarizes drilled bedrock-well depths and yields in the Piedmont portion of the subbasin.

Boyter (1979) compared well data in relation to more than 100 linear fracture zones mapped in parts of Oconee, Pickens, and Anderson Counties. He found that wells drilled into fracture zones yield 10 to 500 gpm, whereas wells outside of fracture zones commonly yield 1 gpm or less. Boyter also observed that wells drilled in valleys

Table 6-12. Well depths and yields for drilled bedrock wells in the Saluda River subbasin

County	Well depth (feet)		Well yield (gpm)	
	Average	Maximum	Average	Maximum
Abbeville	237	455	8	20
Anderson	303	730	32	400
Greenville	243	1,057	18	200
Greenwood	264	642	21	150
Laurens	277	750	17	300
Lexington	194	540	15	150
Newberry	229	725	16	200
Pickens	268	705	20	200
Richland	227	400	17	40
Saluda	236	1,103	15	90
Total	250	1,103	18	400

with linear features generally provide greater than average yields and that metamorphic- and igneous-rock fracture zones offer the best opportunity for maximum yields.

Ground water occurs in the Middendorf aquifer (about 200 feet thick) and the bedrock aquifer in northern Lexington County. In Gilbert and Summit, public-supply wells screened in the Middendorf produce as much as 250 gpm. Pumping tests of 60- to 100-foot deep Middendorf aquifer wells at the Michelin Tire plant indicate that well yields of 200–300 gpm are possible near Red Bank. The highest reported yield from a bedrock well is about 150 gpm.

About 25 percent of DNR's well records for the Piedmont part of the subbasin include reports of large-diameter bored wells. Their depths range between 6 and 88 feet and average 50 feet. Yields commonly are but a few gallons per minute, and the shallowest wells may be unreliable during droughts.

Ground-Water Quality

In the rock aquifers of this subbasin, ground-water pH ranges from 5.1 to 8.3, alkalinity ranges from 5 to 275 mg/L (milligrams per liter), and TDS (total dissolved solids) concentrations range from 5 to 950 mg/L (National Uranium Resource Evaluation program, 1997). The few wells with TDS above 500 mg/L are in the Carolina slate belt.

Radiochemical analyses of ground water from the Tertiary sand aquifer near Leesville, in Lexington County, indicate naturally high concentrations of gross-alpha particle activity up to 45 pCi/L (picoCuries per liter) and radium-226 activity to 23.0 pCi/L. These levels locally exceed acceptable drinking-water standards (Moore and Michel, 1980). The source of the radium, a disintegration product of thorium, is thought to be the granitic rocks cropping out near the Fall Line, and its occurrence appears to be concentrated in the crystalline rocks and sediment in a narrow zone adjoining the Fall Line.

Water-Level Conditions

Ground-water levels are routinely monitored by DNR and USGS in 10 wells in the Saluda River subbasin to help assess trends or changes in hydrologic conditions (Table 6-13). Water levels in these wells are often indicative of local hydrologic conditions that impact the surface-water systems to which the ground water is connected. Changes in observed water levels are almost always a reflection of changes in above-ground hydrologic conditions.

Because ground-water use in this subbasin is very limited, no areas within the subbasin are experiencing significant water-level declines caused by overpumping.

WATER USE

Water-use information presented in this chapter is derived from water-use data for the year 2006 that were collected and compiled by DHEC (Butler, 2007) and represents only withdrawals reported to DHEC for that year. Water-use categories and water-withdrawal reporting criteria are described in more detail in the *Water Use* chapter of this publication.

Water use in the Saluda River subbasin is summarized in Table 6-14 and Figure 6-8. Offstream water use totaled 133,370 million gallons in 2006, ranking it sixth among the 15 subbasins. Of this amount, 132,226 million gallons were from surface-water sources (99 percent) and 1,144 million gallons were from ground-water sources (1 percent). Thermoelectric power production accounted for 62 percent of this total use, followed by water supply (30 percent) and industry (6 percent). Minor amounts of water were also used for agricultural irrigation and golf-course irrigation. Consumptive use in this subbasin is estimated to be 9,716 million gallons, or about 7 percent of the total offstream use.

The two thermoelectric power plants operating in the subbasin used a total of 82,721 million gallons in 2006. SCE&G's McMeekin Station is a coal-fired power plant located adjacent to the Lake Murray Dam in Lexington County. The plant contains two turbines capable of generating 293.6 MW (megawatts) of power (South Carolina Energy Office, 2005). In 2006, it used 50,964 million gallons of water for cooling and steam, drawing its water from the bottom of Lake Murray. It was the largest user in the subbasin.

The Lee Steam Station is a coal-fired power plant owned and operated by Duke Energy. Located on the Saluda River in Anderson County, the plant contains three turbines capable of generating 355 MW of power

Table 6-13. Water-level monitoring wells in the Saluda River subbasin

Well number	Monitoring agency*	Latitude Longitude (deg min sec)	Aquifer	Well location	Land surface elevation (feet)	Depth (feet) to screen top, bottom; or open interval
AND-326	USGS	34 37 14 82 28 56	Crystalline rock	Williamston	785	75–398
GRV-712	USGS	35 06 22 82 37 36	Crystalline rock	Ceasars Head State Park	3,150	28–450
GRV-2543	DNR	35 07 34 82 34 17	Crystalline rock	Jones Gap State Park	1,329	undetermined
GRV-3333	DNR	35 09 57 82 28 17	Crystalline rock	Highway 25, near N.C. state line	1,867	58–260
GRV-3335	DNR	35 07 30 82 34 26	Crystalline rock	Jones Gap State Park	1,352	62–110
GRV-3336	DNR	35 07 30 82 34 26	Shallow	Jones Gap State Park	1,352	14–19
LRN-1705	DNR	34 29 26 82 02 35	Shallow	Joe Adair Outdoor Center, Laurens	641	29–39
LRN-1706	DNR	34 34 14 82 06 50	Crystalline rock	Big Knob Fire Tower	840	undetermined
LRN-1707	DNR	34 22 52 82 00 23	Crystalline rock	Mountville Fire Tower	660	undetermined
SAL-69	DNR	34 05 17 81 40 13	Crystalline rock	Hollywood Elementary School	445	92–480

* *DNR, South Carolina Department of Natural Resources; USGS, United States Geological Survey*

(South Carolina Energy Office, 2005). It also houses three combustion turbine units capable of generating an additional 105.3 MW. In 2006, it used 31,757 million gallons of water from the Saluda River for cooling and steam.

Water-supply use in the Saluda River subbasin was greater than in any other subbasin in the State. Eleven water-supply systems used a total of 40,055 million gallons of water in 2006. Of this amount, 40,033 million gallons were from surface-water sources (99.95 percent) and 22 million gallons were from wells (0.05 percent). The City of Greenville had the largest use, withdrawing 15,019 million gallons from the North Saluda River and Table Rock Reservoir. Greenville operates another surface-water facility in the Upper Savannah River subbasin at Lake Keowee. The City of Columbia facility at Lake Murray withdrew 10,814 million gallons. Other systems of note include Greenwood Commission of Public Works (4,238 million gallons from Lake Greenwood and the Saluda River), Easley Combined Utility (2,762 million gallons from Saluda Lake), and West Columbia (2,599 million gallons from the Saluda River and Lake Murray). Gilbert-Summit Rural Water District had the largest ground-water supply system in the subbasin with withdrawals of 16 million gallons from the crystalline rock and surficial aquifers.

Industrial water use totaled 7,850 million gallons in 2006. Of this amount, 7,825 million gallons were from surface-water sources (99.7 percent) and 25 million gallons were from ground-water sources (0.3 percent). Shaw Industries Group, Inc. in Lexington County was the largest user, having withdrawals totaling 7,788 million gallons.

Irrigation water use totaled 2,314 million gallons in the subbasin. Of this amount, 1,219 million gallons were from surface-water sources (53 percent) and 1,095 million gallons were from ground-water sources (47 percent). Large surface-water users include Mt. Airy Farms in Saluda County (420 million gallons) and Walter P. Rawl & Sons, Inc. in Lexington County (350 million gallons). Walter P. Rawl & Sons, Inc. also used 1,045 million gallons of ground water from the crystalline rock and surficial aquifers.

The total instream water use for hydroelectric power generation was 508,945 million gallons in 2006. Seven hydroelectric power facilities operate in the subbasin, all on the Saluda River. The Saluda Dam Hydroelectric Station at Lake Murray is SCE&G's largest conventional hydroelectric power plant, with five turbines and a capacity of 197.5 MW. In 2006, it used 149,244 million gallons

Table 6-14. Reported water use in the Saluda River subbasin for the year 2006 (modified from Butler, 2007)

Water-use category	**Surface water**		**Ground water**		**Total water**	
	Million gallons	**Percentage of total surface-water use**	**Million gallons**	**Percentage of total ground-water use**	**Million gallons**	**Percentage of total water use**
Aquaculture	0	0.0	0	0.0	0	0.0
Golf course	428	0.3	2	0.2	430	0.3
Industry	7,825	5.9	25	2.2	7,850	5.9
Irrigation	1,219	0.9	1,095	95.7	2,314	1.7
Mining	0	0.0	0	0.0	0	0.0
Other	0	0.0	0	0.0	0	0.0
Thermoelectric power	82,721	62.6	0	0.0	82,721	62.0
Water supply	40,033	30.3	22	1.9	40,055	30.0
Total	132,226		1,144		133,370	

of water. The Buzzard's Roost hydroelectric facility at Lake Greenwood, operated by Duke Energy, has three turbines and a capacity of 15 MW. It used 93,433 million gallons in 2006.

Other hydroelectric plants in the subbasin include Holiday Bridge in Anderson County (92,268 million gallons); Lower Pelzer in Anderson County (83,000 million gallons); Piedmont Hydroelectric Power Project in Greenville County (56,000 million gallons); Upper Pelzer in Anderson County (35,000 million gallons); and Ware Shoals in Laurens County (reported no water use in 2006).

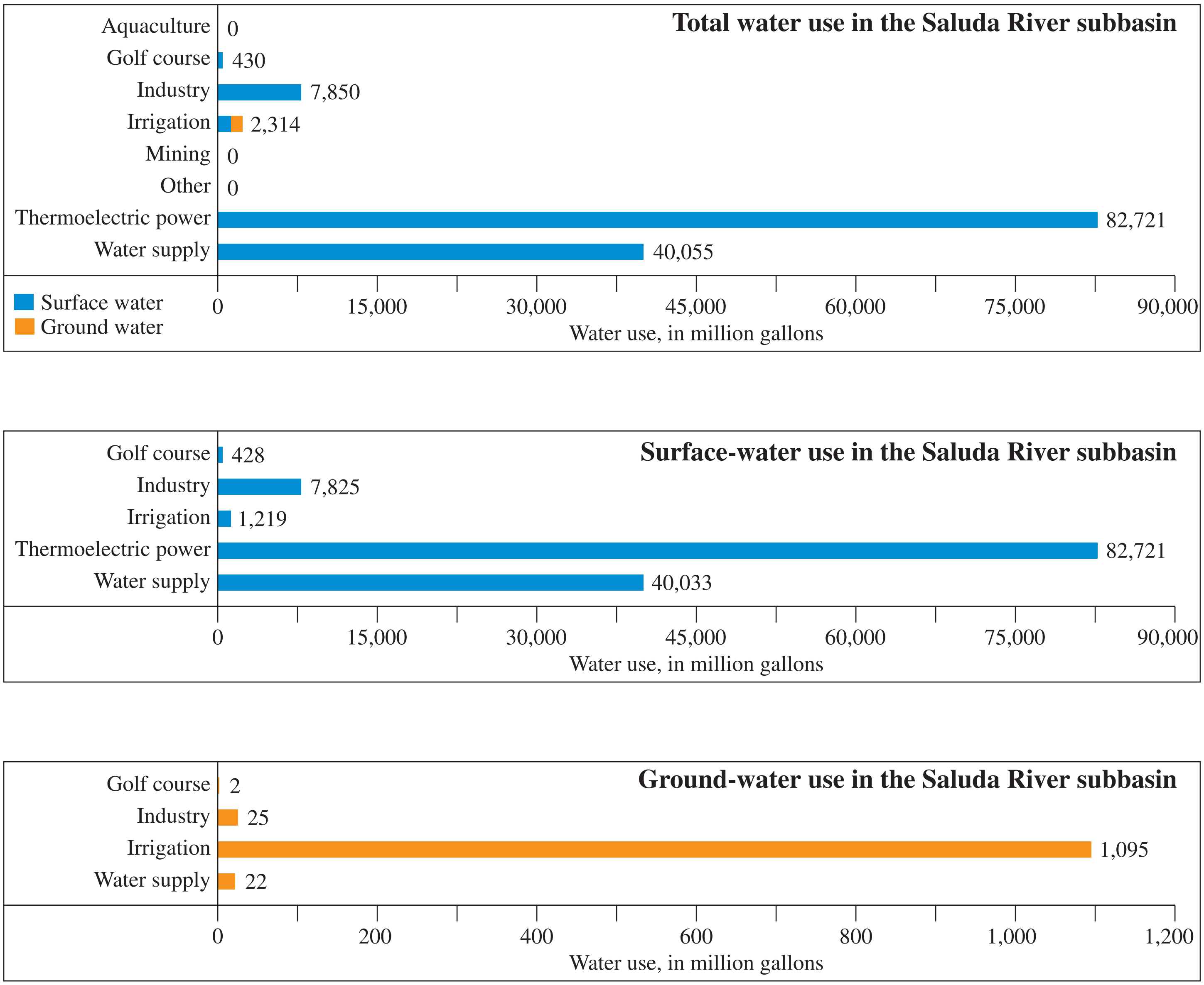


Figure 6-8. Reported water use in the Saluda River subbasin for the year 2006 (modified from Butler, 2007).

CATAWBA-WATEREE RIVER SUBBASIN

CATAWBA-WATEREE RIVER SUBBASIN

The Catawba-Wateree River subbasin bisects the north-central portion of South Carolina. The subbasin parallels the course of the Catawba-Wateree River from the North Carolina border south to the confluence with the Congaree River. Parts of eight South Carolina counties are in the subbasin, including most of Chester, Kershaw, Lancaster, and York Counties, the eastern third of Fairfield County, and small portions of Lee, Richland, and Sumter Counties (Figure 6-9). The subbasin area is approximately 2,315 square miles, 7.5 percent of the State.

DEMOGRAPHICS

The year 2000 population of the subbasin was estimated at 305,900, or 7.6 percent of the State's total population. Significant population increases are expected by the year 2020, with the largest increases anticipated in York and Lancaster Counties. This area of the subbasin encompasses the metropolitan areas of Rock Hill, York, and Lancaster and is influenced by Charlotte, N.C.

In general, the upper part of the Catawba-Wateree subbasin is well developed and urbanized, whereas the lower part is relatively sparsely populated and rural. The major population centers in the South Carolina portion of the subbasin are Rock Hill (49,765), Lancaster (8,177), Camden (6,682), Chester (6,476), and York (6,700).

Year-2005 per capita income in the subbasin ranged from $31,518 in Richland County to $20,307 in Lee County. Richland, York, and Kershaw Counties ranked fifth, seventh, and eighth in the State and were the only subbasin counties with per capita incomes above the State average of $28,285. The 1999 median household incomes ranged from $44,539 in York County to $26,907 in Lee County.

During 2000, the subbasin's counties had combined annual-average employment of non-agricultural wage and salary workers of 160,000. Labor distribution in the subbasin counties included management, professional, and technical services, 26 percent; sales and office, 25 percent; production, transportation, and materials moving, 23 percent; service, 13 percent; construction, extraction, and maintenance, 13 percent; and farming, fishing, and forestry, 1 percent.

In the sectors of manufacturing and public utilities, the counties overlapping the subbasin had an annual product value of $10.6 billion in 2000. Crop and livestock production was $166 million, and the delivered value of timber exceeded $120 million (South Carolina Budget and Control Board, 2005).

SURFACE WATER

Hydrology

The major watercourse draining this subbasin is the Catawba-Wateree River. The headwater streams and much of the drainage area of the Catawba River are in North Carolina. At its confluence with Big Wateree Creek near Lake Wateree in the middle of the subbasin, the Catawba River changes in name to the Wateree River. Major tributaries in the Piedmont portion of the subbasin include Fishing Creek, Rocky Creek, Big Wateree Creek, Sugar Creek, and Cane Creek. Streams draining the upper Coastal Plain below Lake Wateree include Spears Creek, Colonels Creek, and Swift Creek.

