91-156

WATER FACT SHEET

U.S. GEOLOGICAL SURVEY, DEPARTMENT OF THE INTERIOR

NATIONAL WATER-QUALITY ASSESSMENT PROGRAM—The Albemarle-Pamlico Drainage

In 1991, the U.S. Geological Survey (USGS) began to implement a full-scale National Water-Quality Assessment (NAWQA) program. Long-term goals of the NAWQA program are to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to provide a sound, scientific understanding of the primary natural and human factors affecting the quality of these resources. In meeting these goals, the program will produce a wealth of water-quality information that will be useful to policy makers and managers at the national, State, and local levels.

Study-unit investigations constitute a major component of the NAWQA program, forming the principal building blocks on which national-level assessment activities are based. The 60 study-unit investigations that make up the program are hydrologic systems that include parts of most major river basins and aquifer systems. These study units cover areas of 1,200 to more than 65,000 square miles and incorporate about 60 to 70 percent of the Nation's water use and population served by public water supply. In 1991, the Albemarle-Pamlico drainage was among the first 20 NAWQA study units selected for study under the full-scale implementation plan.

The Albemarle-Pamlico drainage study will examine the physical, chemical, and biological aspects of water-quality issues in a coordinated investigation of surface water and ground water in the Albemarle-Pamlico drainage basin. The quantity and quality of discharge from the Albemarle-Pamlico drainage basin contribute to some water-quality problems in the biologically sensitive waters of Albemarle and Pamlico Sounds. A retrospective analysis of existing water-quality data will precede a 3-year period of intensive data-collection and analysis activities. The data resulting from this study and the improved understanding of important processes and issues in the upstream part of the study unit will enhance understanding of the quality of water in Albemarle-Pamlico Sounds, the second largest estuarine system in the United States.

DESCRIPTION OF THE ALBEMARLE-PAMLICO DRAINAGE STUDY UNIT

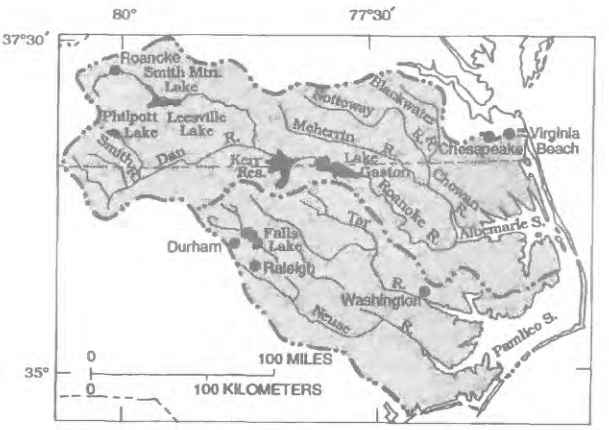
The Albemarle-Pamlico drainage study unit area encompasses about 27,500 square miles and excludes the open waters of Albemarle and Pamlico Sounds. Total population (1990) of the counties and cities that are wholly or partly drained by streams in the study unit is about 3.2 million. The largest cities entirely in the study unit are Raleigh (208,000), N.C., and Roanoke (96,000), Va. Those partly in the unit are Virginia Beach (393,000) and Chesapeake (152,000), Va., and Durham (136,000), N.C. Important industries in the study unit include the manufacture of paper, textiles, furniture, chemicals, apparel, and electrical machinery, and fishing. About 5 percent of the land in the study unit is developed for urban and industrial use, about 30 percent is used for crops (tobacco, soybeans, corn, wheat, and peanuts) and livestock (hogs, poultry, and cattle), about 50 percent is forested, and about 15 percent is wetland (swamp and marsh).

Fifty-six percent of the study unit area is in the Valley and Ridge, Blue Ridge, and Piedmont physiographic provinces, and 44 percent is in the Coastal Plain. Land-surface elevations range from about 3,700 feet above sea level in the Valley and Ridge and Blue Ridge parts of the study unit to sea level in the eastern Coastal Plain.

