GENERAL HYDROLOGY OF SOUTH CAROLINA

by
R. N. Cherry, A. W. Badr, and Andrew Wachob
2001

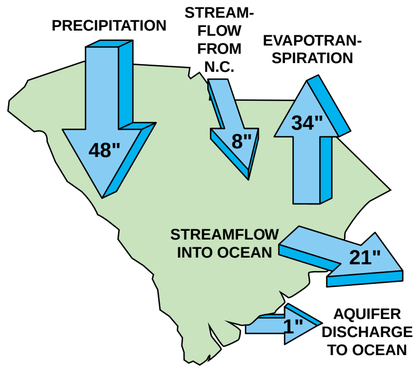


Figure 1. Water budget, in inches, for South Carolina, for the period 1948-1990.

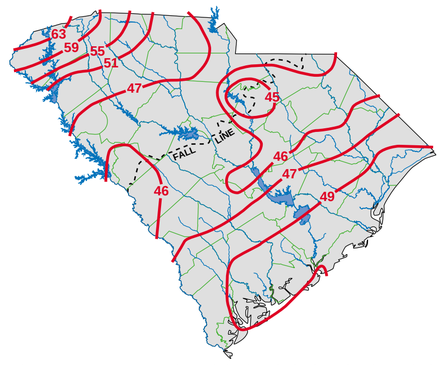


Figure 2. Average annual precipitation, in inches, for the period 1948-1990.

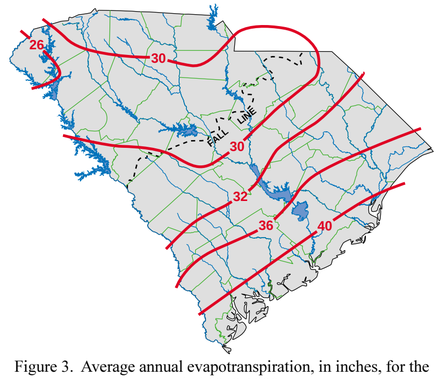


Figure 3. Average annual evapotranspiration, in inches, for the period 1948-1990.

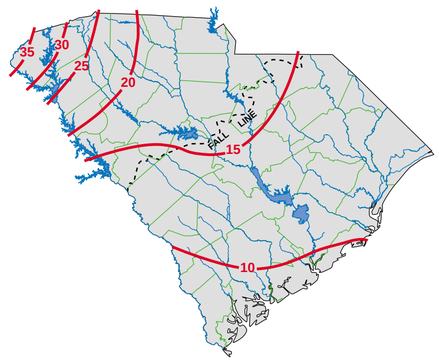


Figure 4. Average annual water yield (precipitation less evapotranspiration), in inches, for the period 1948-1990.

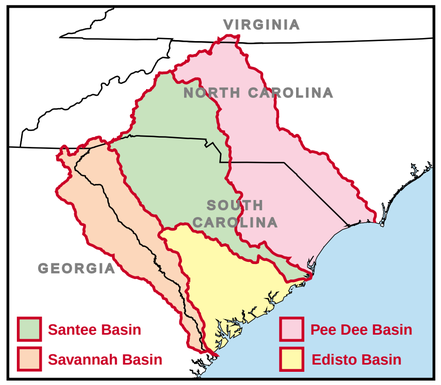
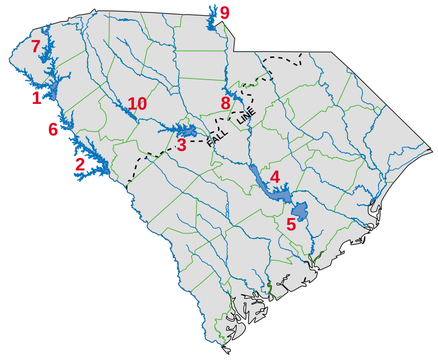


Figure 5. Major stream basins in South Carolina.



	Lake	Drainage basin	Surface area (acres)	Volume (acre-feet)
1	Hartwell	Savannah	56,000	2,549,000
2	Thurmond	Savannah	70,000	2,510,000
3	Murray	Santee	51,000	2,114,000
4	Marion	Santee	110,000	1,400,000
5	Moultrie	Santee	60,000	1,211,000
6	Russell	Savannah	26,650	1,026,000
7	Keowee	Savannah	18,372	1,000,000
8	Wateree	Santee	13,710	310,000
9	Wylie	Santee	12,455	281,900
10	Greenwood	Santee	11,400	270,000

Figure 6. The 10 largest lakes in South Carolina.