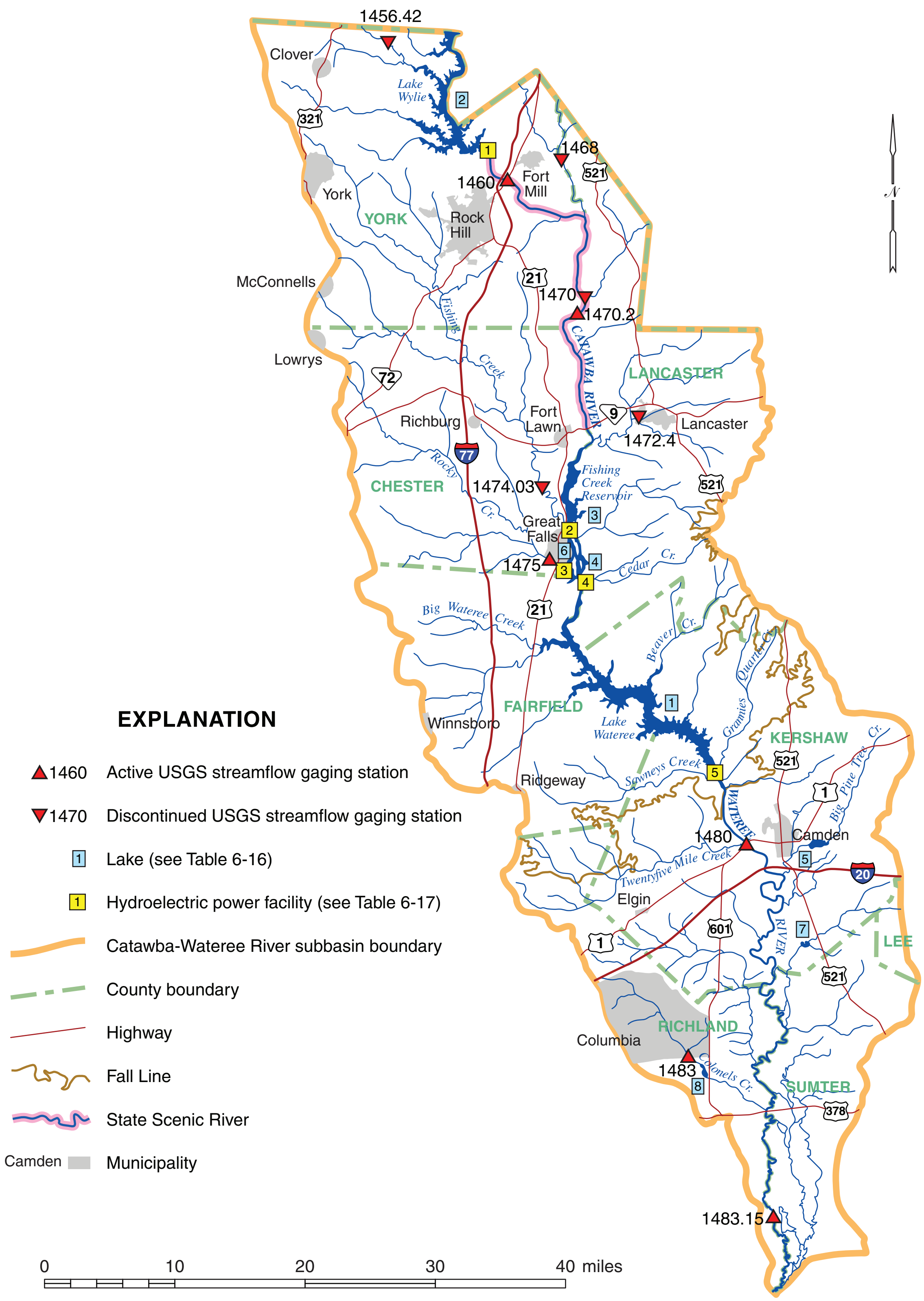


Figure 6-9. Map of the Catawba-Wateree River subbasin.

Controlled releases from a series of six hydroelectric reservoirs in North Carolina and five in South Carolina greatly affect streamflow of the Catawba-Wateree River. Duke Energy owns and operates all the reservoirs and hydroelectric power plants along the river in North and South Carolina.

Streamflow is currently monitored at six gaging stations, four of which are on the Catawba-Wateree River main stem and two on tributary streams (Figure 6-9). Streamflow statistics for these active gages and five discontinued gages are presented in Table 6-15. Streamflow at all main-stem stations has been subject to regulated releases for nearly all of the period of record because of numerous hydroelectric power facilities in North and South Carolina. The gaging station on the Wateree River below Eastover accurately monitors streamflow only below 10,000 cfs (cubic feet per second); the full range of flow is monitored at all other gaging stations.

The Catawba River is well developed by the time it enters South Carolina at Lake Wylie. Average annual flow of the Catawba-Wateree River ranges from 4,226 cfs near Rock Hill to 6,080 cfs near Camden. Streamflow can be expected

Table 6-15. Selected streamflow characteristics at USGS gaging stations in the Catawba-Wateree River subbasin

Gaging station name, location, station number	Period of record	Drainage area (mi²)	Average flow (cfs)	Average flow (cfsm)	90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
Crowders Creek near Clover 1456.42	1991-92 and 2000-01	89.0	58.5	0.66	21.0	11.0 2001	2,350 1991	– – –
Catawba River near Rock Hill 1460	1895-1903 and 1942-2007*	3,050	4,226	1.39	894	132 2002	127,000 1901	151,000 1901
Sugar Creek near Fort Mill 1468	1974 to 1979	262	461	1.76	98.0	24.0 1979	– – –	22,700 1976
Catawba River near Catawba 1470	1968 to 1992	3,530	5,183	1.47	1,060	480 1986	66,800 1989	73,600 1976
Catawba River below Catawba 1470.2	1992 to 2007*	3,540	4,317	1.22	1,100	451 2003	49,800 2003	– – –
Bear Creek at Lancaster 1472.4	1978 to 1982	66.6	53.9	0.81	2.1	0.7 1981	1,990 1980	3,610 1980
Fishing Creek below Fort Lawn 1474.03	2001 to 2003	134	272	2.03	5.8	3 2001	5,490 2003	– – –
Rocky Creek at Great Falls 1475	1951 to 2007*	194	175	0.90	15	0.0 2002	21,100 1967	31,300 1967
Wateree River near Camden 1480	1904-10 and 1929-2007*	5,070	6,080	1.20	1,230	143 1980	149,000 1929	366,000† 1908
Colonels Creek near Leesburg 1483	1966-80 and 2004-07*	38.1	43.4	1.14	18	5.6 2006	893 1967	1,350 1967
Wateree River below Eastover 1483.15	1968 to 2007*	5,590	Indeterminate	– – –	– – –	549 1986	– – –	unknown‡ 1989

mi², square miles; cfs, cubic feet per second; cfsm, cubic feet per second per square mile of drainage area
90% exceeds flow: the discharge that has been exceeded 90 percent of the time during the period of record for that gaging station
** 2007 is the most recent year for which published data were available when this table was prepared*
† A flow estimated at 400,000 cfs occurred at this site in 1916 (outside period of record)
‡ Discharge measured only in main channel; flows greater than 10,000 cfs not recorded

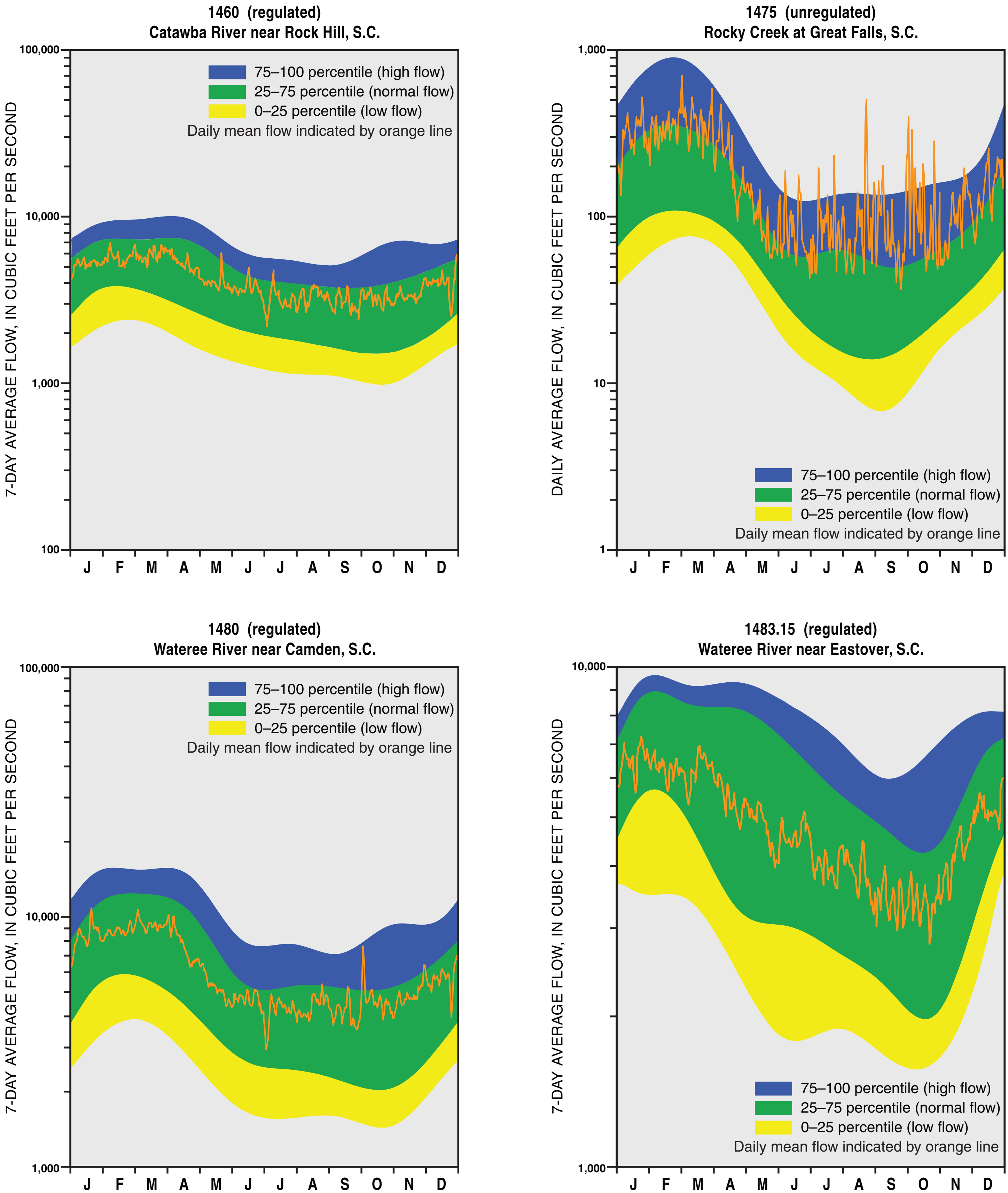


Figure 6-10. Duration hydrographs for selected gaging stations in the Catawba-Wateree River subbasin.

to equal or exceed 894 cfs near Rock Hill and 1,230 cfs near Camden 90 percent of the time. The lowest recorded flow on the main stem (132 cfs) occurred near Rock Hill in 2002 during the 1998–2002 drought. The highest flood flow of record (estimated at 400,000 cfs) was recorded near Camden in 1916. Daily streamflows near Camden are more variable than elsewhere along the river because of fluctuating releases from Lake Wateree (Figure 6-10).

Unlike the main stem, tributary streams are largely unregulated, and flows in these streams rarely exceed 1,000 cfs. Average annual streamflow of one actively-gaged tributary, Rocky Creek at Great Falls, is 175 cfs, with flow in this stream equal to or exceeding 15 cfs 90 percent of the time. At the other active tributary gage, on Colonels Creek near Leesburg, the average annual streamflow is 43 cfs and streamflow is expected to equal or exceed 18 cfs 90 percent of the time. Differing geomorphological characteristics of two major physiographic provinces greatly influence streamflow in these and other tributaries. Colonels Creek is in the upper Coastal Plain, where highly permeable soils, subsurface sediments, and deeply incised streams result in well-sustained flows during periods of low rainfall. Rocky Creek is in the Piedmont, where high relief and impermeable soils result in rapid runoff and limited ground-water storage. It and other Piedmont streams are, therefore, characterized by highly variable flows dependent primarily on rainfall and runoff rather than discharge from ground-water storage (Figure 6-10).

Streamflow in the upper portion of the Catawba-Wateree River is well-sustained throughout the year and provides a reliable source of supply. Although surface-water availability in the portion of the river below Wateree Dam is relatively constant, daily fluctuations and resultant low flows may limit some water-use activities. Larger water users may require storage facilities in this lower stretch of the river to help ensure more reliable surface-water supplies.

Tributary streams in the upper Coastal Plain, such as Colonels Creek, support relatively constant streamflows and provide a reliable surface-water flow if adequate in volume. Tributary streams in the Piedmont are not reliable water-supply sources, however, owing to widely fluctuating flows and low flows during periods of low rainfall. Unregulated Piedmont streams require provisions for storage to ensure sustained surface-water availability.

Development

The Catawba-Wateree River subbasin is intensely developed. Surface-water development consists primarily of dams and reservoirs for hydroelectric power production but also includes several flood-control projects. Before entering South Carolina, the Catawba River passes through six hydroelectric power projects and provides water for one nuclear and three coal-fired thermoelectric power plants.

In the South Carolina portion of the subbasin, the aggregate surface area of all lakes greater than 10 acres is approximately 34,400 acres, with a total volume of 734,800 acre-ft. The three largest reservoirs, all owned and operated by Duke Energy, are Lake Wateree, Lake Wylie, and Fishing Creek Reservoir (Table 6-16). By surface

Table 6-16. Lakes 200 acres or more in the Catawba-Wateree River subbasin (shown on Figure 6-9)

Number on map	Name	Stream	Surface area (acres)	Storage capacity (acre-feet)	Purpose
1	Lake Wateree	Wateree River	13,864[b]	310,000[a]	Power, recreation, and water supply
2	Lake Wylie	Catawba River	13,443[b]	281,900[a]	Power, recreation, industry, and water supply
3	Fishing Creek Reservoir	Catawba River	3,112[b]	80,000[a]	Power, recreation, industry, and water supply
4	Rocky Creek Lake (Cedar Creek Reservoir)	Catawba River	847[b]	23,000[a]	Power, recreation, and water supply
5	Hermitage Mill Pond	Big Pine Tree Creek	600[a]	1,800[a]	Power, recreation, industry, and water supply
6	Great Falls Lake	Catawba River	477[b]	16,000[a]	Power
7	Boykin Mill Pond	Swift Creek	200[a]	640[a]	Recreation
8	Murray Pond	Colonels Creek	200[a]	600[a]	Recreation

Sources: (a) U.S. Army Corps of Engineers (1991)
(b) Duke Energy website http://www.duke-energy.com/lakes/facts-and-maps.asp (2008)

area, Lake Wateree and Lake Wylie are the eighth and ninth largest lakes in the State, respectively. Lake Wateree is the tenth largest reservoir in the State by volume.

Lake Wateree is 8 miles northwest of Camden on the Wateree River. Constructed in 1920 and enlarged in 1925, it is used for power generation, municipal water supplies, industry, and recreation.

Lake Wylie is on the North Carolina-South Carolina border, 5 miles north of Rock Hill. Constructed in 1904 for the generation of hydroelectric power, it is one of the oldest major impoundments in the State. Lake Wylie was enlarged to its present capacity in 1924 and also serves water supply, industrial, and recreational needs.

Fishing Creek Reservoir was built for the production of hydroelectric power in 1916. In addition to power generation, it is used as a municipal water supply and for industrial and recreational needs.

In addition to the hydroelectric power plants at Lake Wylie, Lake Wateree, and Fishing Creek Reservoir, four other hydropower plants are located just downstream from Fishing Creek Reservoir (Table 6-17). The Great Falls and Dearborn Hydroelectric Stations are both located on Great Falls Lake; the powerhouse for Great Falls is on the west side of the dam and the powerhouse for Dearborn is on the east side. The Cedar Creek and Rocky Creek Hydroelectric Stations are both located on Rocky Creek Lake (Cedar Creek Reservoir); Rocky Creek is on the west side of the dam and Cedar Creek is on the east side.

Table 6-17. Hydroelectric power generating facilities in the Catawba-Wateree River subbasin (shown on Figure 6-9)

Number on map	Facility name and operator	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
1	Wylie Duke Energy	Catawba River	Lake Wylie	60	679,938
2	Fishing Creek Duke Energy	Catawba River	Fishing Creek Lake	36.7	783,749
3	Great Falls Duke Energy	Catawba River	Great Falls Lake	24	23,821
3	Dearborn Duke Energy	Catawba River	Great Falls Lake	45	810,158
4	Rocky Creek Duke Energy	Catawba River	Rocky Creek Lake	28	5,377
4	Cedar Creek Duke Energy	Catawba River	Rocky Creek Lake	45	859,455
5	Wateree Duke Energy	Wateree River	Lake Wateree	56	923,086

The Wateree River is the site of the only U.S. Army Corps of Engineers project in the subbasin. In the late 1800's and early 1900's, a 4-foot navigation channel was maintained from the mouth of the river to Camden. The project remains authorized but is no longer active.

