In This Section

- River Basin Description
- Population and Land Use
- Local Governments and Planning Authorities
- Water Use Classifications

Section 2

River Basin Characteristics

This section describes the major characteristics of the Oconee River basin including the following:

- *River basin description* (Section 2.1): the physical features and natural processes of the basin.
- *Population and land use* (Section 2.2): the sociological features of the basin, including the types of human activities that might affect water quality and water resource use.
- *Local governments and planning authorities* (Section 2.3): identification and roles of the local authorities within the basin.
- *Water use classifications* (Section 2.4): description of best uses and baseline goals for management of waters within the basin as defined in the state regulatory framework.

2.1 River Basin Description

This section describes the important geographical, geological, hydrological, and biological characteristics of the Oconee River basin.

The physical characteristics of the Oconee River basin include its location, physiography, soils, climate, surface water and ground water resources, and natural water quality. These physical characteristics influence the basin's biological habitats and the ways people use the basin's land and water resources.

2.1.1 River Basin Boundaries

The headwaters of the Oconee River are in Hall County, where the Middle Oconee and North Oconee Rivers rise. These two rivers run for 55 to 65 miles before joining below Athens to form the Oconee River. The Oconee River flows in a generally southerly direction for another 220 miles to its confluence with the Ocmulgee River to form the Altamaha River. The Oconee River basin, comprising all land areas draining into the Oconee River, is located entirely within the state of Georgia and extends from central northern Georgia, northeast of Atlanta, to central southern Georgia (Figure 2-1). The basin drains a total of 5,330 square miles.

The U.S. Geological Survey (USGS) has divided the Oconee basin into two subbasins, or Hydrologic Unit Codes (HUCs; see Table 2-1). These HUCs are referred to repeatedly in this report to distinguish conditions in different parts of the Oconee River basin. Figure 2-2 shows the location of these subbasins and the associated counties within each subbasin.

Table 2-1. Hydrologic Unit Codes (HUCs) of the Oconee River Basin in Georgia

03070101	Oconee River Above Lake Sinclair Dam
03070102	Oconee River Below Lake Sinclair Dam

2.1.2 Climate

The Oconee River basin is characterized by a warm and humid, temperate climate. Major factors affecting the climate in the basin are latitude, altitude, and proximity to the Blue Ridge Mountains.

Average annual temperature ranges from about 60 °F in the north to 65 °F in the south. Average daily temperatures in the basin for the month of January range from about 40 °F to 45 °F, and for July from 75 °F to 80 °F. In the winter, cold winds from the northwest cause the minimum temperature to dip below freezing for only short periods. Summer temperatures commonly range from the 70s to the 90s (Southeast Regional Climate Center, 1997).

Precipitation is greatest at the north end of the basin, as a result of proximity to the mountainous region of northeast Georgia. Average annual precipitation in the basin, primarily as rainfall, is about 50 inches (in.), but ranges from a low of 47 in. in the southern part of the basin to a high of about 56 in. in the northern region of the basin (U.S. Geological Survey, 1986).

Evapotranspiration generally increases from north to south and ranges from about 26 in. to 35 in. per year. Average annual runoff ranges from 12 in. to almost 30 in. Areal distribution of average annual runoff from 1951 to 1980 reflects basinwide patterns in precipitation and soil-runoff potential. Runoff is greatest at the northern end of the basin, where precipitation is highest, and drops off as one moves southward through the basin (Gebert et al., 1987).

2.1.3 Physiography, Geology, and Soils

The Oconee River basin contains parts of the Piedmont and Coastal Plain physiographic provinces, which extend throughout the southeastern United States. Similar to much of the Southeast, the basin's physiography reflects a geologic history of mountain building in the Appalachian Mountains and long periods of repeated land submergence in the Coastal Plain province.

The Piedmont province is underlain by mostly Precambrian and older Paleozoic crystalline rocks that include mica schist, felsic gneiss and schist, and granite gneiss. Less extensive outcrops of quartzites are also present. The area is characterized by numerous inactive fault zones and joint patterns within the rocks that dictate the surface stream patterns and ground water resources.

The Fall Line is the boundary between the Piedmont and Coastal Plain provinces. This boundary approximately follows the contact between older crystalline metamorphic

Figure 2-1. Location of the Oconee River Basin

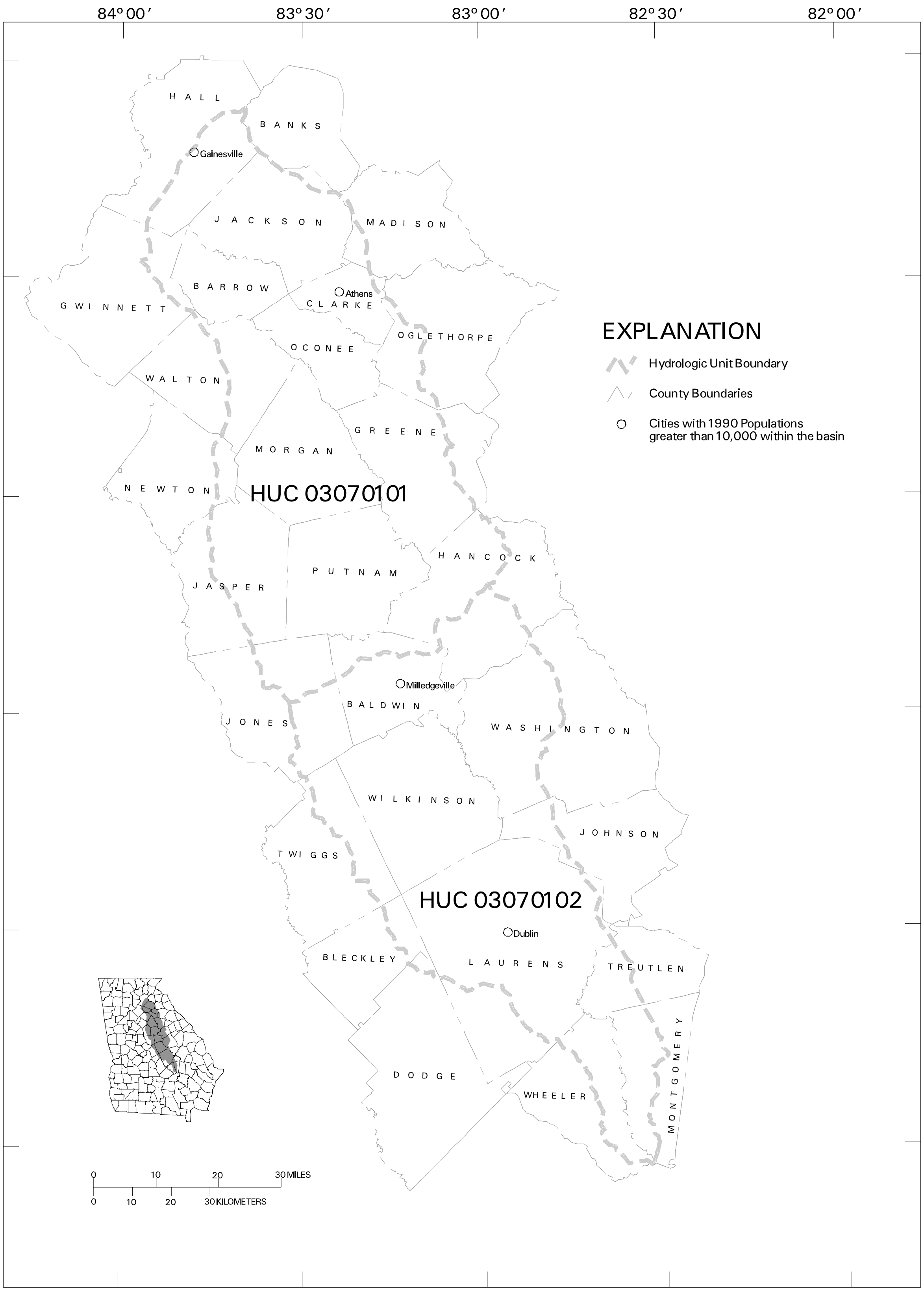

Figure 2-2. Hydrologic Units and Counties of the Oconee River Basin

rocks of the Piedmont province and the younger unconsolidated Cretaceous and Tertiary sediments of the Coastal Plain province. As implied by the name, streams flowing across the Fall Line can undergo abrupt changes in gradient, which are marked by the presence of rapids and shoals. Geomorphic characteristics of streams differ between the Piedmont and Coastal Plain provinces. In the Coastal Plain, streams typically lack the riffles and shoals common to streams in the Piedmont and exhibit greater floodplain development and increased sinuosity.