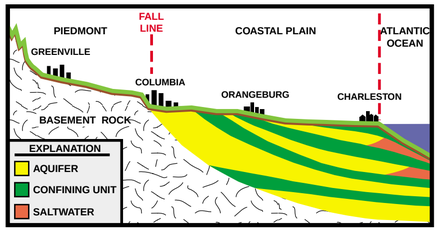


Figure 7. Generalized cross section of South Carolina.

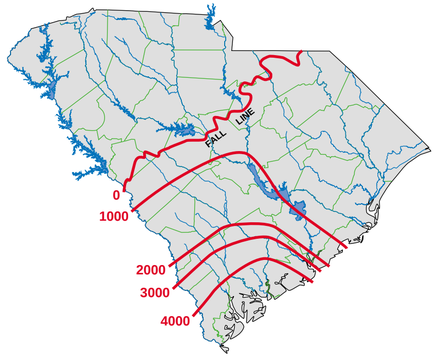


Figure 8. Estimated amount of water, in inches, stored in aquifers of the Coastal Plain.

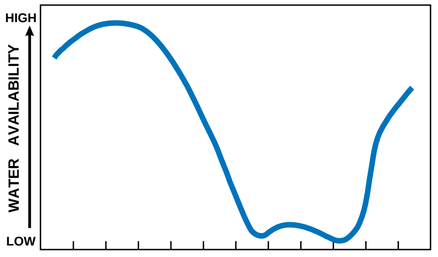


Figure 9. Variation in the availability of water during the year.

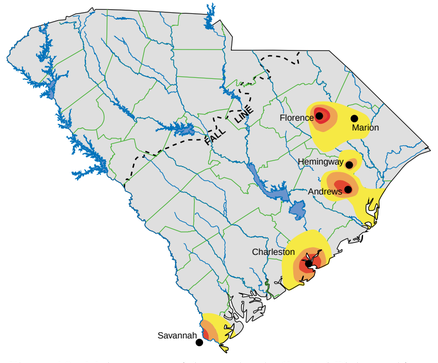


Figure 10. Major cones of depression in Coastal Plain aquifers.

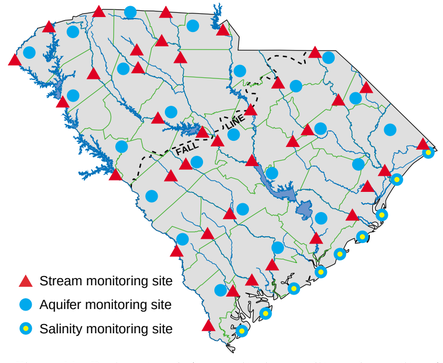


Figure 11. Basic network for monitoring quality and quantity of water in streams, lakes, and aquifers of the state.

Water in South Carolina flows in a large, circulating system called the hydrologic cycle, which may be quantitatively described as the Water Budget (Fig. 1). The hydrologic cycle comprises water that is evaporated from the ocean to the atmosphere where it is later released as precipitation onto land and sea. The precipitation on land is mostly returned either to the atmosphere through evapotranspiration or to the ocean as streamflow and ground water discharge. Some water is stored in lakes and aquifers.

South Carolina receives about 48 inches of precipitation each year. Of this amount, approximately 34 inches is returned to the atmosphere through evapotranspiration, 13 inches is returned to the ocean as streamflow, and less than 1 inch is returned to the ocean as ground water discharge. Streamflow entering from North Carolina is equivalent to about 8 inches of water spread over South Carolina.

The distribution of precipitation and of evapotranspiration within South Carolina is shown in Figures 2 and 3, respectively. Precipitation is highest in the northwestern part of the State and lowest in the central part. Evapotranspiration is highest in the southern part of the State and lowest in the northwestern part. Figure 4 shows the annual water yield, which is the difference between precipitation and evapotranspiration. The water yield is greatest in the northwestern part and least in the southern part of the State.