The NRCS (Natural Resources Conservation Service) has completed four flood-control and drainage projects in the subbasin. These projects include 18.3 miles of channel improvement, 29 floodwater-retarding structures, and land treatment for erosion control and sediment reduction.

In 2008, American Rivers, a national river conservation group, declared the Catawba-Wateree River to be *America's Most Endangered River*. Rapid population growth, particularly in the Charlotte metropolitan area, and inadequate and outdated water-management practices and legislation in both North and South Carolina threaten to impair the river's health and its ability to provide for residents in the future (American Rivers, 2008).

Surface-Water Quality

All water bodies in the Catawba-Wateree subbasin are designated "Freshwater" (Class FW). This class of water bodies is suitable for the survival and propagation of aquatic life, primary- and secondary-contact recreation, drinking-water supply, fishing, and industrial and agricultural uses (DHEC, 2005a).

As part of its ongoing Watershed Water Quality Assessment program, DHEC sampled 113 surface-water sites in the Catawba-Wateree subbasin during 1998 and 2002 in order to assess the water's suitability for aquatic life and recreational uses (Figure 6-11). Aquatic-life uses

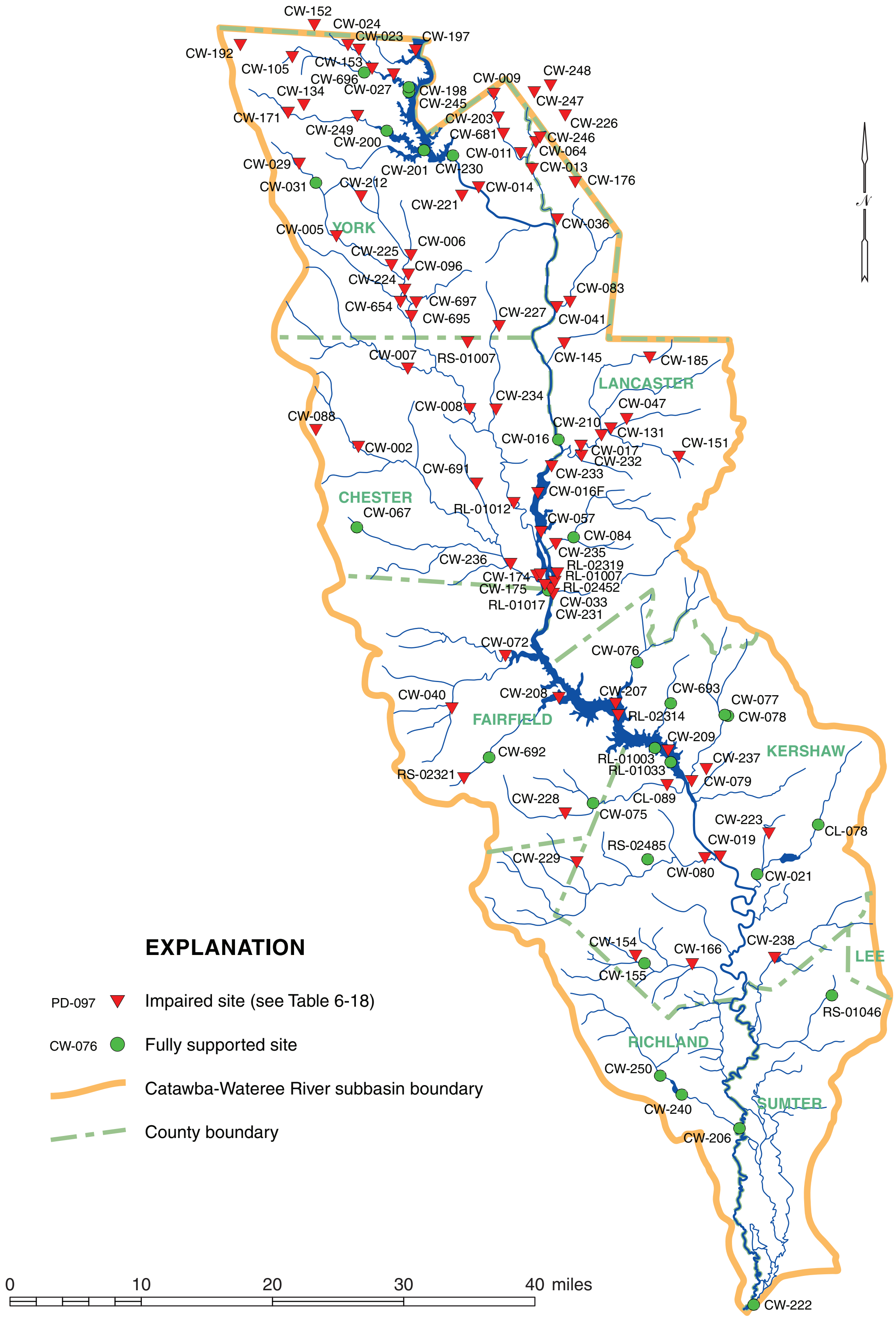


Figure 6-11. Surface-water-quality monitoring sites evaluated by DHEC for suitability for aquatic life and recreational uses. Impaired sites are listed in Table 6-18 (DHEC, 2005a).

Table 6-18. Water-quality impairments in the Catawba-Wateree River subbasin (DHEC, 2005a)

Water-body name	Station number	Use	Status	Water-quality indicator
Lake Wylie	CW-197	Aquatic life	Nonsupporting	Copper
	CW-027	Recreation	Partially supporting	Fecal coliform
South Fork	CW-192	Recreation	Nonsupporting	Fecal coliform
Crowders Creek	CW-152	Aquatic life	Nonsupporting	Copper
		Recreation	Partially supporting	Fecal coliform
	CW-023	Recreation	Nonsupporting	Fecal coliform
	CW-024	Aquatic life	Nonsupporting	Macroinvertebrates
		Recreation	Partially supporting	Fecal coliform
Brown Creek	CW-105	Aquatic life	Nonsupporting	Turbidity
		Recreation	Nonsupporting	Fecal coliform
Beaverdam Creek	CW-153	Recreation	Partially supporting	Fecal coliform
Allison Creek	CW-171	Recreation	Nonsupporting	Fecal coliform
	CW-249	Recreation	Nonsupporting	Fecal coliform
Calabash Creek	CW-134	Recreation	Nonsupporting	Fecal coliform
Hidden Creek	CW-221	Recreation	Nonsupporting	Fecal coliform
Catawba River	CW-014	Recreation	Partially supporting	Fecal coliform
	CW-041	Aquatic life	Nonsupporting	Copper
Fishing Creek Reservoir	CW-016F	Aquatic life	Nonsupporting	Turbidity, total phosphorus
	RL-01012	Aquatic life	Nonsupporting	Chlorophyll-*a*
	CW-057	Aquatic life	Nonsupporting	Total phosphorus
Cedar Creek Reservoir	CW-174	Aquatic life	Nonsupporting	Dissolved oxygen, total phosphorus, total nitrogen
		Recreation	Partially supporting	Fecal coliform
	RL-02319	Aquatic life	Nonsupporting	Total phosphorus
	RL-01007	Aquatic life	Nonsupporting	Chlorophyll-*a*, dissolved oygen
	RL-02452	Aquatic life	Nonsupporting	Total phosphorus
	CW-033	Aquatic life	Nonsupporting	Total phosphorus
Sugar Creek	CW-247	Aquatic life	Nonsupporting	Cadmium, copper
		Recreation	Partially supporting	Fecal coliform
	CW-246	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
	CW-013	Recreation	Nonsupporting	Fecal coliform
	CW-036	Aquatic life	Nonsupporting	Copper
		Recreation	Nonsupporting	Fecal coliform
Little Sugar Creek	CW-248	Recreation	Nonsupporting	Fecal coliform
McAlpine Creek	CW-226	Recreation	Nonsupporting	Fecal coliform
	CW-064	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
Steel Creek	CW-009	Recreation	Nonsupporting	Fecal coliform
	CW-203	Recreation	Nonsupporting	Fecal coliform
	CW-681	Aquatic life	Partially supporting	Macroinvertebrates
	CW-011	Recreation	Partially supporting	Fecal coliform

Table 6-18. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Sixmile Creek	CW-176	Recreation	Nonsupporting	Fecal coliform
Twelvemile Creek	CW-083	Aquatic life	Nonsupporting	Turbidity, copper
		Recreation	Partially supporting	Fecal coliform
Waxhaw Creek	CW-145	Aquatic life	Nonsupporting	Copper
		Recreation	Nonsupporting	Fecal coliform
Cane Creek	CW-185	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
	CW-210	Aquatic life	Partially supporting	Macroinvertebrates
	CW-017	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
Bear Creek	CW-151	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
	CW-131	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Gills Creek	CW-047	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Rum Creek	CW-232	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
Fishing Creek	CW-029	Recreation	Nonsupporting	Fecal coliform
	CW-005	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Nonsupporting	Fecal coliform
	CW-225	Aquatic life	Nonsupporting	Copper
		Recreation	Nonsupporting	Fecal coliform
Wildcat Creek	CW-006	Aquatic life	Nonsupporting	Turbidity
		Recreation	Nonsupporting	Fecal coliform
	CW-096	Aquatic life	Nonsupporting	Turbidity
		Recreation	Nonsupporting	Fecal coliform
Tools Fork	CW-212	Aquatic life	Nonsupporting	Turbidity
		Recreation	Nonsupporting	Fecal coliform
Fishing Creek	CW-224	Recreation	Nonsupporting	Fecal coliform
	CW-654	Aquatic life	Partially supporting	Macroinvertebrates
	CW-008	Recreation	Partially supporting	Fecal coliform
	CW-233	Recreation	Partially supporting	Fecal coliform
Stoney Fork	CW-697	Aquatic life	Partially supporting	Macroinvertebrates
Taylor Creek	CW-695	Aquatic life	Partially supporting	Macroinvertebrates
South Fork Fishing Creek	CW-007	Aquatic life	Partially supporting	Macroinvertebrates
McFadden Branch	RS-01007	Recreation	Nonsupporting	Fecal coliform
Lake Oilphant	CL-021	Aquatic life	Nonsupporting	Ph, chlorophyll-*a*
Neelys Creek	CW-227	Recreation	Partially supporting	Fecal coliform
Tinkers Creek	CW-234	Aquatic life	Nonsupporting	Macroinvertebrates, turbidity
		Recreation	Partially supporting	Fecal coliform
Camp Creek	CW-235	Recreation	Nonsupporting	Fecal coliform

Table 6-18. Continued

Water-body name	Station number	Use	Status	Water-quality indicator
Grassy Run Branch	CW-088	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Rocky Creek	CW-002	Aquatic life	Nonsupporting	Macroinvertebrates, copper
		Recreation	Nonsupporting	Fecal coliform
	CW-236	Recreation	Nonsupporting	Fecal coliform
Beaverdam Creek	CW-691	Aquatic life	Partially supporting	Macroinvertebrates
Rocky Creek arm of Cedar Creek Reservoir	CW-175	Aquatic life	Nonsupporting	Dissolved oxygen, turbidity, total phosphorus
		Recreation	Nonsupporting	Fecal coliform
Lake Wateree	CW-231	Aquatic life	Nonsupporting	Turbidity, total phosphorus
	CW-208	Aquatic life	Nonsupporting	pH, total phosphorus, chlorophyll-*a*
	RL-02134	Aquatic life	Nonsupporting	pH, total phosphorus
	CW-207	Aquatic life	Nonsupporting	pH, total phosphorus
	CW-209	Aquatic life	Nonsupporting	pH, total phosphorus
	CL-089	Aquatic life	Partially supporting	pH
Little Wateree Creek	CW-040	Aquatic life	Nonsupporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
Dutchmans Creek	RS-02321	Recreation	Nonsupporting	Fecal coliform
Big Wateree Creek	CW-072	Aquatic life	Partially supporting	Dissolved oxygen, pH
		Recreation	Nonsupporting	Fecal coliform
Wateree River	CW-019	Aquatic life	Partially supporting	Dissolved oxygen
Grannies Quarter Creek	CW-237	Aquatic life	Partially supporting	pH
		Recreation	Partially supporting	Fecal coliform
Sawneys Creek	CW-228	Recreation	Nonsupporting	Fecal coliform
	CW-079	Recreation	Partially supporting	Fecal coliform
Bear Creek	CW-229	Aquatic life	Partially supporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Twentyfive Mile Creek	CW-080	Aquatic life	Partially supporting	Macroinvertebrates
		Recreation	Partially supporting	Fecal coliform
Little Pine Tree Creek	CW-223	Recreation	Partially supporting	Fecal coliform
Swift Creek	CW-238	Aquatic life	Nonsupporting	Dissolved oxygen
Kelly Creek	CW-154	Recreation	Partially supporting	Fecal coliform
Spears Creek	CW-166	Recreation	Nonsupporting	Fecal coliform

were fully supported at 58 sites, or 51 percent of the water bodies sampled (DHEC, 2005a). The main reasons these water bodies did not meet minimum standards to support aquatic life are low dissolved-oxygen levels, poor macroinvertebrate-community structures, and high phosphorus concentrations. Thirty-eight percent of the sampled water bodies fully supported recreational use; water bodies not fully supporting recreational use exhibited high levels of fecal-coliform bacteria. Table 6-18 summarizes these water-quality impairments.

Although present Lake Wylie water quality is generally good, the potential exists for future water-quality degradation owing to urbanization and industrial growth. Special measures are needed to insure that present water-quality conditions are maintained.

The South Fork Catawba River (which drains into Lake Wylie in North Carolina) has an average total-phosphorus concentration that is several times greater than the EPA goal and is a significant source of phosphorus in downstream lakes (USGS National Water-Quality Assessment Program: *http://sc.water.usgs.gov/nawqa*).

DHEC publishes the most recently observed impairments and water-quality trends online in their 303(d) listings and 305(b) reports.

In 2008, as in earlier years, DHEC issued a fish-consumption advisory for the Wateree River between Lake Wateree and the Congaree River. Fish-consumption advisories are issued in areas where fish contaminated with mercury have been found. The contamination is only in the fish and does not make the water unsafe for skiing, boating, or swimming.

GROUND WATER

Hydrogeology

The Catawba-Wateree River subbasin is partially in the Piedmont and partially in the upper Coastal Plain, creating wide variations in ground-water availability.

The Piedmont portion of the subbasin is predominantly underlain by Charlotte terrane rocks, and includes parts of York, Chester, and Fairfield Counties. The extreme northwest corner of the subbasin, north-central York County, is in the Kings Mountain terrane. Kershaw County is underlain by rocks of the Carolina terrane, and Lancaster County is underlain by the Charlotte terrane to the northwest and the Carolina terrane to the southeast. Both terranes are generally oriented northeast-southwest, with the Charlotte terrane transecting the northernmost part of the subbasin. Some gabbro and granite plutons are scattered throughout the subbasin. The Gold Hill/Silver Hill Shear Zone cuts northeast-southwest across the panhandle of Lancaster County and the northeast corner of Chester County.

Little difference is observed between the yields of drilled wells in the two crystalline-rock terranes. Well yields usually are less than 20 gpm (gallons per minute), although yields greater than 300 gpm have been reported. Well depths range from 40 to 810 feet, but commonly are around 200 feet (Table 6-19). DNR well records show significantly higher average yields in Kershaw County—a statistical bias caused by the disproportionately high number of public-supply and industrial wells inventoried. Such wells are constructed with the intent to obtain the maximum possible yields.

Table 6-19. Well depths and yields for drilled bedrock wells in the Catawba-Wateree River subbasin

County	Well depth (feet)		Well yield (gpm)	
	Average	Maximum	Average	Maximum
Chester/ Cherokee	192	645	16	90
Fairfield	230	585	20	120
Kershaw	316	625	62	275
Lancaster	240	780	16	145
Richland	321	604	14	30
York	206	810	19	400
Total	209	810	19	400

Southeast of the Fall Line in Richland, Kershaw, and Sumter Counties, the sedimentary deposits of the upper Coastal Plain provide a good source of ground water. This part of the subbasin is underlain by the Middendorf, Black Creek, and Tertiary sand aquifers, which dip southeastward and thicken to about 650 feet at the lower end of the subbasin. Southeastern Kershaw County, eastern Richland County, and northwestern Sumter County are in the outcrop area of the Middendorf Formation and therefore the recharge area of the Middendorf aquifer.