Geology

The following is a summary of the general geologic factors that appear to influence the background stream sediment geochemistry and stream hydrogeochemistry. Further details are provided by Cocker (1996).

The Oconee River Basin is located within two physiographic provinces: the Piedmont and the Coastal Plain provinces. The Piedmont province, which constitutes approximately 60 percent of the Oconee River Basin, is underlain by crystalline metamorphic and igneous rocks. The majority (57 percent) of the exposed rocks of the Oconee River Basin consist of several types of gneiss. Biotite gneisses cover 29 percent; granite gneisses cover 14 percent; and amphibolite gneisses cover 5 percent of the Oconee River Basin. Granites occupy 4 percent of the basin. Metasedimentary rocks such as metagraywackes, quartzite, and schists cover 4 percent of the Oconee River Basin. Less than 0.1 percent of the Oconee River Basin is occupied by ultramafic and mafic rock units. Coastal Plain sediments are present over 40 percent of the Oconee River basin. Approximately 85 percent of the Coastal Plain sediments in the basin are sands and clays. The rest include calcareous sediments and Quaternary alluvium. Because of significant differences in chemical composition, porosity, permeability, and origin of the different rock units within the Piedmont and Coastal Plain, these rock units and the stream sediments derived from these rock units significantly influence differences in the stream hydrogeochemistry.

Although each rock unit may exert an effect on stream sediment geochemistry and stream hydrogeochemistry, of greater importance is the regional geologic grouping of rocks of similar compositions, porosity, permeability, and origin. In the Piedmont, two major tectonic terranes: the Inner Piedmont terrane and the Carolina terrane, are separated by a major fault—the Towaliga Fault Zone. On the north side of this fault, the Inner Piedmont terrane consists mainly of granitic and biotitic gneisses with smaller volumes of schists, amphibolites, and ultramafic bodies. Source rocks for these Inner Piedmont rocks were primarily sedimentary and perhaps felsic to intermediate igneous rocks. On the south side of the Towaliga Fault Zone, the Carolina terrane includes predominantly intermediate to mafic metavolcanic or metasedimentary rocks derived from intermediate to mafic volcanic rocks. In addition to their compositional differences, the Inner Piedmont rocks have generally been metamorphosed to a higher grade or intensity than rocks in the Carolina terrane. Rocks in the Carolina terrane appear to be more porous and more reactive with surface and ground waters than rocks in the Inner Piedmont perhaps because of differences in composition and metamorphic grade. Small masses of ultramafic rocks are aligned parallel to the main tectonic fabric of the Piedmont and appear to be local sources for chromium, nickel, iron, and magnesium.

Coastal Plain sediments overlap the southern edge of the Carolina terrane at the Fall Line. Coastal Plain sediments nearest to the Fall Line are Cretaceous to Eocene in age. These sediments are dominantly terrestrial to shallow marine in origin and consist of sand, kaolinitic sand, kaolin, clay casts, and pebbly sand. These sediments host the major kaolin deposits in Georgia with many of these deposits found within the Oconee River Basin. The high porosity and relatively non-reactive quartz sands and clays of these sediments appear to have a limited effect on the surface and ground waters. Younger

Eocene and Oligocene sediments are calcareous and have a greater effect on surface and ground waters. These sediments are located further to the south of the older Cretaceous and older Eocene sandy sediments. In the southern part of the basin are poorly sorted, pebbly, argillaceous, micaceous sands, and sandy clays that are Miocene in age. These sediments appear to have little effect on surface and ground waters.

Much of the southeastern Piedmont is covered by deeply weathered bedrock called saprolite. Average saprolite thickness in the Piedmont rarely exceeds 20 meters, but the thickness can vary widely within a short distance. A considerable amount of ground water flows through the saprolite and recharges streams in the Piedmont. Saprolite is easily eroded when covering vegetation and soil are removed. Predominant soil types in the Piedmont are sandy loam clay to fine sandy loam. South of the Fall Line, soils are loamy sand, sandy loam, and sand. Sandy loam and clay to sand soils cover the rest of the Coastal Plain sediments within the Oconee River Basin. Extensive erosion of soil and saprolite caused by agricultural practices during the 1800s and early 1900s contributed a vast quantity of sediment into stream valleys, choking the streams and raising the streams base level. As conservation practices stabilized erosion, streams began to reestablish grade and cut into the thick accumulations of sediments, remobilizing them into the major rivers and eventually into reservoirs.

Geochemistry

Documentation of the background geochemistry of the Oconee River Basin was based primarily on stream sediment and stream geochemical data obtained as part of the U.S. Department of Energy's National Uranium Resource Evaluation (NURE) Program during the period 1976 to 1978. These databases provide the most extensive geochemical sample coverage for the state. A total of 792 NURE stream sediment sample sites are within the Oconee River Basin and represent a ratio of one stream sediment sample site per 17 km^2. All analyses were done by automated neutron activation techniques (NAA). Details on the collection and analyses of the samples are provided by Cocker (1996). Metals in stream sediments that were examined by Cocker (1996) include aluminum, beryllium, chromium, cobalt, copper, lead, nickel, zinc, iron, magnesium, manganese, titanium, and vanadium. Stream pH, conductivity, and alkalinity were also examined. Data were spatially analyzed by a Geographic Information System (GIS) and by statistical methods.

The Oconee River Basin cuts across five regions that differ in pH, conductivity, and alkalinity. Two regions of higher pH (>7), higher conductivity (>50 micromhos/cm), and higher alkalinity (>0.3 meq/L) are coincident with each other and separate regions of lower pH, lower conductivity, and lower alkalinity. These regions are generally correlative with regional geologic and related geochemical trends. Regions of higher pH, conductivity, and alkalinity include the Carolina terrane and the calcareous rocks of the Coastal Plain. Regions of lower pH, conductivity, and alkalinity include the Inner Piedmont terrane, the older (Cretaceous to Eocene) sediments in the northern part of the Coastal Plain, and the younger Miocene sandy sediments in the southern part of the Coastal Plain. These stream measurements appear related to the reactivity of the rocks and sediments which is controlled mainly by their composition and porosity.

Statistical analyses of basin-wide data suggests several elemental associations: (1) iron-manganese-titanium-vanadium-magnesium; (2) copper-nickel-cobalt-zinc-lead; (3) beryllium-potassium-aluminum; and (4) sodium-aluminum. The first group may be related to iron-magnesium mafic silicates and iron-titanium oxides and reflect the distribution of mafic metavolcanic and metaplutonic rocks in the Carolina terrane. The copper-nickel-cobalt-zinc-lead group may be related to base-metal sulfides and reflect their presence as disseminated or vein mineralization. The beryllium-potassium-aluminum group may be related to pegmatites or granitic plutons. Higher beryllium, potassium, and aluminum concentrations are spatially related to granitic plutons. The sodium-aluminum relation appears to reflect the presence of sodic feldspars or sodic amphiboles in the metavolcanic rocks of the Carolina terrane. Correlation coefficients, as well as spatial distributions suggest that groups 1, 2, and 4 plus pH, alkalinity, and conductivity are related to each other and to rocks of the Carolina terrane. A spatial correlation between ultramafic rocks and the metals chromium, nickel, and magnesium probably indicates a genetic relationship.