Annual temperatures average about 49 degrees Fahrenheit in the mountains and about 61 degrees Fahrenheit near the coast. Average annual precipitation ranges from about 40 to 52 inches, the largest amounts in the eastern and westernmost parts of the study unit. Precipitation generally is evenly distributed throughout the year. Annual snowfall averages 20 inches in the mountains and less than 2 inches near the coast.

The Valley and Ridge province is underlain by consolidated limestone, sandstone, and shale. Consolidated metamorphic, igneous, and sedimentary rocks underlie the Blue Ridge and Piedmont. The Coastal Plain is underlain by unconsolidated sand, silt, and clay, and consolidated to partly consolidated limestone, shell, and sand beds. The soils that have developed in the study unit area include thin, sandy soils on steep slopes in the mountains; thick, clayey soils on moderate to gentle slopes in the Piedmont; clayey and organic soils on very gentle slopes in the Coastal Plain; and sandy soils in the Coastal Plain.

About two-thirds of the average annual precipitation is returned to the atmosphere by evapotranspiration. The remaining 12 to 18 inches, which amounts to about 0.65 million gallons per day per square mile



of drainage area, constitutes the average annual runoff or streamflow. The 7-day, 10-year low runoff ranges from 0.2 to 0.5 million gallons per day per square mile in the mountains to less than 0.005 million gallons per day per square mile in the eastern Piedmont and eastern Coastal Plain. Runoff for December through March averages about twice that for April through November because of large water losses to evapotranspiration during the growing season. The streambed slopes of the rivers in the Chowan basin are the lowest in the study unit, which produce sluggish flows for long periods and flatter, relatively long-lasting flood peaks. Extensive regulation on the Roanoke River and its major tributaries decreases streamflow variability, reduces flood peaks, and augments low flows. The Tar River is swift and rocky at its headwaters, but slows and broadens as it nears Washington, N.C., where it becomes the Pamlico River. Several rivers and creeks drain into Falls Lake near Raleigh and Durham. The Neuse River begins at the outfall from Falls Lake. Flooding is a problem along the Neuse and on tributaries in newly developed urban and suburban areas near Raleigh.

Generally, more than 50 percent of the runoff in the study unit moves through the soils and underlying aquifers before it discharges to streams. The rest discharges directly to the streams as overland runoff. Intense precipitation, clayey soils, steep slopes, and impermeable underlying rock or frozen ground, however, may result in overland runoff being 75 percent or more of the total streamflow. In the central and western parts of the study unit, ground water occurs in and moves through weathered rock or regolith near land surface and fractured metamorphic, igneous, or sedimentary rocks at depth. In the Coastal Plain, ground water occurs in and moves through pore spaces between the sedimentary particles of the deposits. Wells as deep as 700 feet may obtain freshwater from aquifers in the study unit, but most natural ground-water circulation occurs at shallow depths.

Several hydroelectric dams are on the Roanoke River, including Smith Mountain Lake (storage capacity 1,142,000 acre-feet), Leesville Lake (94,960 acre-feet), Kerr Reservoir (2,770,000 acre-feet), and Lake Gaston (515,000 acre-feet). Another hydroelectric project is at Philpott Lake (247,400 acre-feet) on the Smith River, tributary to the Dan River in the Roanoke basin. The largest impoundment in the Neuse River basin is Falls Lake (396,000 acre-feet). Hundreds of smaller man-made lakes or reservoirs are scattered throughout the study unit.

The average daily water use in the study unit in 1985 was approximately 3,000 million gallons per day, of which about 92 percent was from surface-water sources. Water for cooling at four thermoelectric power-generating plants amounted to a total of 2,250 million gallons per day; nearly all was supplied from and returned to surface-water sources. Self-supplied industrial withdrawals totaled 268 million gallons per day. Surface water provided nearly 80 percent of this total. Mining activities used an average of 72 million gallons per day, nearly all from ground-water sources. Public-water suppliers withdrew 177 million gallons per day from streams or lakes, and 49 million gallons per day from aquifers. Aquifers also supply 75 million gallons per day to self-supplied domestic users in rural areas. Irrigation accounted for 126 million gallons per day, about 94 percent from surface-water sources.