Near the town of Wateree, in southeastern Richland County, the total thickness of sedimentary deposits is about 550 feet. The Middendorf aquifer occurs between the depths of 350 and 550 feet and directly overlies the bedrock. From 0 to 350 feet, a series of sand and clay beds represents the Black Creek aquifer. The Tertiary sand aquifer overlies the Black Creek and is the principal source of water for domestic supplies in the high-elevation areas outside the river valley. The transmissivity of the Middendorf aquifer near Eastover has been calculated to be as much as 8,700 ft^2/day, and hydraulic conductivities of 35 to 79 ft/day are indicated.

In northwestern Sumter County, the area around Rembert and Hagood is underlain by alluvial deposits of sand, silt, clay, and gravel along the Wateree River and by the Middendorf aquifer elsewhere. Wells in the Wedgefield area are used primarily for domestic supplies. Shallow industrial wells in the Wateree River valley capture water from that stream and yield as much as 300 gpm. Selected ground-water data for the Coastal Plain portion of the subbasin are presented in Table 6-20.

Table 6-20. Selected Coastal Plain ground-water data for the Catawba-Wateree River subbasin

Vicinity	Aquifer	Well depth (feet)	Major well yield (gpm)
Camden-Lugoff	Middendorf/ crystalline rock	50–560	350
Cassatt	Middendorf	92–182	305
Eastover	Middendorf	250–600	2,000
Rembert-Hagood	Black Creek/ Middendorf	155–320	1,200
Elgin	Middendorf	115–210	350
Wedgefield	Tertiary sand/ Black Creek	74–250	250
Wateree River at Lugoff	Shallow sand and gravel deposits in flood plain	40	300

Ground-Water Quality

In the Piedmont section of the Catawba-Wateree River subbasin, ground water locally has high iron and magnesium concentrations, excessive hardness, and taste problems. The pH ranges from 4.3 to 8.4, alkalinity is less than 250 mg/L (milligrams per liter) and TDS (total dissolved solids) concentrations range between 16 and 1,260 mg/L (National Uranium Resource Evaluation program, 1997).

Both bedrock and Middendorf wells are used in Kershaw County. Water from bedrock wells is generally of good quality; TDS concentrations are less than 200 mg/L; pH is between 7.0 and 8.0; and hardness ranges from very soft to hard. Water from sand wells in the Middendorf is characterized by low TDS, pH, and alkalinity, and is soft and corrosive. Sand wells in Kershaw County rarely have TDS greater than 30 mg/L and hardness greater than 10 mg/L. The pH commonly is between 4.0 and 5.0 (Newcome, 2002).

Newcome (2003) also noted a distinct water-quality contrast between bedrock- and sand-aquifer wells in Richland County. Rock wells commonly produce water having a pH greater than 7.0, and the median concentrations of TDS and hardness are 250 mg/L and 130 mg/L, respectively. Sand wells generally produce water with a pH less than 7.0, and the median concentrations of TDS and hardness are 30 mg/L and 5 mg/L, respectively.

High iron concentrations are common in the Middendorf aquifers of Sumter County, and iron-reducing bacteria are known to cause well problems in both Sumter and Richland Counties (Park, 1980; Newcome, 2003). Steel and brass well screens can corrode because the pH is low, and well screens may be blocked if iron-reducing bacteria thrive; both problems are aggravated where pumps are set inside the well screen. The latter situation also can produce “red water” and probably accounts for many reports of high iron in well water.

Water-Level Conditions

Ground-water levels in this subbasin are not routinely measured by USGS, DNR, or DHEC in any wells within this subbasin.

Because ground-water use in this subbasin is very limited, and because most of the lower part of the subbasin falls within recharge areas for the Middendorf and Black Creek aquifers, no known ground-water-level problems are associated with pumping from these aquifers. Water-level variations within the Coastal Plain aquifers in this subbasin are likely the result of variations in surface-water availability and subsequent recharge rates.

WATER USE

Water-withdrawal information presented here is derived from water-use data for the year 2006 that were collected and compiled by DHEC (Butler, 2007) and represents only withdrawals reported to DHEC for that year. Water-use categories and water-withdrawal reporting criteria are described in more detail in the *Water Use* chapter of this publication.

Offstream water use in the Catawba-Wateree River subbasin, summarized in Table 6-21 and Figure 6-12, totaled 274,922 million gallons in 2006, ranking it fourth among the 15 subbasins. Of this amount, 272,718 million gallons were from surface-water sources (99 percent) and 2,204 million gallons were from ground-water sources (1 percent). The subbasin’s two thermoelectric power plants accounted for 84 percent of the total use, followed by industry (10 percent) and water supply (6 percent). Small quantities of water were also used for agricultural irrigation, golf courses, and mining. Consumptive use in this subbasin is estimated to be 10,459 million gallons, or about 4 percent of the total offstream use.

The Wateree Station, SCE&G’s largest coal-fired power plant, was the largest water user in the subbasin in 2006. Located at the lower end of the subbasin in Richland County, this plant contains two turbines capable of generating 700 MW (megawatts) of power. In 2006, it withdrew 146,349 million gallons of water from the Wateree River for cooling and steam. A closed-cycle cooling-water system was installed in 2006 to reduce withdrawals.

The Catawba Nuclear Station, located adjacent to Lake Wylie in York County, is jointly owned by Duke Energy, North Carolina Electric Membership Corp., and Saluda River Electric Cooperative. Its two turbines have a total capacity of 2,258 MW. In 2006, the station used 83,439 million gallons of water for cooling and steam.

The Catawba-Wateree subbasin ranked third behind the Pee Dee and Congaree subbasins in industrial water use in 2006. A total of 26,738 million gallons were used, 25,849 million gallons (97 percent) from surface-water sources and 889 million gallons (3 percent) from ground-water sources. Bowater, Inc. and International Paper are two of the largest industrial users in the State. Bowater withdrew 12,303 million gallons from the Catawba River, and International Paper in Eastover withdrew 10,516 million from the Wateree River. International Paper also reported withdrawals of 701 million gallons from the Middendorf aquifer.

Water-supply use in the subbasin was 17,124 million gallons, of which surface water accounted for 16,424 million gallons (96 percent) and ground water for 700 million gallons (4 percent). The largest surface-water system was the Catawba River Water Treatment Plant, which withdrew 6,354 million gallons from the Catawba River in York County in 2006. The next largest surface-water supplier was the City of Rock Hill, which withdrew 5,534 million gallons from Lake Wylie. Cassatt Water Company, Inc., which serves rural areas in mainly Kershaw County, reported the largest ground-water withdrawals, at 292 million gallons from the Middendorf aquifer.

Instream water use for the seven Duke Energy hydroelectric power facilities on the Catawba-Wateree River in South Carolina totaled 4,085,584 million gallons in 2006 (Table 6-17).

Table 6-21. Reported water use in the Catawba-Wateree River subbasin for the year 2006 (modified from Butler, 2007)

Water-use category	Surface water		Ground water		Total water	
	Million gallons	Percentage of total surface-water use	Million gallons	Percentage of total ground-water use	Million gallons	Percentage of total water use
Aquaculture	0	0.0	0	0.0	0	0.0
Golf course	297	0.1	169	7.7	465	0.2
Industry	25,849	9.5	889	40.3	26,738	9.7
Irrigation	361	0.1	432	19.6	794	0.3
Mining	0	0.0	14	0.6	14	0.0
Other	0	0.0	0	0.0	0	0.0
Thermoelectric power	229,787	84.3	0	0.0	229,788	83.6
Water supply	16,424	6.0	700	31.8	17,124	6.2
Total	272,718		2,204		274,922	

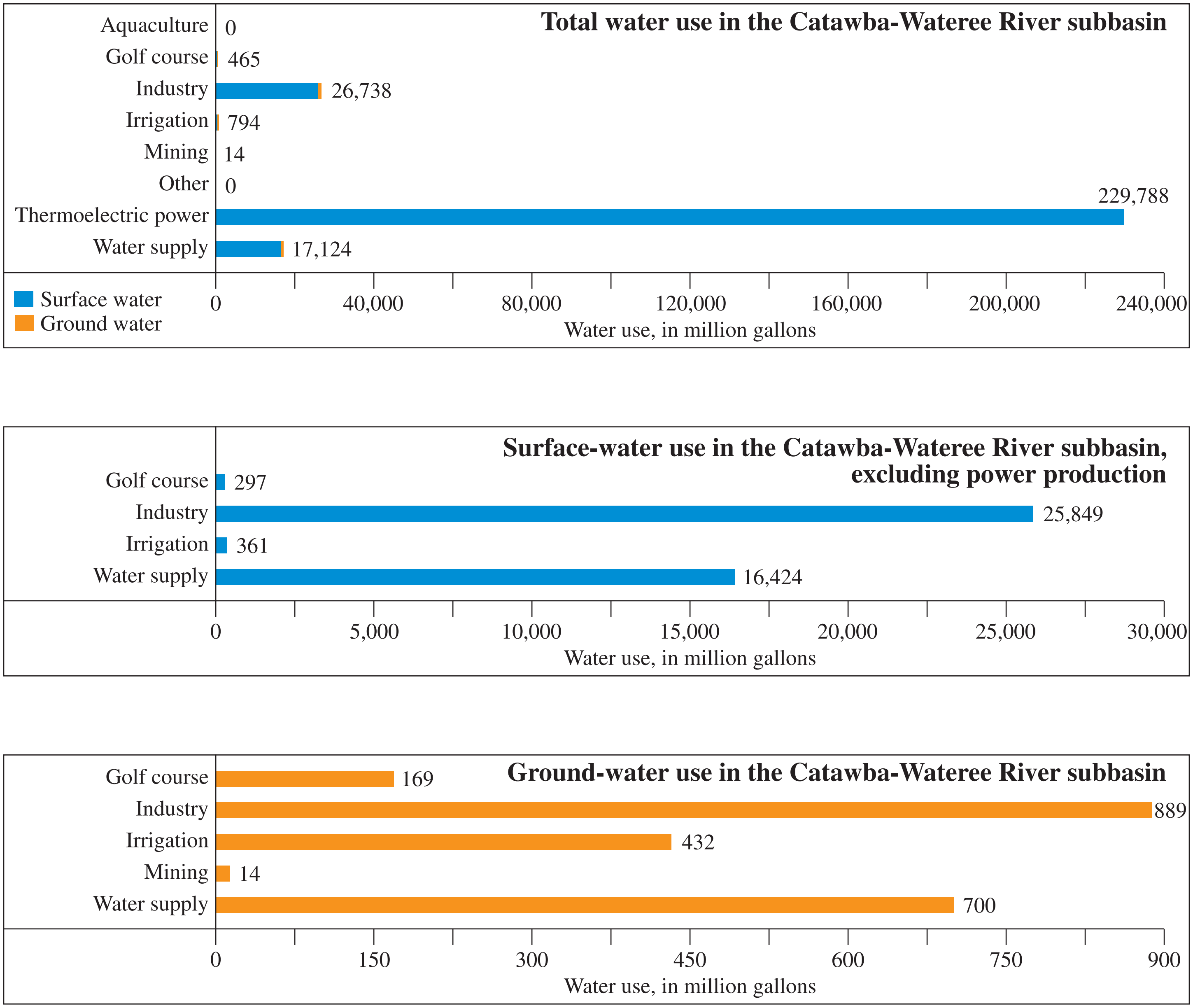


Figure 6-12. Reported water use in the Catawba-Wateree River subbasin for the year 2006 (modified from Butler, 2007).

CONGAREE RIVER SUBBASIN

CONGAREE RIVER SUBBASIN

Located in the geographical center of the State, the Congaree River subbasin is the smallest of the State's 15 subbasins. It encompasses parts of Richland, Lexington, and Calhoun Counties (Figure 6-13). The subbasin area is approximately 705 square miles, 2.3 percent of the State.

DEMOGRAPHICS

The year 2000 population of the subbasin was estimated at approximately 252,400, which was 6.3 percent of the State's total population. The largest growth is anticipated in Lexington County, where population is expected to increase by almost 30 percent by 2020.

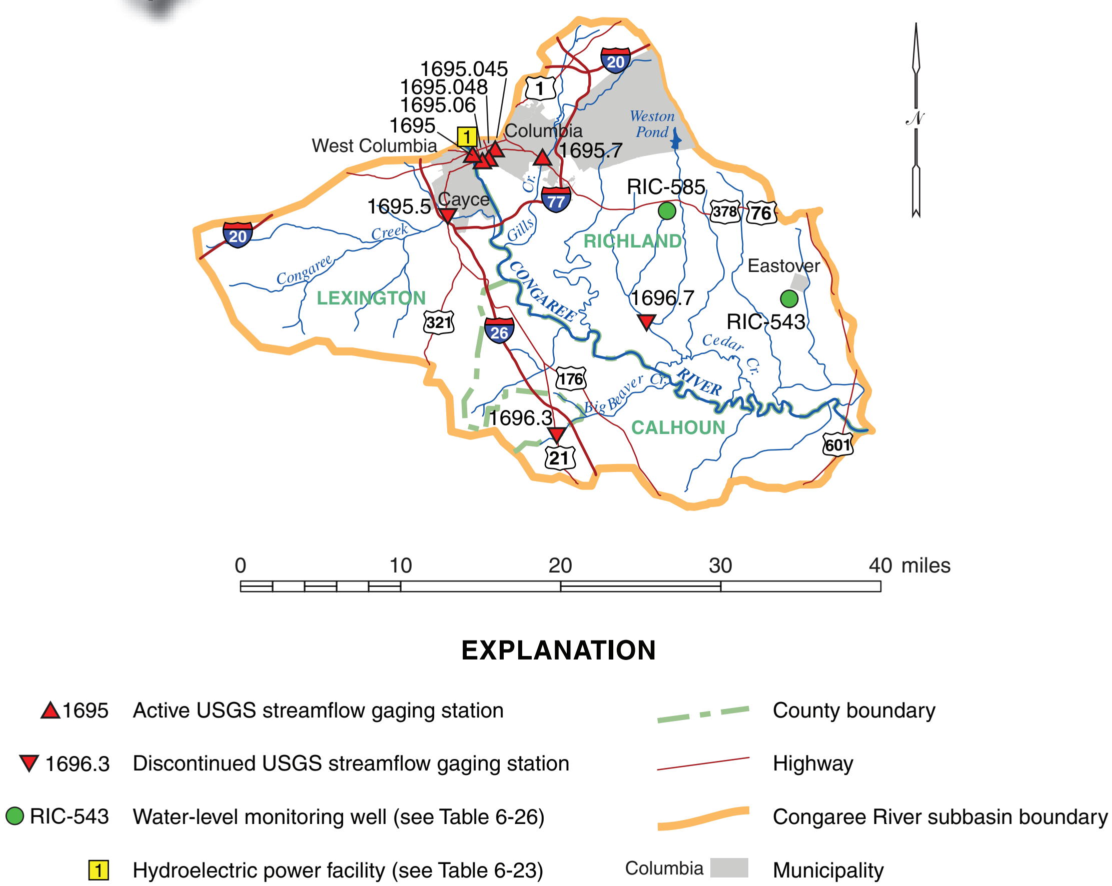


Figure 6-13. Map of the Congaree River subbasin.

The southeastern reach of the subbasin is predominantly rural, whereas the northwestern reach is one of the most densely populated areas of the State. The main center of population is Columbia (116,278). Other major urban areas are Cayce (12,150), West Columbia (13,064), and Forest Acres (10,558), all of which are Columbia suburbs. Fort Jackson, the U.S. Army's largest basic-training center, is located at Columbia.

The year 2005 per capita personal income for the subbasin ranged from $31,575 in Lexington County, which ranked fourth among the State's 46 counties, to $28,429 in Calhoun County, which ranked eleventh. Median household income in 1999 ranged from $44,659 in Lexington County, second in the State, to $32,736 in Calhoun County, which was about $4,000 less than the State's median household income.

During 2000, the counties of the subbasin had combined annual-average employment of non-agricultural wage and salary workers of 267,000. Labor distribution in the subbasin counties included management, professional, and technical services, 37 percent; sales and office, 28 percent; service, 14 percent; production, transportation, and materials moving, 11 percent; construction, extraction, and maintenance, 9 percent; and farming, fishing, and forestry, 1 percent. Because the State capital is Columbia, the number of government employees is disproportionately high in the region: management, professional, and technical employment is 27 percent greater than the State average.

In the sector of manufacturing and public utilities, the subbasin counties had an annual product value of $5.4 billion. Crop and livestock production was $117 million, with first-ranked Lexington County accounting for more than $87 million. All three subbasin counties ranked in the lower half of the State in timber-product output, with an aggregate delivered-timber value of $34 million in 2001 (South Carolina Budget and Control Board, 2005).