Stream sediments spatially associated with the mafic metavolcanic and metaplutonic rocks of the Carolina terrane contain higher concentrations of chromium, cobalt, copper, nickel, zinc, iron, manganese, titanium, vanadium, and sodium than most other rock types within the Oconee River Basin. Base and precious metal mining has occurred in the past and is presently underway in the Carolina terrane of South Carolina. The association of certain toxic metals such as mercury, antimony, and arsenic with the mineral deposits in South Carolina suggests that those metals may also exist within the geologically similar rocks of the Carolina terrane in the Oconee River Basin.

Metal concentrations tend to be lowest in the stream sediments located in the Coastal Plain of the Oconee River Basin. This is related to intensive chemical weathering during formation of those Coastal Plain sediments and to subsequent (present) intensive chemical weathering. Highest metal values tend to be those for aluminum which may be related to the aluminous kaolin deposits in the Cretaceous to Eocene age sediments.

Some stream sediment samples and associated stream samples in the NURE database may be affected by nearby human activities. These activities may have increased concentrations of certain heavy metals and affected the pH, conductivity, and alkalinity of the streams. Activities which appear to have affected the geochemistry of the streams and stream sediments the most include: urban activities, waste disposal sites, and sewage.

Soils

Soils of the Oconee River basin are divided into three major land resource areas (MLRAs, formerly called soil provinces) as shown in Figure 2-3. About 60 percent of the area is located in the Southern Piedmont MLRA, about 30 percent in the Southern Coastal Plain MLRA, and 10 percent in the Carolina and Georgia Sand Hills MLRA.

The Southern Piedmont portion of the Oconee basin is underlain primarily by granite and gneiss. Dominant soils in the area have a fine sandy loam surface layer and a deep, red clayey subsoil.

Soils in the Southern Coastal Plain portion of the basin developed in sandy and loamy marine sediments. The dominant soils are very deep and have a loamy sand surface layer and a loamy subsoil.

The Carolina and Georgia Sand Hills portion of the basin lies along the Fall Line between the Piedmont and Coastal Plain. The parent materials in which the soils formed are primarily sandy and loam marine sediments, which occasionally overlay residual Piedmont materials. There are two major groups of soils in the area. One of these soils consists of very deep sands with very little soil profile development. The other soils have a sandy surface layer and a loamy subsoil. The subsoil varies in depth, but is generally not as deeply developed as in the Coastal Plain soils.

2.1.4 Surface Water Resources

The Oconee River basin contains several major rivers, as well as man-made reservoirs.

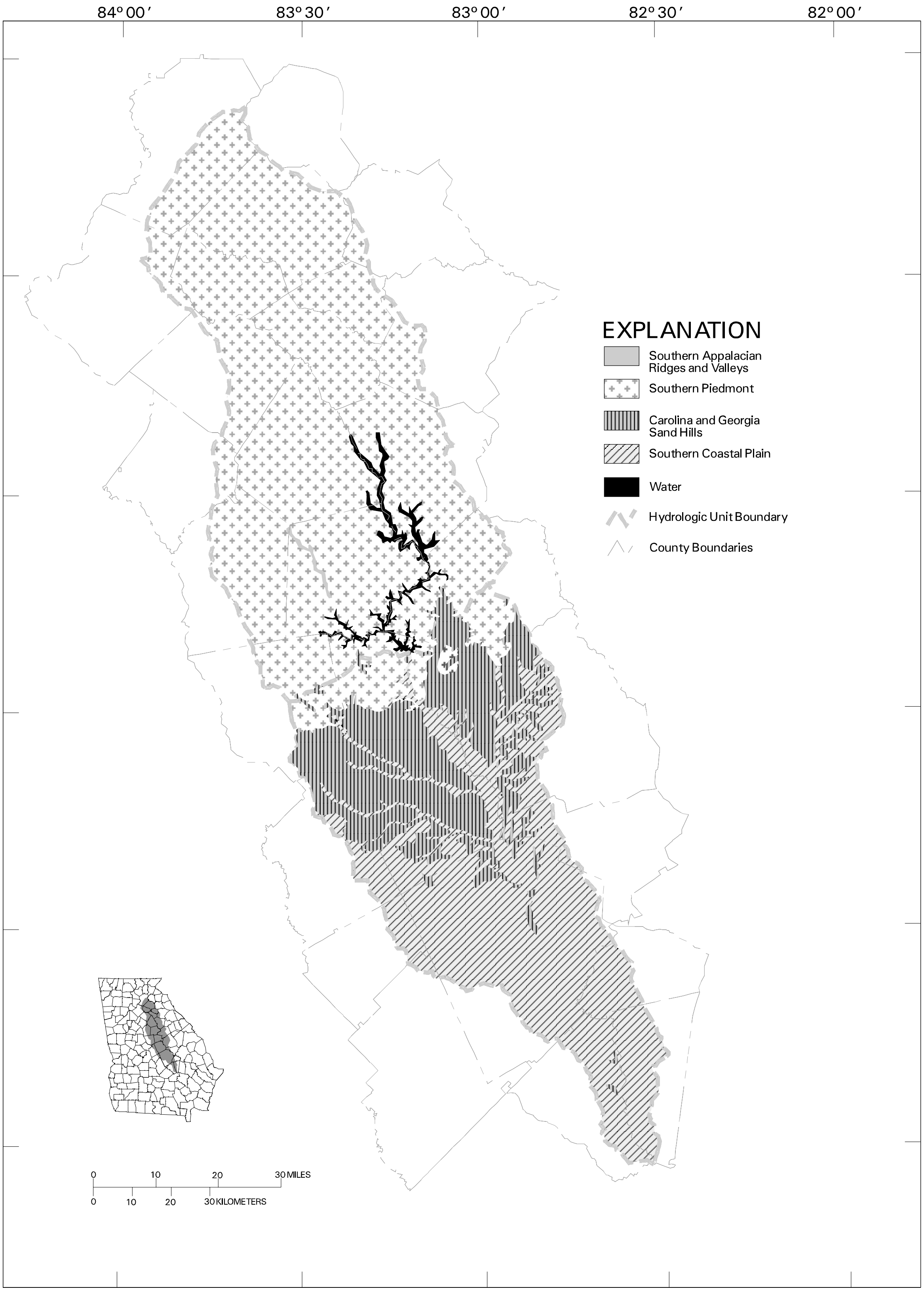

Figure 2-3. Major Land Resource Areas in the Oconee River Basin

North Oconee and Middle Oconee Rivers

Two headwater tributaries—the North Oconee River and the Middle Oconee River—originate at the northern end of the Oconee basin, in the Piedmont physiographic province, at an elevation of about 1,000 feet about mean sea level. These headwater streams are generally well entrenched, flow through narrow floodplains, and have steep gradients ranging from 4.5 to 7.4 feet per mile. These tributaries each flow for approximately 55 to 65 miles to a point just south of Athens, where they join to form the Oconee River.

Oconee River Above Sinclair Dam

From the junction of the North and Middle Oconee Rivers, the Oconee River flows freely for about 20 miles until it joins the northern end of Lake Oconee, a 21,000-acre reservoir formed by Wallace Dam. Immediately downstream of Lake Oconee is the 15,330-acre Lake Sinclair, also a man-made reservoir, formed behind Sinclair Dam (located about 5 miles upstream of Milledgeville). North of Sinclair Dam, the Oconee River flows through the Piedmont physiographic province, where the river is well entrenched, cutting through igneous and metamorphic rock.