Streams

Streams are the primary means of conveyance of water to the ocean. Streams receive water from precipitation falling directly onto the streams, from overland flow, and from the ground water system. Water that reaches a stream is generally discharged to the ocean in less than two weeks unless retained by impoundments or diverted for some use. The four major stream basins in the State that carry water to the ocean are the Pee Dee, Santee, Edisto-Ashley-Combahee, and Savannah (Fig. 5). There are approximately 11,000 miles of streams in South Carolina.

Streams serve as a source of water for public supply, commerce, industry, irrigation, livestock, aquaculture, mining, power generation, and recreational activities such as fishing, boating, and swimming. Charleston, Columbia, Greenville, and Myrtle Beach are major cities that use streams as their water-supply source. Streams receive waste discharges from cities, agricultural land, and industries. The amount of waste that a stream may legally be allowed to receive is based largely on the magnitude of streamflow and the nature of the waste. During periods of low streamflow, waste products may cause the amount of dissolved oxygen in water to be lowered, with a negative impact on the stream ecosystem.

Lakes

Lakes serve generally as water storage facilities and are usually parts of stream systems. Like streams, lakes receive water from precipitation falling directly onto them, from overland flow, and from ground water discharge. Lakes are constructed for various reasons, such as flood control, water supply, hydropower generation, and recreation, and each lake may have some or all of the above uses. During periods of high streamflow, the storage of water in lakes reduces flooding, and during periods of low streamflow, the release of water stored in lakes can sustain the flow of streams downstream. Figure 6 shows the location, area, and volume of the 10 largest lakes in South Carolina.

Aquifers

A cross section of South Carolina (Fig. 7) shows that igneous and metamorphic basement rock underlies the entire State. In the Coastal Plain (the area between the ocean and the Fall Line), this rock is covered with sand, limestone, and clay sediments that reach thicknesses greater than 3,000 feet at the coast. Aquifers are sand or limestone zones beneath the surface of the ground that yield water to wells and springs. Aquifers receive water mostly from precipitation in areas where the aquifers are exposed at the surface or covered by permeable sediments, and also in areas where the pressure difference between aquifers is great enough to move water vertically through clay layers (confining units) that normally retard the movement of water between aquifers. Aquifers feed water to streams by seepage and constitute the primary source of water to streams during periods of low precipitation. A large quantity of water is stored in the Coastal Plain aquifers (Fig. 8), which serve as a source of water for public supply, commerce, industry, irrigation, livestock, aquaculture, and mining. Wells in these aquifers yield water at rates as great as 3,000 gallons per minute, and the water generally requires little or no treatment before use.

Although the sediments that form the Coastal Plain aquifers are not found in the Piedmont (the area above the Fall Line), some water occurs within fractures of the basement rock. Wells that penetrate these fractures generally yield some water but usually less than 10 gallons per minute; wells that fail to penetrate fractures yield no water.

Potential Hydrological Problems

The availability of water varies not only from one part of the State to another, but also seasonally during the year (Fig. 9). More water is available during the winter than the summer, mostly due to differences in the evapotranspiration rate, which is greater in the warmer months than the cooler months. During warmer months, when the availability of water is the lowest, water demand is the highest.

Withdrawing water from wells lowers the water level in the aquifers. These areas of lowered water levels are called “cones of depression” in aquifers of the Coastal Plain, as shown in Figure 10. Lowering the water level may cause adverse effects, such as well interference, land subsidence, or sinkhole formation. Additionally, withdrawing water from wells near the coast, where aquifers are open to the nearby ocean, may cause saltwater from the ocean to intrude into the freshwater aquifers. Saltwater intrusion reduces the availability of water for all uses.

The flow of streams and water levels in lakes and aquifers are monitored throughout the State (Fig. 11) to determine the availability of water and to improve the management of the resource. When streamflows or water levels in lakes or aquifers are low, a “drought declaration” may be activated and withdrawal of water for nonessential use restricted.

References

Cherry, R.N., and Badr, A.W., 1998, South Carolina Water Plan: South Carolina Department of Natural Resources.

U.S. Army Corps of Engineers, Charleston District, 1991, Inventory of lakes in South Carolina, ten acres or more in surface area.

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