SURFACE WATER

Hydrology

The major watercourse in the subbasin is the Congaree River, formed by the confluence of the Saluda and Broad Rivers at Columbia. Several small- to moderately-sized tributaries discharge into the main stem; the largest of these are Congaree Creek, Gills Creek, Cedar Creek, and Toms Creek. This subbasin is mostly in the upper Coastal Plain, with portions of the eastern region in the middle Coastal plain. Much of the Congaree River and lower portions of tributary streams are associated with swamplands. The Columbia metropolitan area makes extensive use of surface water in the upper portion of the subbasin.

Currently, streamflow in the subbasin is monitored at five sites (Figure 6-13). Two gaging stations—one on the Congaree River (1695) and one on Gills Creek (1695.7)—have been in service for more than 40 years. The other three stations were installed in 2007 on Rocky

Table 6-22. Selected streamflow characteristics at USGS gaging stations in the Congaree River subbasin

Gaging station name, location, station number	Period of record	Drainage area (mi^2)	Average flow (cfs)	Average flow (cfsm)	90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
Congaree River at Columbia 1695	1939 to 2007*	7,850	8,872	1.13	2,820	576 2007	150,000 1976	155,000† 1976
Congaree Creek at Cayce 1695.5	1959 to 1980	122	222	1.82	148	111 1970	1,600 1959	1,840 1959
Gills Creek at Columbia 1695.7	1966 to 2007*	59.6	72.2	1.21	13	1.1 2007	1,730 1986	2,880 1979
Big Beaver Creek near St. Matthews 1696.3	1966 to 1993	10.0	13.6	1.36	7.1	3.9 1988	285 1971	1,360 1971
Cedar Creek near Hopkins 1696.7	1981 to 1985	66.9	66.2	0.99	26.0	4.2 1982	372 1983	– – –

mi^2, square miles; cfs, cubic feet per second; cfsm, cubic feet per second per square mile of drainage area
90% exceeds flow: the discharge that has been exceeded 90 percent of the time during the period of record for that gaging station
** 2007 is the most recent year for which published data were available when this table was prepared*
† About 364,000 cfs occurred at this site in 1908 (outside period of record)

Branch, a small creek that flows through Columbia. There are also two stage-only gaging stations in the lower reaches of the subbasin, one on the main stem and one on Cedar Creek. Streamflow statistics for two active and three discontinued streamflow gaging stations are presented in Table 6-22.

Average annual flow of the Congaree River at Columbia is 8,872 cfs (cubic feet per second) and should be at least 2,820 cfs 90 percent of the time. The lowest flow of record (576 cfs) occurred in August 2007. Although the greatest flow measured at the Congaree River at Columbia gage is 155,000 cfs, which occurred in October 1976, the flow of the river is believed to have exceeded 200,000 cfs in six different years between 1908 and 1939, before the current gaging station was established. Streamflow at this site during a 1908 flood event is estimated to have peaked at 364,000 cfs. Although the daily flow of the Congaree River may be highly variable because of fluctuating releases from hydroelectric-power facilities upstream on the Saluda and Broad Rivers, the minimum available flow is still significant and reliable the year around (Figure 6-14).

Tributary streams on opposite sides of the Congaree River exhibit different streamflow characteristics. Streams draining the western side of the subbasin, such as Congaree Creek and Big Beaver Creek, have nearly constant streamflows and provide an excellent source of water supply. Congaree Creek has the most-regular year-round streamflow of any gaged stream in the State. Big Beaver Creek also indicates well-sustained year-round flow with little significant variation.

Streams draining the eastern side of the subbasin are typical of most middle Coastal Plain streams and exhibit moderately-sustained flow. They originate in an area of nearly impermeable, red, clayey sand and are therefore characterized by limited steady flow. Streamflow characteristics of Gills Creek (Figure 6-14) reflect

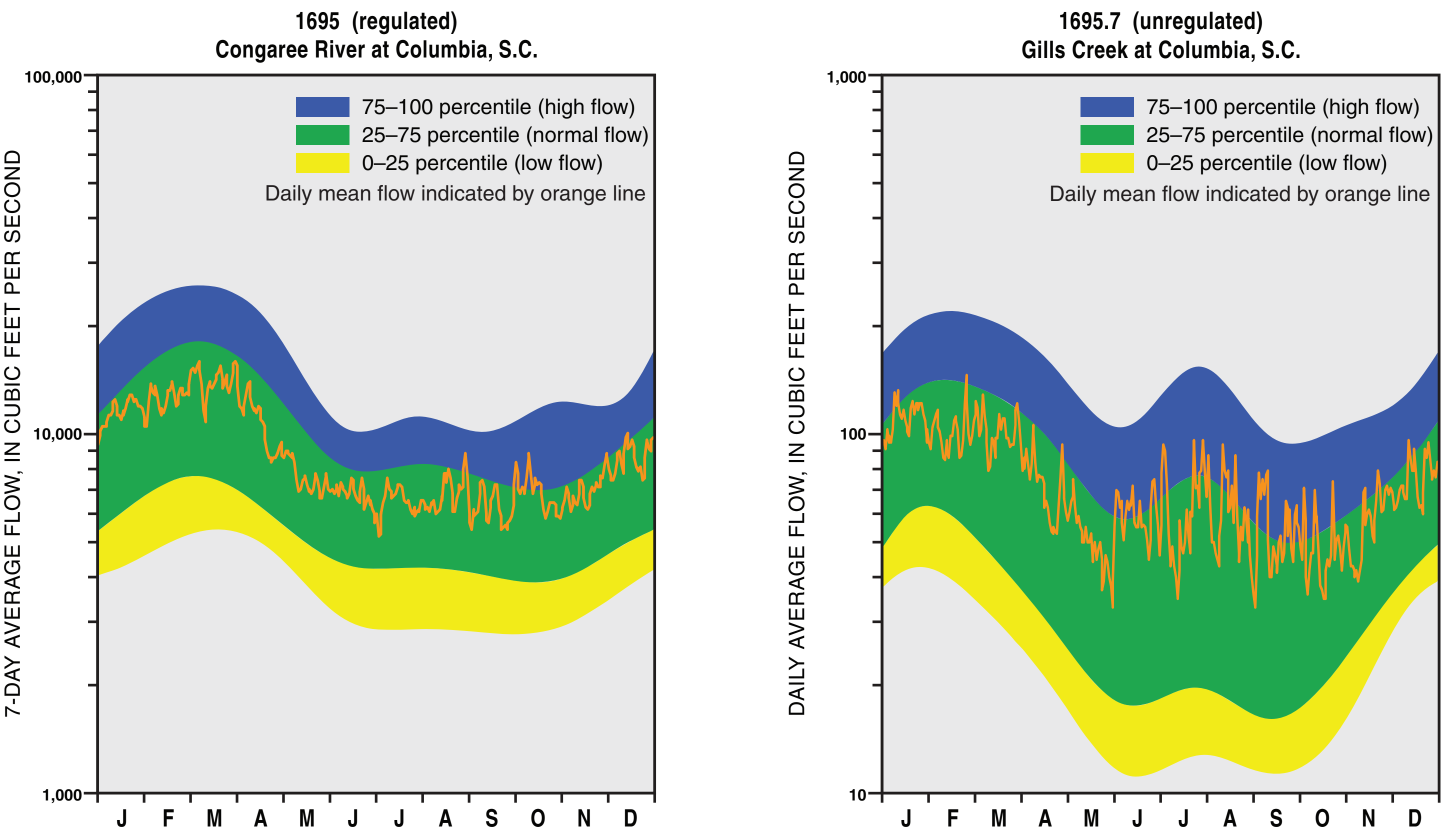


Figure 6-14. Duration hydrographs for selected gaging stations in the Congaree River subbasin.

the more variable, less well-sustained flows of these eastern tributaries. Several flood-control and recreational impoundments along Gills Creek also affect natural streamflow in this tributary. Although streamflow on the eastern side of the subbasin is more variable, some base-flow support from ground-water reserves should ensure limited year-round surface-water availability.

Development

There is little surface-water development in the Congaree River subbasin. With a surface area of 240 acres and a volume of 2,300 acre-ft, Weston Pond, on the U.S. Army training facility at Fort Jackson, is the only lake greater than 200 acres in area in the subbasin. Lakes larger than 10 acres have an aggregate surface area of 3,045 acres and a total volume of 16,607 acre-ft.

The lowermost portion of the inactive Columbia Canal, which takes in water from the Broad River and discharges it into the Congaree River, is in the Congaree River subbasin. The subbasin's only hydroelectric power station is located at the lower end of the canal (Table 6-23). The city of Columbia also uses the canal for water supply.

The U.S. Army Corps of Engineers (COE) has no active navigation projects in the subbasin. At one time there were plans for a navigation channel along the entire length of the Congaree River. Approximately 70 percent of the project was completed before it was deauthorized by Congress in 1977.

The Natural Resources Conservation Service (NRCS) started work on a flood-control project in the Cabin Branch watershed near Hopkins in 1997, but the project was not completed as of 2008.

Congaree National Park, at the southeast end of the subbasin, is among the State's most significant land- and water-conservation areas. The 22,200-acre park protects the largest contiguous tract of old-growth bottomland hardwood forest remaining in the United States. Blanketed by giant hardwoods and towering pines, the park's flood-plain forest includes one of the highest canopies in the world and contains some of the tallest trees in the eastern United States. Congress approved National Park status for the former National Monument in 2003.

Table 6-23. Hydroelectric power generating facilities in the Congaree River subbasin (shown on Figure 6-13)

Number on map	Facility name and operator	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
1	Columbia SCE&G	Broad / Congaree River	Columbia Canal	10.6	350,770

Surface-Water Quality

All water bodies in the Congaree River subbasin are designated "Freshwater" (Class FW). Class FW are freshwater bodies that are suitable for survival and propagation of aquatic life, primary- and secondary-contact recreation, drinking water, fishing, and industrial and agricultural uses (DHEC, 2004a).

As part of its ongoing Watershed Water-Quality Assessment program, DHEC sampled 30 surface-water sites between 1997 and 2001 in order to assess the water's suitability for aquatic life and recreational uses (Figure 6-15). Aquatic-life uses were fully supported in 23 sites, or 77 percent of the water bodies sampled in this subbasin. Water at impaired sites did not support, or only partially supported, aquatic life primarily because of low dissolved-oxygen levels. Recreational use was fully supported in 52 percent of the sampled water bodies; water bodies that did not support recreational use exhibited high levels of fecal-coliform bacteria (DHEC, 2004a). Water-quality impairments in the subbasin are summarized in Table 6-24. DHEC publishes the most recently observed impairments and water-quality trends online in their 303(d) listings and 305(b) reports.

In 2008, as in previous years, DHEC issued a fish-consumption advisory for the entire Congaree River and for Windsor, Carys, and Forest Lakes (all on Gills Creek). Fish-consumption advisories are issued in areas where fish contaminated with mercury have been found. The contamination is only in the fish and does not make the water unsafe for skiing, boating, or swimming.

GROUND WATER

Hydrogeology

The entire Congaree River subbasin is in the Coastal Plain and is underlain everywhere by the Middendorf aquifer. In the southern part of Richland and Lexington Counties, rocks of the Black Creek Formation overlie the Middendorf aquifer and constitute most of the Black Creek aquifer. Near the Fall Line, the Black Creek is absent and the Middendorf is directly overlain by Tertiary sand aquifers of younger age. The Coastal Plain sediments commence at the Fall Line and thicken in a southeasterly direction to 650 feet near Wateree.

At sites near the Fall Line, ground water is usually obtained from the underlying crystalline-rock aquifers of the Carolina slate belt, and well yields are highly variable.

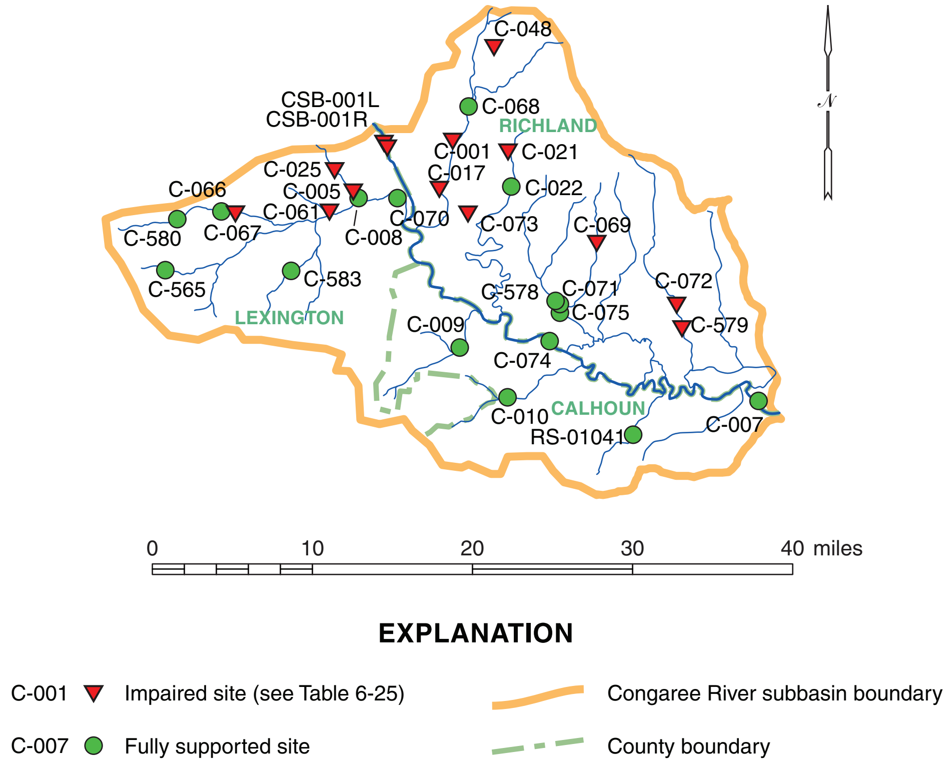


Figure 6-15. Surface-water-quality monitoring sites evaluated by DHEC for suitability for aquatic life and recreational uses. Impaired sites are listed in Table 6-24 (DHEC, 2004a).

Table 6-24. Water-quality impairments in the Congaree River subbasin (DHEC, 2004a)

Water-body name	Station number	Use	Status	Water-quality indicator
Congaree River	CSB-001L	Recreation	Partially supporting	Fecal coliform
	CSB-001R	Aquatic life	Nonsupporting	Zinc
Mill Creek	C-021	Recreation	Partially supporting	Fecal coliform
Reeder Point Branch	C-073	Aquatic life	Nonsupporting	Dissolved oxygen, pH
		Recreation	Nonsupporting	Fecal coliform
Red Bank Creek	C-067	Recreation	Partially supporting	Fecal coliform
Savana Branch	C-061	Recreation	Partially supporting	Fecal coliform
Sixmile Creek	C-005	Aquatic life	Partially supporting	Dissolved oxygen
		Recreation	Nonsupporting	Fecal coliform
Lake Caroline	C-025	Aquatic life	Nonsupporting	Total phosphorus
		Recreation	Nonsupporting	Fecal coliform
Gills Creek	C-001	Recreation	Nonsupporting	Fecal coliform
	C-017	Aquatic life	Partially supporting	Dissolved oxygen
		Recreation	Partially supporting	Fecal coliform
Windsor Lake	C-048	Aquatic life	Partially supporting	Dissolved oxygen, pH
Cedar Creek	C-069	Recreation	Partially supporting	Fecal coliform
Toms Creek	C-579	Aquatic life	Partially supporting	Macroinvertebrates
	C-072	Recreation	Partially supporting	Fecal coliform

For example, two rock wells in West Columbia are 385 feet and 95 feet deep and produce 12 gpm (gallons per minute) and 56 gpm, respectively. These wells were obtained only after three dry holes had been drilled at the same location. Nearby, wells 240 and 400 feet deep yield 150 and 15 gpm, respectively.

The Town of Eastover is supplied by ground water from wells, about 100 feet deep, that tap the Black Creek aquifer. This aquifer is separated from the deeper Middendorf aquifer by several confining beds composed of clay or silty clay. Table 6-25 contains selected well data for two areas of the Congaree River subbasin.

Table 6-25. Selected ground-water data for the Congaree River subbasin

Vicinity	Aquifer	Well depth (feet)	Major well yield (gpm)
Columbia	Middendorf	50–300	75–250
Eastover	Black Creek/ Middendorf	60–500	100–500

Ground-water levels are regularly monitored in two wells by DNR in this subbasin (Table 6-26 and Figure 6-13). Water levels in other wells in the subbasin are sometimes measured to help develop potentiometric maps of the Middendorf aquifer.