Oconee River Below Sinclair Dam

Below Sinclair Dam, the Oconee River flows freely, with the exception of one abandoned diversion dam near Milledgeville, for about 143 miles to its confluence with the Ocmulgee to form the Altamaha River. About 5 miles south of Sinclair Dam, the river enters the transition zone between the Piedmont and upper Coastal Plain known as the Fall Line Hills District, which represents the ancient shoreline of the Atlantic Ocean. This area is characterized by an increased gradient in the Oconee River: the average gradient of the river here is 1.23 feet/mile (0.233 m/km), as compared to 1.05 feet/mile (0.199 m/km) in the Coastal Plain portion of the river between Dublin and its confluence with the Ocmulgee. In the Coastal Plain province, channel substrates are more homogeneous, consisting almost entirely of sand. The channel itself is more sinuous, shifting, and unstable than in the Piedmont, with easily erodible banks.

From the headwaters of the North Oconee River to the confluence with the Ocmulgee River, the Oconee River flows for a total length of about 285 miles and drains a total of 5,330 square miles.

Flow Rates of the Oconee River

From 1897 to 1996, the median discharge of the Oconee River at Dublin, Georgia (USGS Station 02223500) was 2,980 cubic feet per second (ft^3/s). Dublin is the southernmost active USGS gaging station located on the Oconee mainstem, representing a drainage area of 4,400 square miles, or about 83 percent of the Oconee River basin. Over the past 100 years, mean daily discharge at Dublin ranged from a low of 350 ft^3/s on September 11, 1951, to a high of 94,900 ft^3/s on April 13, 1936. Both of these extremes occurred prior to regulation of the Oconee River by Sinclair Dam (completed in 1953) and Wallace Dam (completed in 1979). These impoundments have apparently altered the flow regime in the river, reducing the median flow somewhat and tempering the extremes. Before completion of Sinclair Dam, median flow in the Oconee River was 3,210 ft^3/s; after completion of Wallace Dam, the median flow in the Oconee River was 2,280 ft^3/s.

Figure 2-4 displays trends in discharge at the Dublin gaging station for the past 20 years as boxplots. Each entry on the plot summarizes daily average flow measurements for a water year. (The water year is defined as running from October of the previous

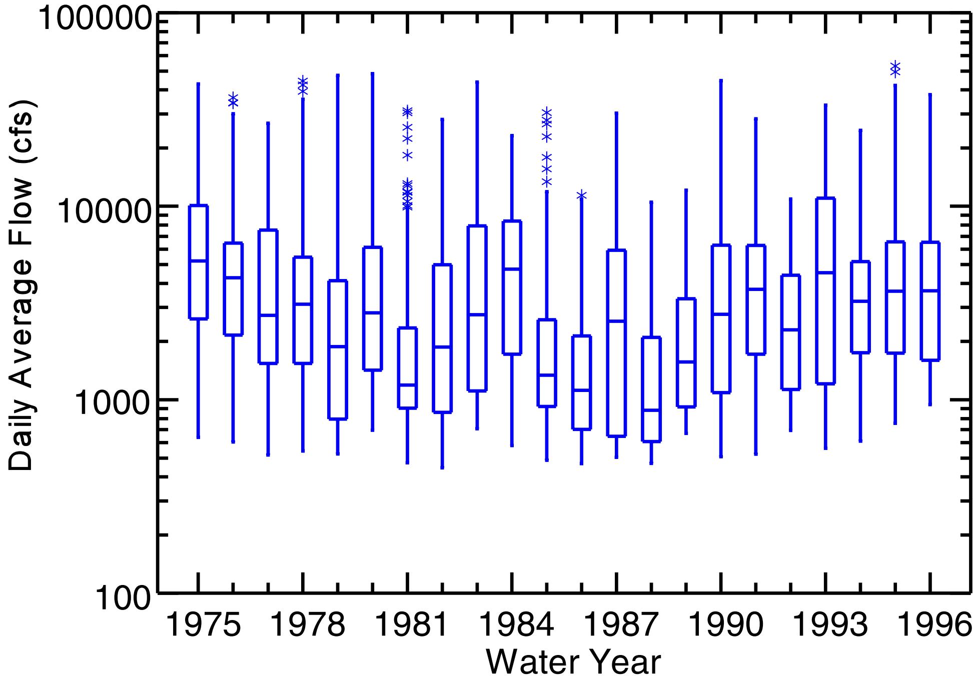

Figure 2-4. Summary of Oconee River Flows Measured at Dublin, 1975-1996

calendar year through September of the current year). The center horizontal line marks the median flow for the year, which is the 50th percentile or flow that is exceeded on half of the days in the year. The upper and lower edges of the box represent the 75th and 25th percentiles, respectively. The lines or "whiskers" extending from each box show the range of data, except that high values far above the median are shown as asterisks or circles.

As shown in Figure 2-4, from 1975 to 1996 the median discharge of the Oconee River at Dublin, Georgia, was 2,510 ft^3/s. Over the past 20 years, mean daily discharge at Dublin ranged from a low of 445 ft^3/s on October 1, 1981, to a high of 53,100 ft^3/s on February 21, 1995 (Figure 2-4). Median yearly flows show significant variability over the same period, ranging from 883 ft^3/s in 1988 to 5,220 ft^3/s in 1990.

As discussed in Section 2.1.1, the Oconee River basin is subdivided into two Hydrologic Units (HUCs). Stream networks within the Georgia portions of each of these HUCs are shown in Figures 2-5 and 2-6.

Reservoirs

The Oconee River basin contains two major surface water reservoirs, Lake Sinclair and Lake Oconee (Figure 2-7 and Table 2-2). Both of these reservoirs are Georgia Power Company facilities designed and operated for the production of hydroelectric power. An additional reservoir—the Bear Creek Regional Reservoir—is under development and expected to be operational by the year 2001.

Lake Sinclair

Lake Sinclair drains an area of 2,910 square miles from the upper Oconee River basin above Baldwin County. The construction of Sinclair Dam began in 1929 but was suspended as a result of the Great Depression. Construction was resumed in 1949 and

