

NATIONAL WATER QUALITY ASSESSMENT PROGRAM: ENVIRONMENTAL SETTING OF THE APALACHICOLA-CHATTAHOOCHEE- FLINT RIVER BASIN

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INTRODUCTION

In 1991, the Apalachicola-Chattahoochee-Flint (ACF) River basin was among the first 20 basins in which studies were initiated as part of the U.S. Geological Survey's National Water-Quality Assessment (NAWQA) program. The major objectives of the NAWQA program are to provide a description of current water-quality conditions for a large part of the Nation's water resources; to define long-term trends in water quality; and to identify, describe, and explain the major factors that affect water-quality conditions and trends (Hirsch and others, 1988). The NAWQA program will provide an improved scientific basis for evaluating the effectiveness of water-quality-management programs, and for predicting the likely effects of changes in land- and water-management practices.

The basin-wide scope of the ACF River basin study of NAWQA differs from previous, more geographically limited water-quality assessments in that it requires a broader, holistic framework for understanding determinants of water quality. In addition to measuring chemical and physical indicators of water quality, the NAWQA program will assess the status of aquatic ecosystems by using surveys of fish, invertebrate, and benthic algal communities. The purpose of this presentation is to summarize major factors, both natural and anthropogenic, that affect surface- and ground-water quality and the health of aquatic ecosystems in the ACF Basin.

PHYSICAL SETTING OF THE ACF BASIN

The ACF River basin lies in Georgia, Alabama, and Florida, and covers an area of 19,600 square miles in parts of three physiographic provinces. The basin is underlain by five major aquifer systems: crystalline rock aquifers in the Blue Ridge and Piedmont physiographic provinces, and four aquifer systems in the Coastal Plain physiographic province. Basin hydrology is influenced by 16 reservoirs, 13 of which are on the Chattahoochee River. These reservoirs play a major role in controlling flow and influencing the quality of water in the basin.

The Chattahoochee River is 430 miles long, drains an area of 8,770 square miles, and has an average discharge of 11,500 cubic feet per second (ft³/s). The river begins in the

Blue Ridge Province in the mountainous region of northeast Georgia which is characterized by steep topography and relatively high precipitation and runoff. Annual precipitation ranges from 53 to 70 inches and annual runoff from 27 to 37 inches. The part of the Chattahoochee River basin in the Blue Ridge Province is underlain by crystalline rock, and surface water in the area is siliceous and low in natural mineral content.

The Flint River, which is 340 miles long and drains an area of 8,460 square miles, has an average discharge of 9,800 ft³/s and begins in the Piedmont Province near Atlanta's Hartsfield International Airport. In the upper part of the Flint River basin annual precipitation ranges from 44 to 59 inches, and annual runoff ranges from 10 to 39 inches. The upper part of the Flint River basin, which lies in the Piedmont Province, is characterized by both broad and narrow ridges separated by narrow valleys. Natural surface water quality in that part of the basin in the Piedmont Province is similar to that in the Blue Ridge, but the water generally has higher concentrations of dissolved minerals and higher turbidity (Cherry, 1961).

The Chattahoochee and Flint Rivers flow through the Piedmont and Coastal Plain Provinces to their confluence at Lake Seminole where they form the Apalachicola River. The parts of these river basins that lie in the Coastal Plain Province are underlain by unconsolidated sediments consisting of sand, gravel, and clay. Surface water tends to be siliceous in the upper part of the Coastal Plain Province but is predominantly carbonate in southwestern Georgia where it is in contact with limestone. Rainfall in the lower Chattahoochee and Flint River basins ranges from 43 to 55 inches annually. Rainfall in this area is rapidly absorbed by the permeable soils, and runoff ranges from 12 to 28 inches annually.

The Apalachicola River is 106 miles long and drains an area of about 2,400 square miles in the lower Coastal Plain Province. Because of the low gradient of the lower Coastal Plain Province, the channel of the Apalachicola River meanders through a wide, swampy floodplain. The floodplain ranges in width from 0.6 miles below Lake Seminole to 5 miles near its mouth, where the Apalachicola River flows

through a system of distributaries to the Apalachicola Bay. The Apalachicola River has an average discharge of 26,000 ft³/s.

BIOLOGICAL SETTING OF THE ACF BASIN

The climate, topography, and physiography of the ACF River basin result in a complex, natural setting that supports a diverse flora and fauna. Prior to European settlement, the ACF River basin was largely forested. The Blue Ridge and Piedmont Provinces supported an oak-hickory-pine forest, and the Coastal Plain Province supported an oak-sweetgum-pine forest; gum-cypress forests were present in floodplains (Plummer, 1975).

The ACF River basin is inhabited by 148 known species of freshwater fishes in 21 families. Sixteen of these species have been introduced and 6 are endemic. Introduced species include the rainbow and brook trout, white catfish, flathead catfish, goldfish, carp, rough shiner, white bass, green sunfish, smallmouth bass, white crappie, yellow perch, sauger, and walleye. Endemic species include the grayfin redbhorse, greater jumprock, bluestripe shiner, highscale shiner, bandfin shiner, and the shoal bass. The gulf sturgeon is the only fish species in the basin listed as threatened by the U.S. Fish and Wildlife Service, but an additional 16 species are listed by Alabama, Florida, or Georgia as being threatened, rare, unusual, or of special concern.