Table 6-26. Water-level monitoring wells in the Congaree River subbasin

Well number	Monitoring agency*	Latitude Longitude (deg min sec)	Aquifer	Well location	Land surface elevation (feet)	Depth (feet) to screen top, bottom; or open interval
RIC-543	DNR	33 52 30 80 42 08	Middendorf	Webber School, Eastover	184	370–410
RIC-585	DNR	33 56 56 80 50 27	Middendorf	Horrel Hill Elementary School	328	263–293

* *DNR, South Carolina Department of Natural Resources*

Ground-Water Quality

The upper reaches of this subbasin (in eastern Lexington and southern Richland Counties) are in the outcrop areas of the Middendorf and Black Creek aquifers. Water from the Black Creek aquifer generally has TDS (total dissolved solids) concentrations less than 50 mg/L (milligrams per liter) and a pH less than 5.5. Water from the Middendorf aquifer generally has TDS less than 100 mg/L and pH less than 7 (Speiran and Aucott, 1994). Water quality is similar but more mineralized in the lower reaches (Greaney, 1993).

The Tertiary sand aquifer, where it crops out in Calhoun County, yields good water. It is generally a soft, calcium bicarbonate type with a low TDS (less than 100 mg/L) and nearly neutral pH. Iron concentrations locally exceed the recommended limit of 0.3 mg/L and may stain clothing and fixtures (Greaney, 1993).

Naturally occurring radioactive ground water has been found in the subbasin. In the Cayce-West Columbia area of Lexington County, gross alpha-particle activity was measured as great as 105 picoCuries per liter.

WATER USE

Water-use information presented in this chapter is derived from water-use data for the year 2006 that were collected and compiled by DHEC (Butler, 2007) and represents only withdrawals reported to DHEC for that year. Water-use categories and water-withdrawal reporting criteria are described in more detail in the *Water Use* chapter of this publication.

Offstream water use in the Congaree River subbasin is summarized in Table 6-27 and Figure 6-16. Offstream water withdrawals in the Congaree River subbasin totaled 32,179 million gallons in 2006, ranking it tenth among the 15 subbasins. Of this amount, 30,659 million gallons were from surface-water sources (95 percent) and 1,520 million gallons were from ground-water sources (5 percent). Industrial use accounted for 95 percent, followed by mining (2 percent) and water supply (1 percent). Small amounts of ground and surface water were also withdrawn for golf course, irrigation, and aquaculture uses. Consumptive use in this subbasin is estimated to be 3,635 million gallons, or about 11 percent of the total offstream use.

With a total of 30,520 million gallons in 2006, the Congaree River subbasin ranked second behind the Pee Dee subbasin for industrial water use in the State. Surface-water sources accounted for 29,956 million gallons (98 percent) and ground-water sources for 564 million gallons (2 percent). Eastman Chemical Co., the largest industrial user in the State, withdrew 28,262 million gallons from the Congaree River. U.S. Silica Co. had withdrawals of 375 million from ground-water sources (Black Creek and Middendorf aquifers).

Mining water use was 710 million gallons in 2006. Of this amount, 392 million was from surface-water sources (55 percent) and 318 million was from ground-water sources (45 percent). Most of this water (664 million gallons) was pumped at the Martin Marietta Aggregates quarry in Cayce to dewater the quarry.

Water-supply use totaled 435 million gallons and was provided entirely by ground water. Of the four water-supply systems that have wells in this subbasin, the Gaston Rural Community Water District was the largest user, pumping 247 million gallons from the Black Creek and Middendorf aquifers. Most of this subbasin's population, in the metropolitan Columbia and West Columbia areas, use surface water drawn from the Broad and Saluda subbasins.

Instream water use for hydroelectric power generation totaled 350,770 million gallons in 2006, all at the only hydroelectric facility in the subbasin, the Columbia Canal Hydroelectric facility. Located at the downstream end of the Columbia Canal, this power plant, owned by the city of Columbia and operated by SCE&G, contains seven turbines with a total generating capacity of 10.6 megawatts.

Table 6-27. Reported water use in the Congaree River subbasin for the year 2006 (modified from Butler, 2007)

Water-use category	Surface water		Ground water		Total water	
	Million gallons	Percentage of total surface-water use	Million gallons	Percentage of total ground-water use	Million gallons	Percentage of total water use
Aquaculture	22	0.1	15	1.0	37	0.1
Golf course	288	0.9	38	2.5	326	1.0
Industry	29,956	97.7	564	37.1	30,520	94.8
Irrigation	1	0.0	150	9.9	151	0.5
Mining	392	1.3	318	20.9	710	2.2
Other	0	0.0	0	0.0	0	0.0
Thermoelectric power	0	0.0	0	0.0	0	0.0
Water supply	0	0.0	435	28.6	435	1.4
Total	30,659		1,520		32,179	

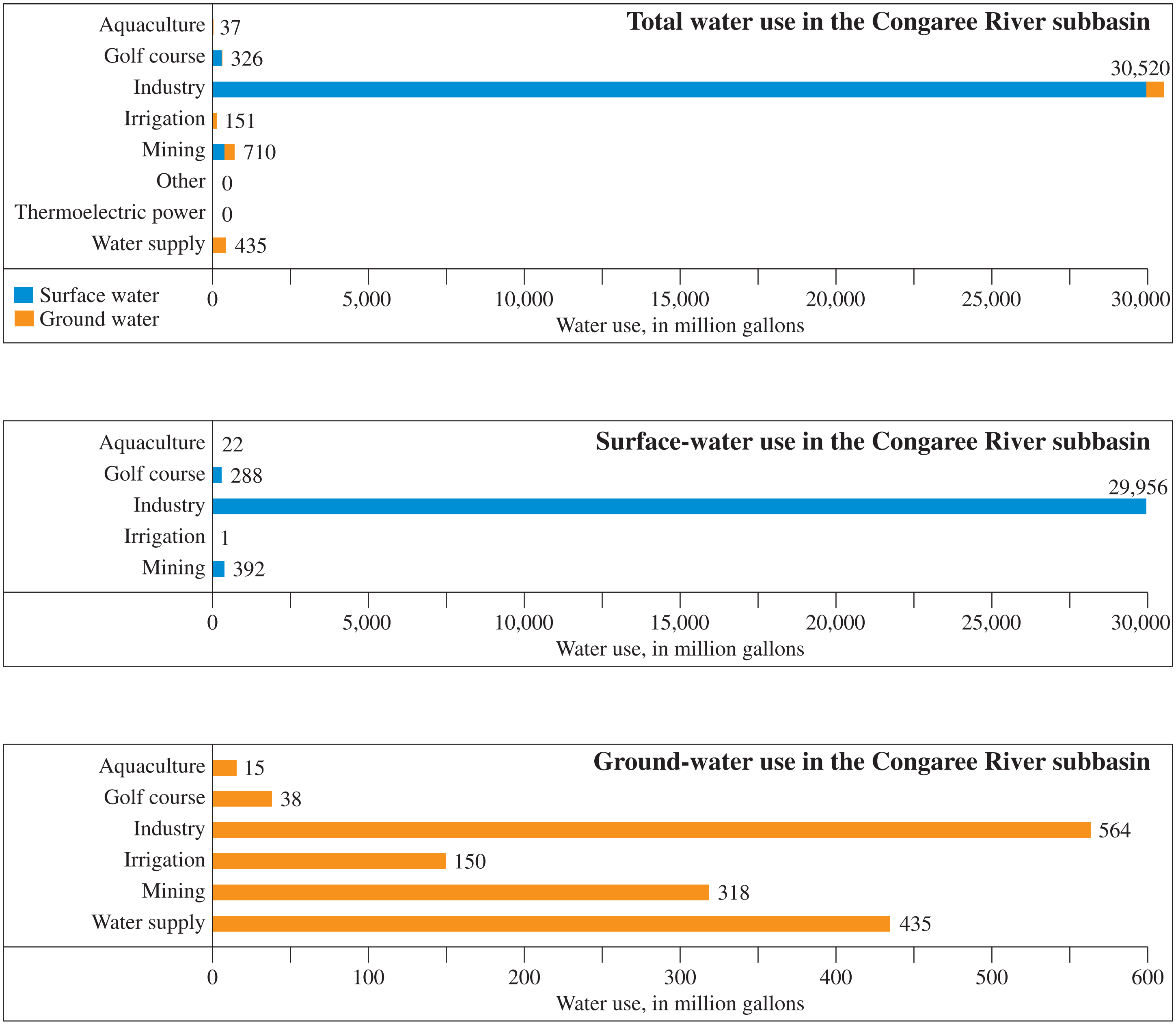


Figure 6-16. Reported water use in the Congaree River subbasin for the year 2006 (modified from Butler, 2007).

SANTEE RIVER SUBBASIN

SANTEE RIVER SUBBASIN

The Santee River subbasin transects the middle and lower parts of the Coastal Plain, extending from the confluence of the Congaree and Wateree Rivers southeast to the Atlantic Ocean. With a northwest-southeast orientation, this basin encompasses parts of eight South Carolina counties: Berkeley, Calhoun, Charleston, Clarendon, Georgetown, Orangeburg, Sumter, and Williamsburg (Figure 6-17). The subbasin area is approximately 1,275 square miles, 4.1 percent of the State.

DEMOGRAPHICS

The year 2000 population of the subbasin was estimated at 39,100, just 1.0 percent of South Carolina's total population. The largest population increases by 2020 are expected to occur near the coast, in Berkeley and Georgetown Counties. The subbasin is primarily rural and contains no major urban areas or centers of population, although there are a number of small towns. The largest of these towns in 2000 were St. Matthews (2,107), St. Stephen (1,776), and Summerton (1,016); all three towns had larger reported populations in 1980 than in 2000.

Economically, this is one of the most disadvantaged areas of South Carolina. Average county per capita incomes in 2005 ranged from $20,005 in Williamsburg County, ranking 45th of 46 counties, to $34,158 in Charleston County, ranking second. Three counties in the subbasin—Charleston, Georgetown, and Calhoun—had per capita incomes above the State average of $28,285. Of the other five subbasin counties, only Berkeley County approached the State average. Median household incomes in 1999, the most recent report available, ranged from $24,214 in Williamsburg County, ranking 44th in the State, to $39,908 in Berkeley County, which ranked seventh. Only Charleston and Berkeley Counties had median household incomes above the State average of $37,082.

During 2000, the counties of the subbasin had combined annual-average employment of non-agricultural wage and salary workers of 314,000. Labor distribution in the subbasin counties included management, professional, and technical services, 30 percent; sales and office, 25 percent; service, 16 percent; production, transportation, and materials moving, 16 percent; construction, extraction, and maintenance, 11 percent; and farming, fishing, and forestry, 1 percent.

Manufacturing output by the subbasin's seven principal counties totaled $12.7 billion in 1997, with Sumter, Berkeley, and Charleston Counties accounting for nearly two-thirds of the region's product value. Crop and livestock production was valued at $337.5 million in 2000.

SURFACE WATER

Hydrology

The Santee River, formed by the confluence of the Congaree and Wateree Rivers in the upper Coastal Plain, is the dominant watercourse in this subbasin. In its original form, the 144-mile long Santee River had the fourth-largest average flow of any river on the Atlantic coast of the United States, and periodic flooding nourished extensive swamplands along its entire length. With the construction of the Santee Dam (also known as Wilson Dam) in 1941, much of upper reach of the Santee River became part of Lake Marion, which is the dominant hydrologic feature in this subbasin. About 10 miles from its mouth, the river bifurcates into two channels, the North Santee River and

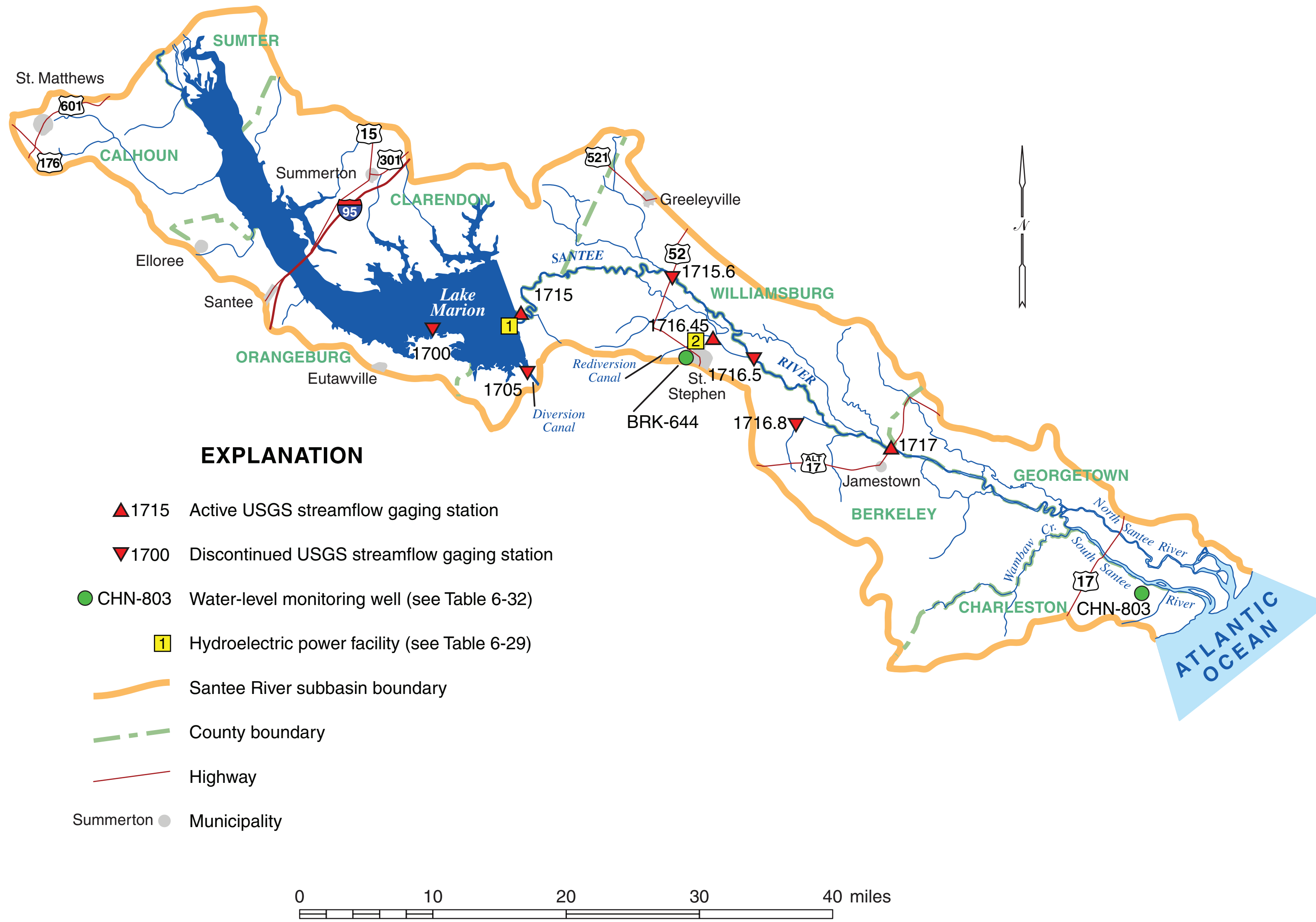


Figure 6-17. Map of the Santee River subbasin.

the South Santee River, that are roughly parallel and separated by about 2 miles. The two channels reach the ocean at Santee Point, a few miles south of Winyah Bay.

Lake Marion was created in conjunction with Lake Moultrie, in the Ashley-Cooper River subbasin, to provide a major source of hydropower for the State. The original operation of Lake Marion diverted almost all of the Santee River flow through a canal into Lake Moultrie, which discharges into the Cooper River. Under normal conditions, only a small amount of water—often as little as 500 cfs (cubic feet per second)—passed Santee Dam and continued into the Santee River.

The construction of Lake Marion and the subsequent diversion of most of the Santee River into the Cooper River changed the character of both rivers. The lower Santee River, deprived of much of its flow, became more saline near the coast, while the increased flow of the Cooper River decreased its salinity near the Charleston Harbor but greatly increased its sediment load, which caused shoaling problems and thus a need for more dredging to keep the harbor functional. To mitigate these problems, in 1985 the U.S. Army Corps of Engineers (COE) began operating a rediversion canal to return water from Lake Moultrie back to the Santee River. The normal operation of Lake Moultrie releases enough water—usually 4,500 cfs—into the Cooper River to keep its salinity low, while returning the remaining flow back into the Santee River. Flow from the rediversion canal enters the Santee River near St. Stephen, about 35 river miles downstream from Santee Dam.

Several small tributary streams drain the subbasin, the largest of these being Halfway Swamp Creek and Wambaw Creek.