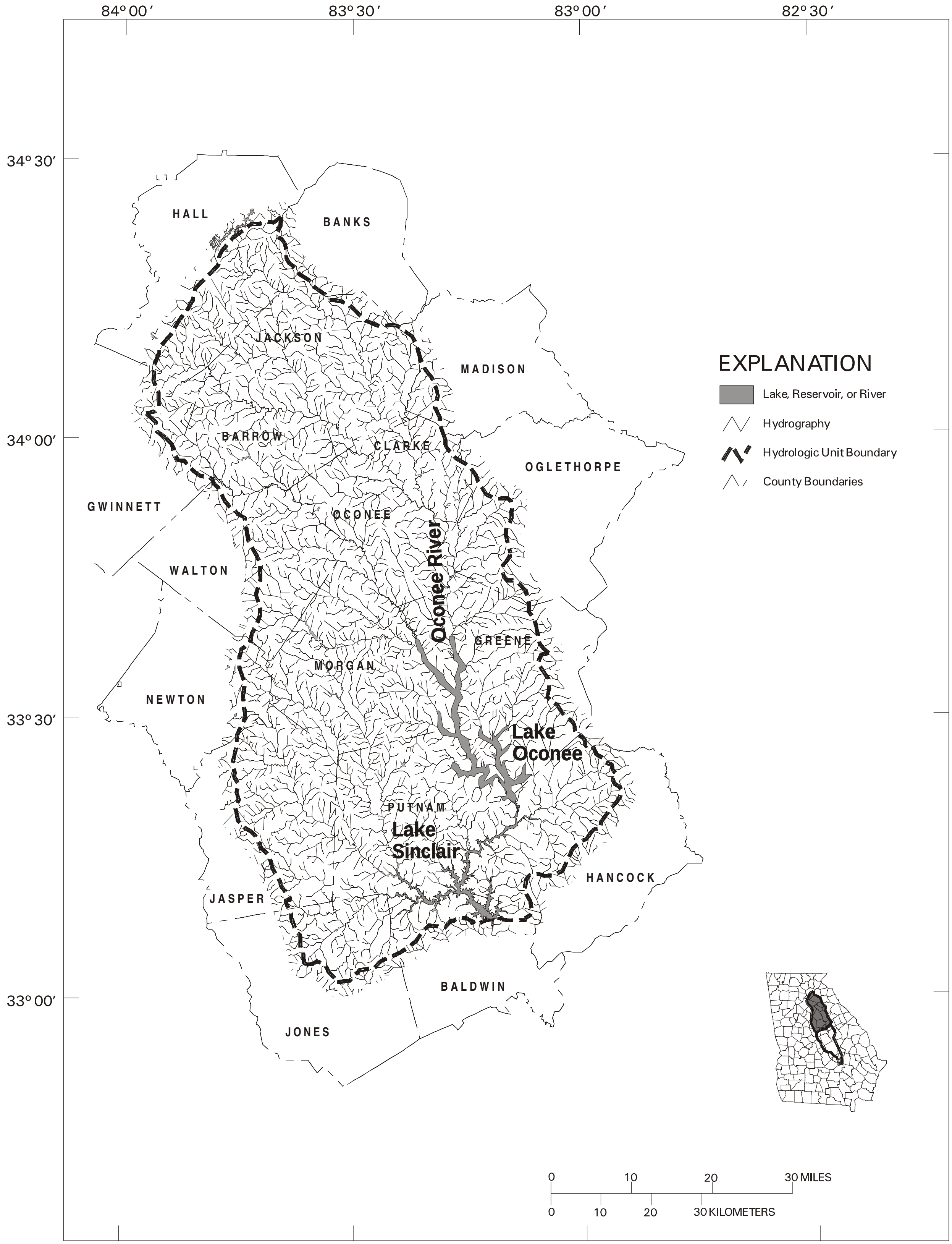

Figure 2-5. Hydrography, Upper Oconee River Basin, HUC 03070101

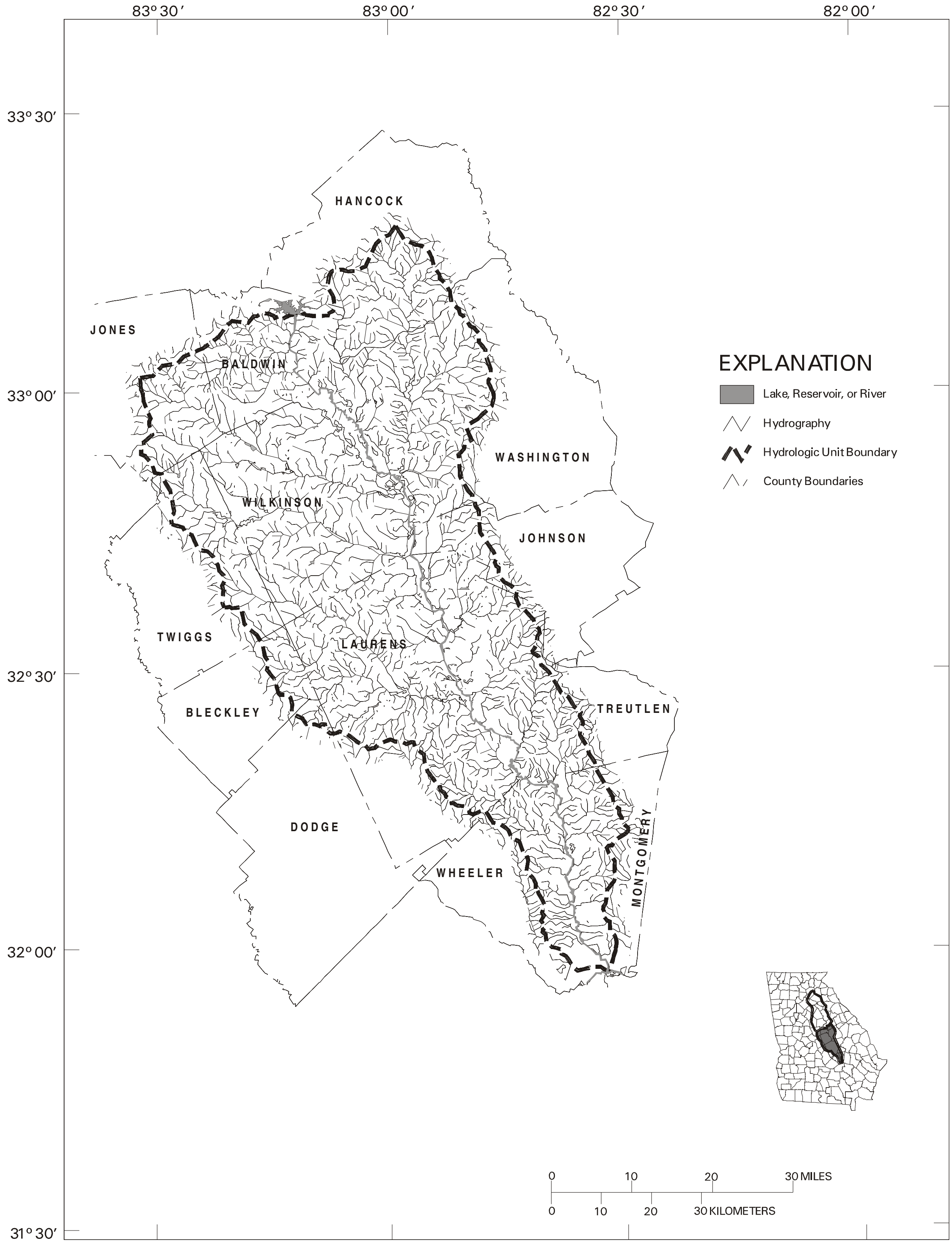

Figure 2-6. Hydrography, Lower Oconee River Basin, HUC 03070102

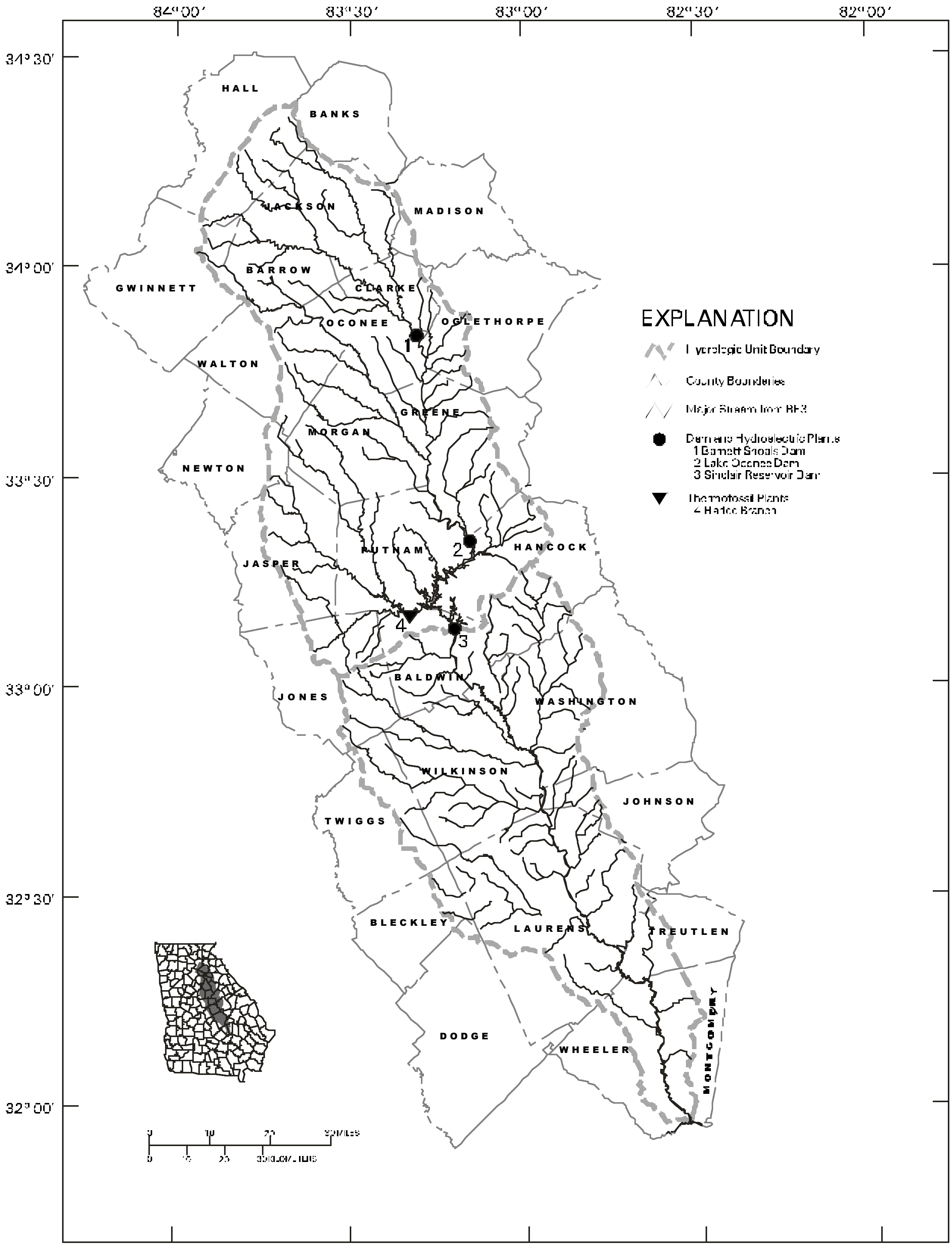

Figure 2-7. Location of Mainstem Dams and Power-Generating Plants in the Oconee River Basin

Table 2-2. Major Dams and Impoundments in the Oconee River Basin

Project Name	Owner/Yr Initially Completed	Drainage Area (mi²)	Reservoir Size (ac)	Reservoir Storage Volume (ac-ft)	Total Power Capacity (kW)	Normal Lake Elevation (ft)
Lake Oconee	Georgia Power/1979	1,830	21,000	470,000	321,000	435.6
Lake Sinclair	Georgia Power/1953	2,910	15,330	330,000	45,000	340.6

completed in 1953. The dam consists of a concrete cavity structure 1,420 feet long with earth embankments on either side totaling 1,595 feet. Lake Sinclair spreads out over a 15,330-acre area at normal pool and has a shoreline that approaches 417 miles in Baldwin, Putnam, Hancock, and Jones counties in central Georgia. The first commercial operation of the facility was in 1953. There are two conventional turbines at Lake Sinclair with installed capacity of 45 megawatts. The project is operated as a hydroelectric peaking facility to meet peak demand in the Georgia Power Company system.

Lake Oconee

Lake Oconee, located immediately upstream of Lake Sinclair, drains some 1,830 square miles of land mass from the upper Oconee River basin above Morgan and Greene counties. Its 374 miles of shoreline lie in Hancock, Putnam, Morgan, and Greene counties in north-central Georgia. Georgia Power Company began commercial operation of Lake Oconee upon completion of