Historic records indicate that the ACF River basin supported a diverse mollusk fauna that include 49 species of unionid mussels in 17 genera, of which 9 are endemic (Johnson, 1972). Six unionid mussel species currently are listed by the U.S. Fish and Wildlife Service as candidates for status as threatened or endangered (U.S. Department of the Interior, 1991). The U.S. Fish and Wildlife Service currently is conducting a survey of the mussel fauna of the basin to determine the status of these species.

The construction of reservoirs has resulted in a substantial increase in lentic habitat in the basin. Nutrients and sediments that may be retained in these reservoirs influence the water quality and trophic status of these systems. Retention of nutrients and sediments are of concern in West Point Lake and Lake Blackshear, where eutrophication has occurred, and in Lake Seminole, which has extensive macrophyte growth. Stable water levels, shallow depths, and sedimentation in Lake Seminole produce conditions favorable to prolific production of macrophytes, including exotic species such as hydrilla, Eurasian watermilfoil, water hyacinth, and giant cutgrass.

CULTURAL SETTING OF THE ACF BASIN

Population of the ACF River basin in 1990 was estimated at 2.6 million people. Nearly 90 percent of the total population in the basin lived in Georgia, and nearly 75 percent

lived in the Atlanta metropolitan area. The population in the ACF River basin has increased 37 percent between 1970 and 1990, and 92 percent of this increase was in Georgia, predominantly in the Atlanta metropolitan area. Population in the basin is projected to increase by 15 percent to 3.0 million by the year 2000, and by 30 percent to 3.4 million by 2010. The largest increases in population are projected for the Atlanta metropolitan area (Paul Lycett, Georgia Department of Community Affairs, written commun., October 1992; Carolyn Trent, University of Alabama Center for Business and Economic Research, written commun., December 1992; University of Florida, 1992).

Less than 3 percent of the basin is managed as Federal or State forests or parks, and most of the landscape has been transformed by human activity. In 1972-76, approximately 59 percent of the basin was covered by forest, 29 percent was agricultural, 5 percent was forested wetland, 4 percent was urban, and 3 percent was water and barren land based on estimates from high-altitude aerial photography (U.S. Geological Survey, 1972-78). Approximately 64 percent of the basin was forested in 1987; the forests consist chiefly of second-growth hardwoods and large acreages of planted pine. Approximately 25 percent of these forests was timberlands owned by companies or individuals involved in manufacturing wood products (Brown 1987, Thompson 1989, Vissage and Miller 1991). Agricultural land represented a mix of cropland, pasture, orchards, and areas of confined feeding for poultry and livestock production. In 1990, approximately 250 million broiler chickens, 500 thousand cattle, and 225 thousand swine were produced in the basin. The dominant agricultural land use in the Piedmont Province is pasture and confined feeding for dairy or livestock production. Most of the poultry operations in the ACF River basin are concentrated in the upper part of the Chattahoochee River basin upstream of Lake Lanier. Row-crop agriculture, orchards, and silviculture were most common in the part of the basin in the Coastal Plain. In this area, the top 5 crops in order of decreasing acres harvested in 1990 were peanuts, corn, soybeans, wheat, and cotton. In 1987, approximately 2 million acres of land in the basin were treated with pesticides, and 1.3 million acres were fertilized (U.S. Bureau of the Census, 1989a,b,c). The largest concentration of urban land in the basin is in the Atlanta area, where urban land cover increased by 36 percent between 1975 and 1985 (Richard Courtney, Atlanta Regional Commission, written commun., October 1992).

Freshwater withdrawals for offstream use in the ACF River basin totaled 2,020 million gallons per day (Mgal/d) in 1990. Of the total withdrawals of freshwater, Georgia accounted for 1,650 Mgal/d (82 percent), Florida for 188 Mgal/d (9 percent), and Alabama for 183 Mgal/d (9 percent). Approximately 20 percent of the water withdrawn in 1990 was consumed. Total water use within the ACF River basin has increased by 37 percent since 1970. The increase can be attributed to an increase in public-supply water use, mainly in

the metropolitan Atlanta area, and to an increase in agricultural water use, mostly in the Dougherty Plain area of southwest Georgia. Between 1970 and 1990, ground-water withdrawals increased by 243 percent to 303 Mgal/d and surface-water withdrawals increased by 25 percent to 1,720 Mgal/d. More than 600,500 acres were irrigated in the ACF River basin in 1990. Georgia accounted for 92 percent of irrigated acreages in the basin with most of the irrigation occurring in the Dougherty Plain (Marella and others, 1993).

SUMMARY

NAWQA's assessment of water quality in the ACF River basin will consider the effects of variations in natural conditions, and in anthropogenic influences in the basin. The northern part of the basin lies predominantly in the Piedmont Province where major influences on water quality are human activity in the growing Atlanta metropolitan area, the poultry industry concentrated upstream of Lake Lanier, and silviculture. The dominant influence on water quality in the Coastal Plain Province is intensive row-crop agriculture and silviculture. The design of NAWQA's ACF River basin study includes a sampling program to assess these various influences and their cumulative effects on water quality.

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