Historical streamflow data for the undeveloped Santee River are available from one discontinued gaging station (1700), which was inundated by Lake Marion. Before development of the Santee Cooper lake system, year-round flow in the Santee River at that site was well-sustained (Figure 6-18). Average annual streamflow was 15,400 cfs and could be expected to equal or exceed 7,000 cfs 90 percent of the time.

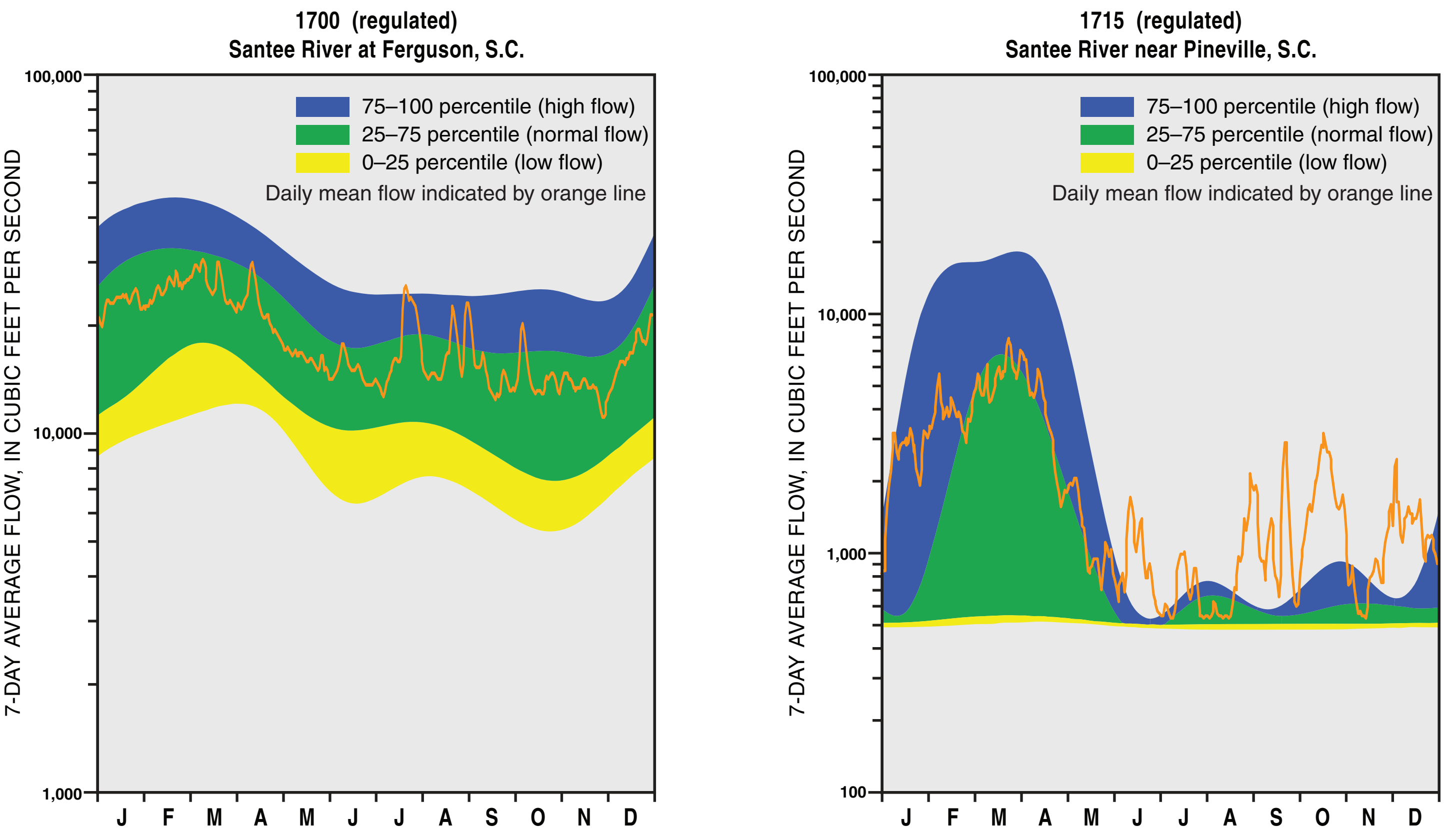


Figure 6-18. Duration hydrographs for selected gaging stations in the Santee River subbasin.

Three gaging stations currently monitor streamflow in the Santee River subbasin, two on the Santee River and one on the rediversion canal (Figure 6-17). No gaging stations are active on tributary streams. Five stage-only gaging stations monitor river elevation continuously, and Lake Marion's surface elevation is also monitored by two lake-level gages. Statistics for active and discontinued streamflow gaging stations are presented in Table 6-28.

Currently, average annual streamflow in the Santee River is 2,121 cfs near Pineville (just below Santee Dam) and 10,610 cfs near Jamestown (below the rediversion canal). Ninety percent of the time, flow at these sites should be at least 489 cfs and 934 cfs, respectively. Annual average flow in the rediversion canal is 8,741 cfs. Contribution from tributary streams in the lower portion of the Santee River is small and only slightly increases main-stem flow. Before the completion of the rediversion canal, most streamflow in the lower portion of the Santee River was contributed by discharges from Santee Dam. From February through May, very high flow occurs; the rest of year, flow is fairly steady (Figure 6-18). Occasional discharge of large volumes of water helps to relieve Lake Marion of floodwater inflow from upstream, and withholding discharge sustains adequate water levels in Lake Marion for recreation, hydroelectric power, and other uses. During periods of excessive rainfall, the level of the Santee River near Jamestown frequently exceeds its flood stage.

Table 6-28. Selected streamflow characteristics at USGS gaging stations in the Santee River subbasin

Gaging station name, location, station number	Period of record	Drainage area (mi^2)	Average flow		90% exceeds flow (cfs)	Minimum daily flow (cfs), year	Maximum daily flow (cfs), year	Maximum peak flow (cfs), year
			(cfs)	(cfsm)				
Santee River at Ferguson 1700	1907 to 1941	14,600	15,400	1.05	7,000	2,630 1925	– – –	168,000 1916
Diversion Canal near Pineville 1705	1943 to 1986	Indeter-minate	14,684	– –	6,086	– – –	– – –	40,300 1983
Santee River near Pineville 1715	1942 to 2007*	Indeter-minate	2,121	– –	489	9.0 1947	153,000 1945	155,000 1945
Santee River near Russellville 1715.6	1979 to 1996	Indeter-minate	45.2	– –	469	– – –	120,000 1979	– – –
Rediversion Canal near St. Stephen 1716.45	1986 to 2007*	Indeter-minate	8,741	– –	14	– – –	31,200 1989	31,200 1989
Santee River below St. Stephen 1716.5	1970 to 1981	14,900	2,871	0.19	568	481 1981	97,100 1975	98,900 1975
Wedboo Creek near Jamestown 1716.8	1966-72 and 1973-92	17.4	13.1	0.75	0.43	0.0 many years	1,220 1987	– – –
Santee River near Jamestown 1717	1986 to 2007*	Indeter-minate	10,610	– –	934	460 1986	90,600 2003	102,000 2003

mi^2, square miles; cfs, cubic feet per second; cfsm, cubic feet per second per square mile of drainage area
90% exceeds flow: the discharge that has been exceeded 90 percent of the time during the period of record for that gaging station
** 2007 is the most recent year for which published data were available when this table was prepared*

Since Lake Marion was created, the lowest flow of record for the Santee River (9 cfs at Pineville) occurred in 1947 because of repair work on the spillway, and the greatest flow recorded (155,000 cfs at Pineville) resulted from a tropical storm in 1945 that caused extensive flooding throughout the eastern portion of South Carolina.

The only streamflow gaging station on a tributary stream, Wedboo Creek near Jamestown, was discontinued in 1992. Average annual streamflow was 13.1 cfs, and flow equaled or exceeded 0.43 cfs 90 percent of the time. This stream exhibited highly variable flow and occasional no-flow conditions typical of lower Coastal Plain streams.

Although flow in the Santee River is somewhat variable, the river still generally provides a good supply of surface water, particularly below the rediversion canal. Tributary streams probably are unreliable supply sources because of highly-fluctuating flows and possible no-flow conditions during periods of low rainfall. Streamflow in tributaries in the upper reaches of the subbasin near the upper Coastal Plain region may be less variable because of ground-water support and may provide a more reliable supply source.

Development

Other than the creation of Lake Marion, surface-water development in the subbasin is very limited. Excluding Lake Marion, the aggregate surface area of all lakes greater than 10 acres in the subbasin is 1,400 acres, and the total volume is 5,000 acre-ft. Two hydroelectric power facilities are located within this subbasin (Figure 6-17; Table 6-29).

The nearly eight-mile long Santee Dam, on the Santee River 17 miles south of Manning, forms Lake Marion. Completed in 1941, the lake extends nearly 40 miles upstream, almost to the confluence of the Congaree and Wateree Rivers. Although it is the State's largest reservoir by surface area, at 110,600 acres, Lake Marion averages a depth of only about 12.5 feet and ranks fourth in volume (1,400,000 acre-ft). It is owned and operated by the South Carolina Public Service Authority (Santee Cooper). The 1.92-megawatt capacity of the Santee Dam is negligible, but the dam's 62 spillway gates are important flood-control structures. Lake Marion also is a major economic asset by virtue of its recreational attractions, and part of the lake is in the Santee National Wildlife Refuge.

Table 6-29. Hydroelectric power generating facilities in the Santee River subbasin (shown on Figure 6-17)

Number on map	Facility name and operator	Impounded stream	Reservoir	Generating capacity (megawatts)	Water use in year 2006 (million gallons)
1	Santee Spillway Santee Cooper	Santee River	Lake Marion	2	148,325
2	St. Stephen Santee Cooper	Lake Moultrie Rediversion Canal	Lake Moultrie	84	878,848

An 84-megawatt hydroelectric power station is located on the rediversion canal at St. Stephen, near the Santee River flood plain. A fish lift, built by the COE and operated by DNR, is part of the St. Stephen project and permits inland migration of anadromous shad, bass, and sturgeon from the Santee River into Lake Moultrie.

Prior to the construction of Santee Dam, the COE maintained the entire river for navigation. After construction of the dam, direct navigation from the lower reaches of the Santee River to the upper reaches was discontinued.

Surface-Water Quality

All classified streams in the Santee River subbasin are designated "Freshwater" (Class FW). This class of water is suitable for the survival and propagation of aquatic life, primary- and secondary-contact recreation, drinking-water supply, fishing, and industrial and agricultural uses (DHEC, 2005b).

As part of its ongoing Watershed Water-Quality Assessment program, DHEC sampled 63 surface-water sites in the Santee River subbasin in 1998 and 2002 in order to assess the water's suitability for aquatic life and recreational use (Figure 6-19). Aquatic-life uses were fully supported at 44 sites, or 70 percent of the water bodies sampled in this subbasin; most of the impaired water exhibited pH problems or high phosphorus concentrations. Recreational use was fully supported in 75 percent of the sampled water bodies; water bodies that did not support recreational use exhibited high levels of fecal-coliform bacteria (DHEC, 2005b). Water-quality impairments in the subbasin are listed in Table 6-30.

The herbicides atrazine, simazine, and tebuthiuron have been detected in almost every stream in the Santee subbasin, including those in forested areas; however, concentrations are below the guideline levels that protect aquatic life and drinking water (USGS National Water-Quality Assessment Program: *http://sc.water.usgs.gov/nawqa*).

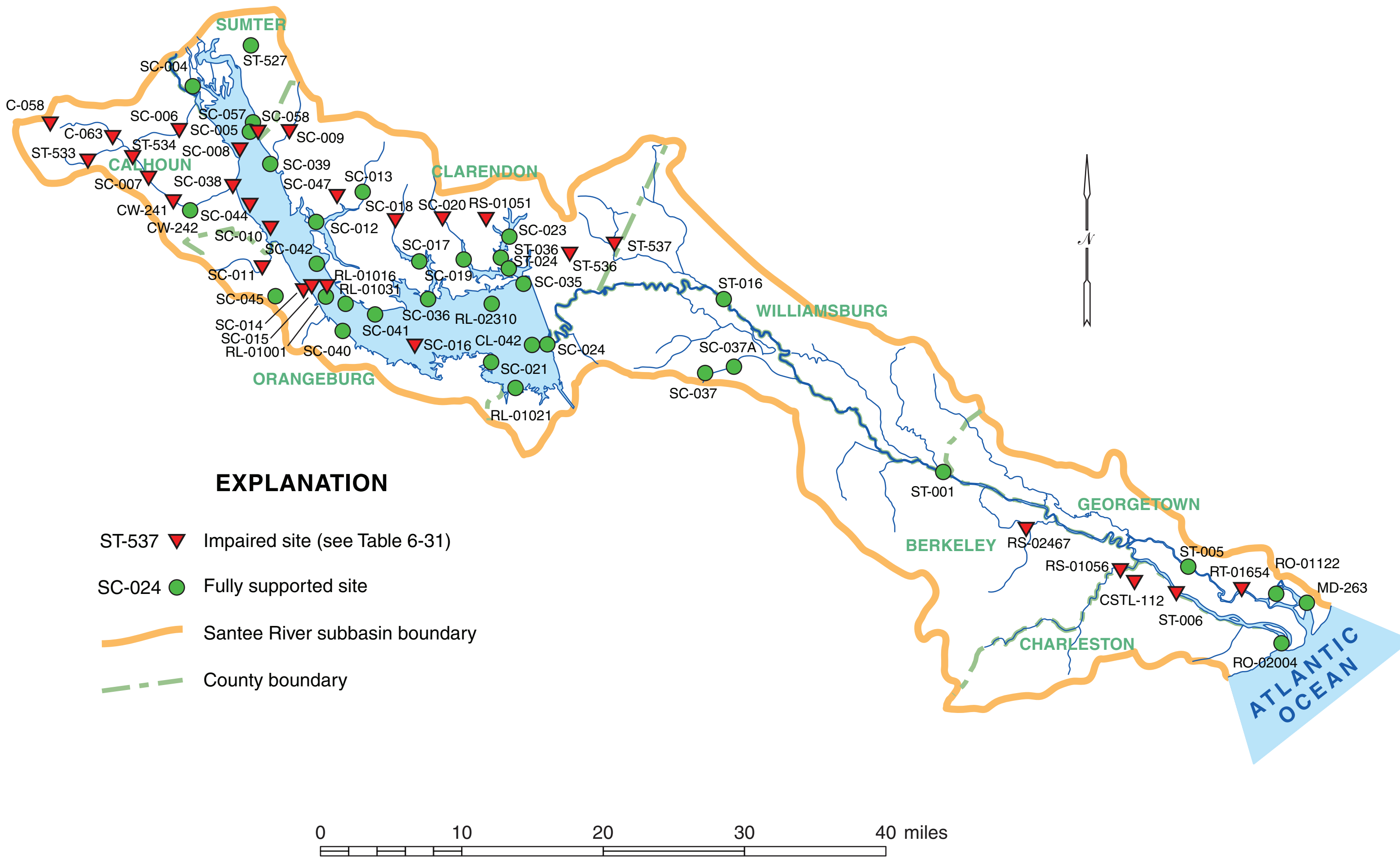


Figure 6-19. Surface-water-quality monitoring sites evaluated by DHEC for suitability for aquatic life and recreational uses. Impaired sites are listed in Table 6-30 (DHEC, 2005b).