MAJOR WATER-QUALITY ISSUES

Surface-water quality issues in the Albemarle-Pamlico drainage study unit are primarily related to sediments, nutrients, trace metals, and organic constituents such as pesticides. For example, sediment, the most frequently cited cause of stream degradation in the study unit, affects water quality in several ways, including reducing clarity of surface water; transporting phosphorus, trace metals, and hydrophobic organic compounds; and reducing the flow capacity of streams and the storage capacity of lakes and reservoirs.

Overabundance of nutrients, especially phosphorus and nitrogen, causes accelerated eutrophication of lakes, reservoirs, and slow-moving streams in the study unit. Algal blooms occur in nutrient-rich waters. Decaying algae depletes oxygen available in the water, which kills fish. Fish populations may also be affected by changes in dominant algal species caused by fluctuations in the availability of nutrients. Trace-metal accumulation in bottom sediments, a problem in several reaches of the major rivers in the study unit, adversely affects aquatic life and can enter the food chain. Under certain circumstances, trace metals remobilize and affect the suitability of water for public supply. Pesticides, which are introduced to surface waters by runoff from agricultural lands and lawns, have toxic effects on aquatic life and affect the suitability of water for drinking. Some pesticides also enter the food chain.

Acid precipitation is a problem, too, in poorly buffered streams in the headwaters of the Roanoke basin. Decreased pH levels caused by acid precipitation reduce biological diversity and productivity in streams and mobilize trace metals associated with soils and sediments. Acid precipitation, however, is an important source of nitrogen in nutrient-rich waters. Conversion of wetlands to croplands or managed forests also adversely affects water quality and wetland ecosystems. Wetlands produce oxygen, trap nutrients and sediments, and slow floodwaters. Nearly 60 percent of the original Great Dismal Swamp, a large wetland in the study area, has been converted to croplands.

The quality of ground water in the Albemarle-Pamlico drainage study unit generally is suitable for most uses, but ground-water issues that are related to excessive concentrations of constituents in water do exist. For example, excessive chloride concentrations (more than 250 milligrams per liter) occur naturally in ground water at depths in Coastal Plain aquifers and where aquifers are adjacent to tidal rivers and sounds or to the ocean. Chloride contamination also occurs from road salt that is used to deice highways. Radon-gas emissions, which occur in areas underlain by Piedmont granite and granite-gneiss aquifers, is derived from the decay of radium in many of these aquifers and is soluble in ground water. Long-term exposure to radon gas may be hazardous to human health.

Nitrate and phosphate concentrations greater than about 2 milligrams per liter occur locally in ground water from shallow aquifers in the area. Such concentrations generally indicate contamination from barnyards, septic tanks, or fertilized cropland. Nitrate concentrations of 10 milligrams per liter or more, which affect human health, are known to occur most frequently in water from the Valley and Ridge limestone aquifers and the shallow sand aquifers in the Coastal Plain. Pesticides, petroleum and other organic compounds, and bacterial contamination in ground water have been increasing throughout the area. Potential sources of these contaminants include point sources such as landfills and nonpoint sources such as agricultural croplands.

COMMUNICATION AND COORDINATION

Communication and coordination between USGS personnel and other interested scientists and water-management organizations are critical components of the NAWQA program. Each of the study-unit investigations will have a local liaison committee consisting of representatives who have water-resources responsibilities from Federal, State, and local agencies, universities, and the private sector. Specific activities of each liaison committee will include exchange of information about water-quality issues of regional and local interest; identification of sources of data and information; assistance in the design and scope of project products; and review of project-planning documents and reports. The liaison committee for the Albemarle-Pamlico drainage study unit will be formed in 1991.

Information on technical reports and hydrologic data related to the NAWQA program can be obtained from:

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