Wallace Dam in 1979. There are two conventional turbines and four pumpback units at the powerhouse. In general, the pump turbines are operated in pumping mode to move water up from Lake Sinclair to Lake Oconee during periods of low demand for electricity, usually at night. This water is then used to drive the turbines to generate electricity during periods of peak demand, usually in the day. The installed capacity of the powerhouse is 321 megawatts. Pool elevation of Lake Oconee does not fluctuate seasonally but varies about 1½ feet daily as a result of the pumped storage operation.

Planned Reservoirs

In northeast Georgia, the counties of Jackson, Barrow, Clarke, and Oconee, under the umbrella of the Upper Oconee Basin Water Authority, successfully negotiated a contract that would allow the four counties to cooperatively develop the Bear Creek Regional Reservoir. The reservoir will cover 505 acres and hold 14,980 acre-feet of water at normal pool. It is expected to satisfy water needs for the four counties through the year 2050. This locally sponsored regional reservoir is under development and is expected to begin selling water by mid-2001.

2.1.5 Ground Water Resources

The Oconee River basin is a dynamic hydrological system containing interactions between aquifers, streams, reservoirs, floodplains, and estuaries. Many principal rivers receive a substantial contribution of water from ground water baseflow during dry periods. Three major aquifer systems, described below, underlie the Oconee River basin. Generalized outcrop areas of major aquifers in the Oconee River basin are shown in Figure 2-8. These aquifers are generally separated by confining units.