Table 6-30. Water-quality impairments in the Santee River subbasin (DHEC, 2005b)

Water-body name	Station number	Use	Status	Water-quality indicator
Warley Creek	SC-006	Recreation	Nonsupporting	Fecal coliform
Stream upstream of Safety Kleen, Pinewood	SC-058	Aquatic life	Nonsupporting	pH
Lake Marion	SC-008	Aquatic life	Nonsupporting	Total phosphorus
	SC-044	Aquatic life	Partially supporting	pH
	SC-010	Aquatic life	Nonsupporting	Total phosphorus
	SC-014	Aquatic life	Nonsupporting	Total phosphorus, total nitrogen, pH, chlorophyll-*a*
	SC-015	Aquatic life	Nonsupporting	pH
	RL-01016	Aquatic life	Partially supporting	pH
	SC-016	Aquatic life	Partially supporting	pH
Spring Grove Creek	SC-009	Recreation	Nonsupporting	Fecal coliform
Big Poplar Creek	SC-011	Recreation	Nonsupporting	Fecal coliform
Lake Inspiration	C-058	Aquatic life	Nonsupporting	Dissolved oygen, total phosphorus, total nitrogen, pH, turbidity
		Recreation	Partially supporting	Fecal coliform
Halfway Swamp Creek	C-063	Recreation	Nonsupporting	Fecal coliform
	ST-534	Aquatic life	Partially supporting	Marcoinvertebrates
	SC-007	Recreation	Nonsupporting	Fecal coliform
	CW-241	Recreation	Nonsupporting	Fecal coliform
Lyons Creek	ST-533	Aquatic life	Partially supporting	Marcoinvertebrates
Halfway Swamp Creek arm of Lake Marion	SC-038	Aquatic life	Nonsupporting	Total phosphorus
Big Branch	SC-047	Aquatic life	Nonsupporting	Dissolved oygen
		Recreation	Nonsupporting	Fecal coliform
Tawcaw Creek	SC-018	Aquatic life	Nonsupporting	Dissolved oygen
		Recreation	Nonsupporting	Fecal coliform
Potato Creek	SC-020	Aquatic life	Nonsupporting	Dissolved oygen, pH
		Recreation	Partially supporting	Fecal coliform
White Oak Creek	RS-01051	Recreation	Partially supporting	Fecal coliform
Doctor Branch	ST-537	Aquatic life	Partially supporting	Marcoinvertebrates
Bennetts Branch	ST-536	Aquatic life	Partially supporting	Marcoinvertebrates
Echaw Creek	RS-02467	Recreation	Nonsupporting	Fecal coliform
Wambaw Creek	CSTL-112	Recreation	Partially supporting	Fecal coliform
Minim Creek	RT-01654	Aquatic life	Partially supporting	Turbidity
Cedar Creek	RS-01056	Recreation	Nonsupporting	Fecal coliform
South Santee River	ST-006	Aquatic life	Nonsupporting	Turbidity
		Recreation	Partially supporting	Fecal coliform

Water-quality conditions can change significantly from year to year, and water bodies are reassessed every 2 years for compliance with State water-quality standards. DHEC publishes the most recent impairments and water-quality trends online in their 303(d) listings and 305(b) reports.

In 2008, as in earlier years, DHEC issued a fish-consumption advisory for mercury in several areas of the Santee River subbasin, including Lake Marion, the diversion canal, the rediversion canal, the Santee River (from Lake Marion to the South Santee River), both the North and South Santee Rivers (from the Santee River to the U.S. Highway 17 bridge) and Wambaw Creek in Charleston County and Wadmacon Creek in Georgetown County. Fish-consumption advisories are issued in areas where fish are contaminated with mercury; the contamination is only in the fish and does not make the water unsafe for swimming or boating.

GROUND WATER

Hydrogeology

The Santee River subbasin is in the middle and lower Coastal Plain. The northwestern portion of the subbasin is underlain by more than 1,000 feet of unconsolidated sediments. The thickness increases to approximately 2,500 feet at the southeastern limit. The Middendorf aquifer underlies the entire subbasin and can support large wells; however, it is too deep to be employed as a water source by most users. Transmissivities of 3,100 and 5,300 ft^2/day have been indicated by pumping tests.

The Black Creek aquifer is the major source of ground water throughout Clarendon, Williamsburg, and Georgetown Counties. The top of this aquifer is 300 feet deep at Summerton and about 800 feet deep at the mouth of the Santee River. Wells can be expected to yield 100 to 1,000 gpm (gallons per minute); the highest yields probably will be attained in the upper part of the basin.

The top of the Peedee Formation, comprising the lower part of the Tertiary sand aquifer, is 100 to 250 feet below land surface and deepens to the south through Clarendon and Williamsburg Counties.

The Black Mingo Formation, part of the Tertiary sand aquifer, and surficial deposits cover the Peedee Formation in Clarendon and Williamsburg Counties. Wells in these deposits commonly produce 20 to 50 gpm.

The Orangeburg County area is underlain by the Middendorf, Black Creek, Tertiary sand, and Floridan aquifers. Together, these aquifers have a total thickness of 1,150 to 1,850 feet, thickening in a southerly direction. All but the Middendorf are tapped by wells in the area. On pumping tests, wells yielding 73 to 620 gpm indicated aquifer transmissivities of 1,100 to 33,000 ft^2/day. It is common for wells to be screened in two of the aquifers. The Tertiary sand and Floridan aquifers are the most commonly used at the eastern end of the subbasin.

In the Jamestown area of Berkeley County, all the aquifers mentioned above are available for water supply. Jamestown uses wells in the Black Creek aquifer at nearly 900 feet, and St. Stephen taps the Middendorf at about 1,250 feet. Selected well data for the subbasin are presented in Table 6-31.

Table 6-31. Selected ground-water data for the Santee River subbasin

Vicinity	Aquifer	Well depth (feet)	Major well yield (gpm)
Clarendon County	Middendorf	725–950	500–1,000
	Black Creek	250–675	90–675
	Peedee	100–250	150
Calhoun County	Tertiary sand/ Black Creek/ Middendorf/	100–800	30–1,400
Eutawville	Floridan	80–100	425–620
	Tertiary sand	180–460	200–2,800
Jamestown	Black Creek	700–900	100–375
St. Stephen	Black Creek/ Middendorf	1,050–1,260	300–500
Mullins	Black Creek	320–390	370–1,500
Aynor	Black Creek	300–350	150–800
Loris	Tertiary sand (Peedee)	100–200	250–500
	Black Creek	320–460	250–800

The Jamestown area in northeastern Berkeley County, like the area south of Lake Marion, exhibits a covered karst topography underlain at shallow depths by the Floridan aquifer. This aquifer is the most important source of ground water for domestic use in the area. Ground-water pumping from limestone quarries resulted in instances of land-surface collapse and water-level declines in wells more than a mile from the center of pumping.

Ground-Water Quality

Water from the Middendorf aquifer is generally low in TDS (total dissolved solids), chloride, fluoride, and pH and is soft and corrosive in the upper reaches of the subbasin (Greaney, 1993). Iron concentrations may exceed recommended limits (Greaney, 1993; Johnson, 1978). The aquifer becomes more mineralized toward the coast, where the concentrations of TDS, sodium, and chloride increase to more than 1,000, 500, and 250 mg/L (milligrams per liter), respectively (Speiran and Aucott, 1994).

The Black Creek aquifer is the principal aquifer for the Santee River subbasin. The water generally is soft and a sodium bicarbonate type, and mineralization increases toward the coast. Total dissolved solids concentrations range from 50 mg/L in the upper reaches to more than 1,000 mg/L near the coast (Speiran and Aucott, 1994). The pH ranges from 4.5 in the upper reaches to greater than 8.5 in the lower reaches. Iron concentrations commonly exceed standards (Johnson, 1978; Greaney, 1993). Sodium concentrations are greater than 250 mg/L near the coast. Fluoride exceeds recommended drinking-water levels in eastern Williamsburg and Georgetown Counties. Turbidity, caused by a colloidal suspension of the calcium carbonate mineral aragonite, has been reported in a few wells in Clarendon, Williamsburg, and Georgetown Counties (Johnson, 1978; Pelletier, 1985).

The Tertiary sand and extended Floridan aquifers, where present in Calhoun, Clarendon, and Williamsburg Counties, yield water of good quality. In Calhoun County, it is generally a soft, calcium bicarbonate type with a low TDS, nearly neutral pH, and locally high iron concentrations (Greaney, 1993). In northern Berkeley County, water is usually obtained from both the Floridan aquifer and Tertiary sand aquifer and is a hard, calcium bicarbonate or sodium bicarbonate type. TDS and chloride usually are less than 350 and 30 mg/L, respectively, and pH is between 7 and 8 (Meadows, 1987).

Water-Level Conditions

Ground-water levels are regularly monitored by DNR in two Floridan-aquifer wells in the Santee River subbasin in order to help assess trends or changes in water levels within that aquifer (Table 6-32). Water levels in other wells are sometimes measured to help develop potentiometric maps of the Middendorf, Black Creek, and Floridan aquifers.

Table 6-32. Water-level monitoring wells in the Santee River subbasin

Well number	Monitoring agency*	Latitude Longitude (deg min sec)	Aquifer	Well location	Land surface elevation (feet)	Depth (feet) to screen top, bottom; or open interval
BRK-644	DNR	33 24 16 79 56 03	Floridan	St. Stephen Middle School	75	53–93
CHN-803	DNR	33 09 10 79 21 30	Floridan	Santee Coastal Reserve	11	48–113

* *DNR, South Carolina Department of Natural Resources*

Water levels in the Middendorf aquifer are about 25 feet below estimated predevelopment levels in the upper part of the subbasin and about 75 feet below estimated predevelopment levels in the lower part of the subbasin (Hockensmith, 2008a). These declines are primarily the result of regional lowering of water levels throughout the aquifer, rather than from pumping of wells within this subbasin.

In the lower part of the subbasin, in southern Georgetown County and in the northeastern corners of Berkeley and Charleston Counties, water levels in the Black Creek aquifer are influenced by the large cone of depression that has developed around Andrews and Georgetown (in the Black and Waccamaw subbasins; see Figure 5-25). In this area, Black Creek water levels are as much as 100 feet lower than estimated predevelopment levels. In the upper portion of this subbasin, Black Creek water levels are less than 25 feet lower than estimated predevelopment levels (Hockensmith, 2008b).

In the Floridan/Tertiary sand aquifer, a small cone of depression has developed around Eutawville, near Lake Marion in eastern Orangeburg County, with water levels having declined 45 feet since 1965 (Hockensmith, 2009). Elsewhere in this subbasin, water levels in this aquifer are not significantly lower than estimated predevelopment levels.

WATER USE

Water-use information presented in this chapter is derived from water-use data for the year 2006 that were collected and compiled by DHEC (Butler, 2007) and represents only withdrawals reported to DHEC for that year. Water-use categories and water-withdrawal reporting criteria are described in more detail in the *Water Use* chapter of this publication.

Water use in the Santee River subbasin is summarized in Table 6-33 and Figure 6-20. Reported offstream water use in the Santee River subbasin was 1,743 million gallons in 2006, the least of the State's 15 subbasins. Of this amount, 1,457 million gallons were from ground-water sources (84 percent) and 286 million gallons were from surface-water sources (16 percent). Water-supply and irrigation uses each accounted for about 40 percent of the total use, and industry and golf-course uses each accounted for about 10 percent. Consumptive use in this subbasin is estimated to be 877 million gallons, or about 50 percent of the total offstream use.

All of the 694 million gallons withdrawn for water-supply use were provided by ground water. Of the 11 water-supply systems that have wells in the subbasin, the town of Santee in Orangeburg County was the largest user, pumping 137 million gallons from two wells, both completed in the Black Creek aquifer. It was followed by the town of St. Matthews, which pumped 122 million gallons (Black Creek aquifer), and the town of Summerton, which pumped 115 million gallons (Middendorf aquifer).

In 2008, the Lake Marion Regional Water Agency opened a water treatment plant capable of treating 8 million gallons a day from Lake Marion, which will serve parts of Berkeley, Calhoun, Clarendon, Dorchester, Orangeburg, and Sumter Counties and several municipalities; most of this use is outside the subbasin. The treatment plant will be owned, operated, and maintained by Santee Cooper.

Irrigation water use totaled 688 million gallons in the subbasin in 2006. Of this amount, 562 million gallons were from ground-water sources (82 percent) and 126 million gallons were from surface-water sources (18 percent). Haigler Farms, Inc. in Calhoun County was the largest irrigator, pumping 417 million gallons from 10 wells, most of which tap the Black Creek aquifer.

Industrial water use in the subbasin was 186 million gallons in 2006. Of this amount, 134 million gallons were from ground-water sources (72 percent) and 52 million gallons were from surface-water sources (28 percent). The largest user was Georgia Pacific Corp. in Berkeley County, which used 101 million gallons pumped from the Black Creek aquifer.

Golf-course water use totaled 172 million gallons, about 10 percent of the total water used in the subbasin in 2006. Of this amount, 107 million gallons came from surface water (74 percent) and 65 million came from ground water (26 percent). The largest user was Santee Cooper Resort, which withdrew 81 million gallons of surface water.

Instream water use for the two hydroelectric power generating facilities—St. Stephen on the Lake Moultrie rediversion canal and the Santee Spillway Hydroelectric Station—totaled 1,027,173 million gallons in 2006. The St. Stephen plant used 878,848 million gallons and the Santee Spillway Hydroelectric Station used 148,325 million gallons.

Table 6-33. Reported water use in the Santee River subbasin for the year 2006 (modified from Butler, 2007)

Water-use category	Surface water		Ground water		Total water	
	Million gallons	Percentage of total surface-water use	Million gallons	Percentage of total ground-water use	Million gallons	Percentage of total water use
Aquaculture	0	0.0	0	0.0	0	0.0
Golf course	107	37.6	65	4.4	172	9.8
Industry	52	18.1	134	9.2	186	10.7
Irrigation	126	44.3	562	38.6	688	39.5
Mining	0	0.0	3	0.2	3	0.2
Other	0	0.0	0	0.0	0	0.0
Thermoelectric power	0	0.0	0	0.0	0	0.0
Water supply	0	0.0	694	47.6	694	39.8
Total	286		1,457		1,743	

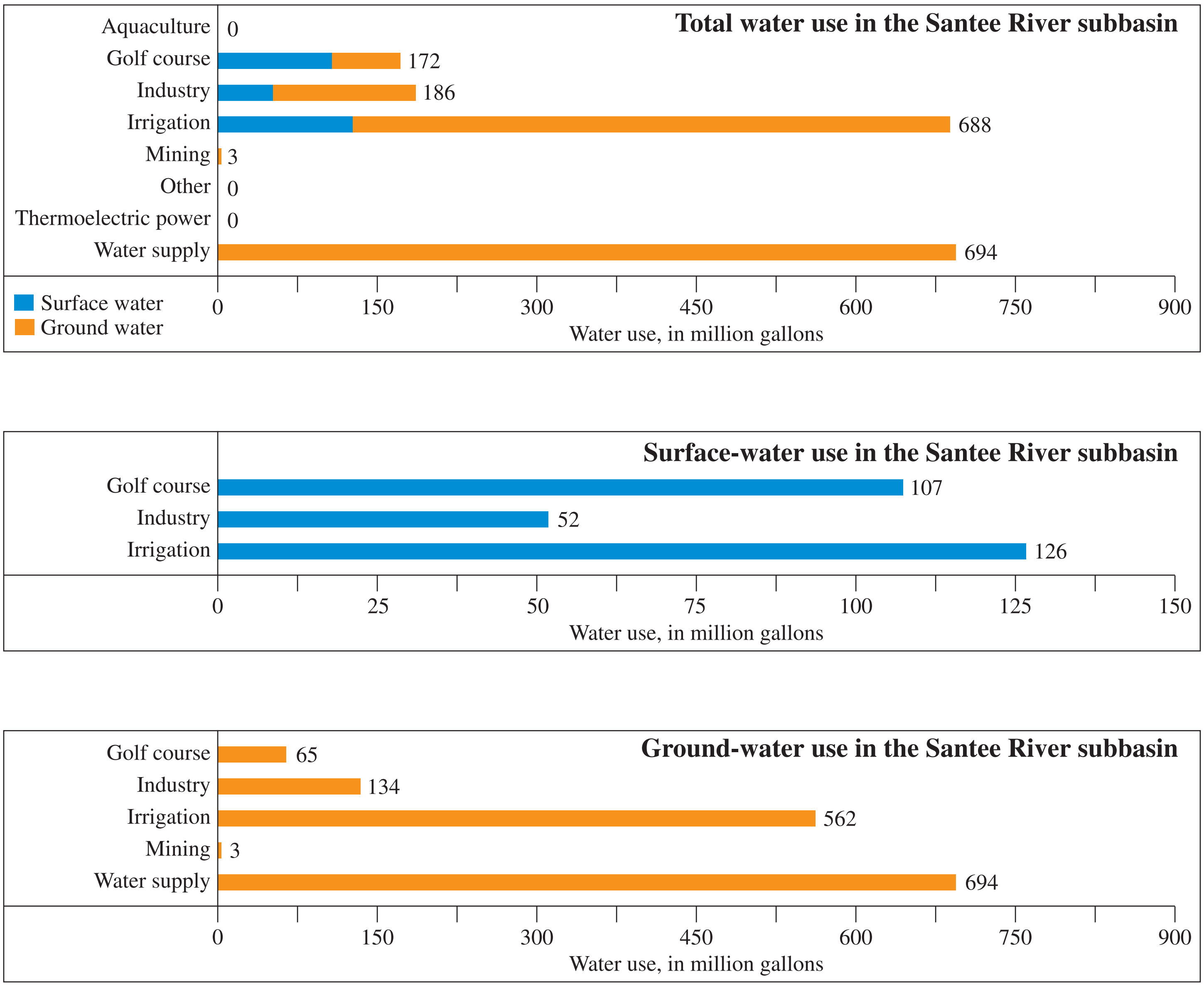


Figure 6-20. Reported water use in the Santee River subbasin for the year 2006 (modified from Butler, 2007).