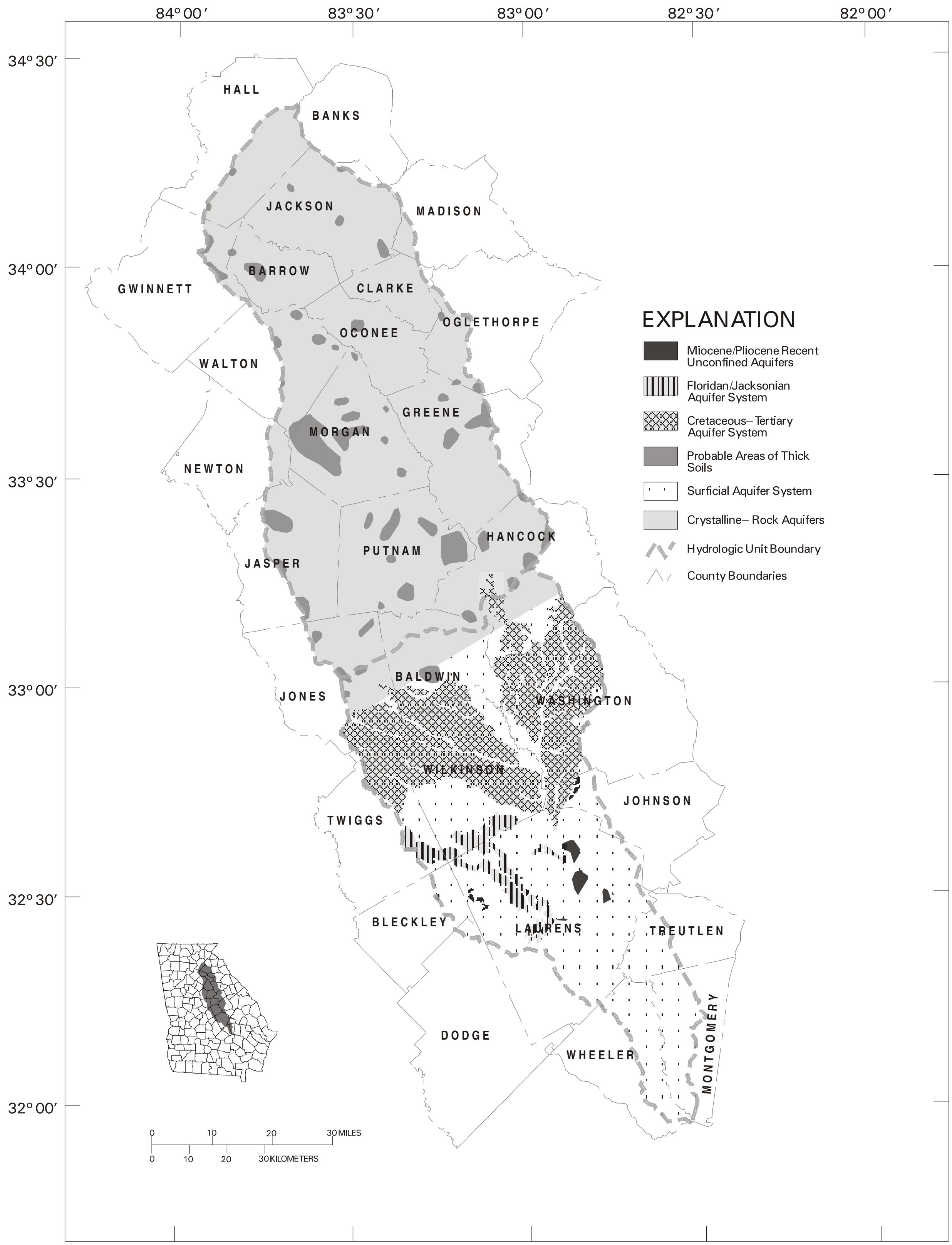

Figure 2-8. Hydrogeologic Units Underlying the Oconee River Basin

Piedmont Province - Crystalline Rock Aquifers

The Piedmont province section of the Oconee River basin is underlain by bedrock consisting primarily of granite, gneiss, schist, and quartzite. These rock formations make up the ***crystalline rock aquifers,*** which are generally unconfined and not laterally extensive. These rocks tend to be impermeable, and thus where ground water is present, it is stored in a mantle of soil and saprolite (i.e., decomposed rock) and transmitted to wells via fractures or other geologic discontinuities in the bedrock. Well yields in this aquifer tend to be unpredictable; typical yields are 1 to 25 gallons per minute, though systematic well-siting techniques have produced high-yielding wells (greater than 100 gallons per minute) on a regular basis. Currently, the crystalline rock aquifers are used primarily for private water supplies and livestock watering. It is commonly believed that ground water in this part of the state is not sufficient to supply such uses as municipal supplies and industry.

Because water is transmitted through faults and fractures, each surface water drainage basin or watershed is also a ground water drainage basin or watershed; surface and ground water are in such close hydraulic interconnection that they can be considered as a single and inseparable system. In the Piedmont, the decomposed rock or saprolite which holds groundwater also contains considerable clay, which acts as a barrier to ground water pollution. This section of the Oconee River basin has below-average pollution susceptibility.

Coastal Plain Province - Floridan and Cretaceous Aquifer Systems

South of the Fall Line, the Oconee River flows through the Coastal Plain hydrogeologic province. Here, the aquifers are porous sands and carbonates and include alternating units of sand, clay, sandstone, dolomite, and limestone that dip gently and thicken to the southeast. Several of these are prolific producers of ground water. Unlike the Piedmont, ground water is the dominant source of water. In this area, the aquifers are of two types—unconfined and confined. The unconfined aquifers are hydraulically interconnected to surface water bodies and the two form a single system; the confined or artesian aquifers, however, are buried and hydraulically isolated from surface water bodies. Confining units between these aquifers are mostly silt and clay. The unconfined aquifers in this area are susceptible to pollution. The confined aquifers, because they are buried and isolated, are somewhat immune to pollution from ground-level activities.

To the south of the Fall Line, progressively younger sediments crop out and overlie older sediments. The complex interbedded clastic rocks and sediments of Coastal Plain aquifers range in age from Quaternary to Cretaceous. Because of gradational changes in hydrologic properties, aquifer and stratigraphic boundaries are not always coincident.

The regional direction of ground-water flow in the Coastal Plain is from north to south; however, local flow directions vary, especially in the vicinity of streams and areas having large ground-water withdrawals. Rivers and streams in the Coastal Plain province commonly are deeply incised into underlying aquifers and receive substantial amounts of ground-water discharge.

The Coastal Plain portion of the Oconee River contains two distinct aquifer systems, described below.

Cretaceous Aquifer System

The Cretaceous aquifer system is the deepest of the principal aquifers in South Georgia. Cretaceous units crop out immediately below the Fall Line. The principal water-bearing formation is the Providence Sand of Late Cretaceous Age. Older Cretaceous strata generally are too deep to be economically developed (Couch et al., 1995). The Cretaceous aquifer system serves as a major source of water in the northern third of the Coastal Plain. The aquifer system consists of sand and gravel that locally contain layers of clay and silt that function as confining beds. Wells in this aquifer typically yield between 50 and 1,200 gallons per minute.

Floridan Aquifer System

The Floridan aquifer system is one of the most productive ground water reservoirs in the United States. This system supplies about 50 percent of the ground water used in the state. It is used as a major water source throughout the Coastal Plain region of the state. The Floridan aquifer system consists primarily of limestone, dolostone, and calcareous sand. It is generally confined, but is semiconfined to unconfined near its northern limit. Wells in this aquifer are generally high-yielding (typically 1,000 to 5,000 gallons per minute) and are extensively used for irrigation, municipal supplies, industry, and private domestic supply.

2.1.6 Biological Resources

The Oconee River basin supports a diverse and rich mix of terrestrial and aquatic habitats and is home to a number of federally and state-protected species. The basin includes portions of three "bottomland forest habitat regions," as delineated by the Georgia Natural Heritage Inventory—Lower Piedmont, Upper Coastal Plain, and Vidalia Uplands (Ambrose, 1987). These regions describe areas that are relatively homogeneous with respect to vegetation associated with river, lake, and wetland environments. Some of the most important biological resources of the basin are summarized below.

Terrestrial Habitats

The health of aquatic ecosystems is linked to the health of terrestrial ecosystems. All parts of the Oconee River basin have been subjected to varying degrees of forest-cover alteration. Small-scale disturbance of native forests began with American Indians who used fire to create fields for cultivation. Forest disturbance was greatly accelerated by European settlers who logged throughout the basin and extensively cleared land for agriculture in the Piedmont and Coastal Plain.

Prior to European settlement, the Oconee River basin was mostly forested. Historically, native forests in the Piedmont province were dominantly deciduous hardwoods and mixed stands of pine and hardwoods. The Coastal Plain supported oak-sweetgum-pine forests, with gum-cypress in floodplain forests. Parts of the lower Coastal Plain were vegetated by open savannahs of wiregrass and longleaf pine (Wharton, 1978).

Lower Piedmont

This habitat region includes the Winder Slope, Washington Slope, Greenville Slope, and Pine Mountain districts. With the exception of the Pine Mountain district, topography in this area is gently to steeply undulating. The lower Piedmont contains the lower stretches of major Piedmont alluvial streams, as well as the headwaters of Coastal Plain alluvial streams (Oconee, Ocmulgee, Savannah, and Flint). Streams of the lower Piedmont have a high periodicity of flooding (roughly four peaks per year, as opposed to the two peaks of Coastal Plain streams) and are characterized by an alternation of shoals, slow runs, and slow water areas. Bottomland sites may contain thick layers of alluvium from erosion of the intensively farmed upland sites.

Floodplain forests of the Lower Piedmont contain a combination of northern and southern elements. Dominant species along stream banks include oak (*Quercus* sp.), hickory (*Carya* sp.), ash (*Fraxinus* sp.), elm (*Ulmus* sp.), American hornbeam (*Carpinus caroliniana)*, cottonwood (Populus deltoides), water tupelo (*Nyssa aquatica*), and black tupelo (*Nyssa sylvatica*) (Evans, 1994). Forests of the "low swamp" may contain red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), black tupelo (*Nyssa sylvatica*), swamp chestnut oak (*Quercus michauxii*), willow oak (*Q. phellos*), overcup oak (*Q. lyrata*), red mulberry (*Morus rubra*), stiff dogwood (*Cornus stricta*), he-huckleberry (*Lyonia ligustrina*), and possumhaw (*Ilex decidua*). Higher banks and terraces may contain loblolly pine (*Pinus taeda*), American beech (*Fagus grandifolia*), water oak (*Quercus nigra*), river birch (*Betula nigra)*, American hornbeam (*Carpinus caroliniana)*, mountain laurel (*Kalmia latifolia)*, and common pawpaw (*Asimina triloba*).

Floodplains in the Lower Piedmont region may also contain several Coastal Plain elements such as sweet bay (*Magnolia virginiana*), water tupelo (*Nyssa aquatica*), and water hickory (*Carya aquatica*). Ravine forests of the Pine Mountain area contain a mixture of Mountain, Piedmont, and Coastal Plain biotic elements (Wharton, 1978) and thus represent an important anomalous vegetation type.

Upper Coastal Plain

This region, which includes the Fall Line Hills and Fort Valley Plateau districts, represents the zone of contact between older metamorphic rocks of the Piedmont and younger sediments of the Coastal Plain. Characteristics of alluvial streams draining the Piedmont change rapidly in this region; floodplains widen considerably, and rapids, shoals, and waterfalls are common.

Below the Fall Line, the Oconee basin’s forest type changes from pine-oak-hickory to southeastern evergreen. The bottomland swamp forest (flooding more than 6 months annually) is mainly cypress-tupelo with hardwood bottoms (flooding less than 6 months annually) composed of hickory-gum communities (GADNR, 1976). While the Upper Coastal Plain region is more easily distinguished from other regions on the basis of its upland sand hill and red loam hill communities, bottomland forests in this region are quite variable, differing from those in the Lower Piedmont mainly in the number of coastal plain elements. Species typically found include black tupelo (*Nyssa sylvatica*), water tupelo (*N. aquatica*), sweetgum (*Liquidambar styraciflua*), flowering dogwood (*Cornus florida*), southern red oak (*Quercus falcata*), water oak (*Q. nigra*), sycamore (*Platanus occidentalis*), red maple (*Acer rubrum*), swamp chestnut oak (*Quercus michauxii*), overcup oak (*Q. lyrata*), laurel oak (*Q. laurifolia*), white oak (*Q. alba*), willow oak (*Q. phellos*), American beech (*Fagus grandifolia*), boxelder (*Acer negundo*), black willow (*Salix nigra*), common alder (*Alnus serrulata*), and southern magnolia (*Magnolia grandiflora*).

The Fort Valley Plateau represents an anomalous physiographic area that is similar in its geologic and soil characteristics to the extensive Black Lands of Alabama. It is included in this region primarily because of its geographic location within the Fall Line Hills and its limited extent.

Vidalia Upland

This area contains a well-developed dendritic system over Irwington sand, Twiggs clay, or undifferentiated Neogene sediments. Streams in this region flow toward the Atlantic Ocean via the Oconee, Ocmulgee, Altamaha, Ogeechee, and Savannah drainages. Extensive alluvial deposits have formed on the wide floodplains and terraces of these three river systems. This region contains some outstanding examples of Coastal Plain alluvial river swamp systems. Several blackwater swamp systems (e.g., the Ohoopee and Canoochee) are also well represented. This region contains few or no limesinks, but has many small Carolina bays and a few disappearing streams. Upland areas bordering the Oconee and Ocmulgee Rivers have been used extensively for row-crop production, pasture, and timber production. Many bottomlands along these rivers are similarly intensively managed for hardwood pulp and timber production. Much of the bottomland hardwood acreage in these areas consists of young secondary growth stands, containing species such as baldcypress (*Taxodium distichum*), water tupelo (*Nyssa aquatica*), water hickory (*Carya aquatica*), river birch (*Betula nigra*), overcup oak (*Quercus lyrata*), swamp chestnut oak (*Q. michauxii*), willow oak (*Q. phellos*), laurel oak (*Q. laurifolia*), water oak (*Q. nigra*), shumard oak (*Q. shumardii*), loblolly pine (*Pinus taeda*), spruce pine (*Pinus glabra*), American elm (*Ulmus americana*), red maple (*Acer rubrum*), persimmon (*Diospyros virginiana*), sweetgum (*Liquidambar styraciflua*), and sycamore (*Platanus occidentalis*).

Wetland Habitats

Wetlands are lands transitional between terrestrial and deep-water habitats where the water table is at or near land surface or the land is covered by shallow water (Cowardin et al., 1979). Most wetlands in the Oconee River basin are forested wetlands located in floodplains of streams and rivers. Forested-floodplain wetlands are maintained by the natural flooding regime of rivers and streams, and in turn, influence the water and habitat quality of riverine ecosystems.

Assessments of wetland resources in Georgia have been carried out with varying degrees of success by the Natural Resources Conservation Service (NRCS), the U.S. Fish and Wildlife Service National Wetland Inventory (NWI), and Georgia's Department of Natural Resources. Georgia DNR compiled a wetlands mapping database in 1991 which is based on classification of Landsat Thematic Mapper (TM) satellite imagery taken during 1988-1990. Total wetland acreage based on landsat TM imagery is 265,125 acres or 7.8 percent of land area in the Oconee River basin. These data underestimate the acreage of forested wetlands, where considerable acreage may have been classified as hardwood or mixed forest.

Aquatic Fauna

This section focuses on aquatic or wetland species including fishes, amphibians, aquatic reptiles, and aquatic invertebrates. However, the Oconee River basin is rich in many other fauna that rely on the water resources of the basin, including many species of breeding birds and mammals. Although a description of these bird and mammal species is beyond the scope of this report, the water needs of these species, such as bald eagles, fish-eating mammals, and migratory water fowl, should be considered in water-resource planning and management.

Fish Fauna

The Oconee River basin is dominated by a warm-water fishery. Warm-water species of recreational importance include largemouth bass, white bass, the hybrid sunshine bass, crappie, pickerel, channel and white catfish, and several varieties of sunfish and suckers.

The diverse fish fauna of the Oconee River basin includes 74 species representing 13 families. Two species of fish occurring within the basin have been listed for protection by state agencies as endangered. The largest number of species is in the minnow family Cyprinidae. Minnows are small fish that can be seen darting around in streams that are only a few feet wide. Other families with large numbers of species are the sunfish and bass family, the catfish family, and the sucker family. Species that have the largest numbers of individuals living in streams typically are minnows and suckers. These species are often not well known because unlike sunfish, bass, and catfish, people do not fish for them, although certain minnows may be used as bait. Minnows have an important role in the aquatic food chain as prey for larger fish, snakes, turtles, and wading birds such as herons. Suckers can grow to more than 1 foot long and are named for their down-turned mouths, which they use to “vacuum” food from stream bottoms. Although suckers are not popular game fish, they are ecologically important because they often account for the largest fish biomass in streams.

Freshwater Fisheries. Several lakes within the Oconee River basin provide excellent habitat for various freshwater fisheries. The Wildlife Resources Division owns and manages Marben Farms Public Fishing Area, a series of ponds totaling 295 acres on tributaries of the Oconee River in Jasper and Newton Counties. These ponds offer excellent fishing for bluegill, channel catfish, and largemouth bass. The ponds lie within the Charlie Elliott Wildlife Center, a 6,400-acre multiuse facility that provides wildlife education through outreach programs and through on-site facilities. The property also includes Clybel Wildlife Management Area, which is managed for public hunting.

The two major reservoirs in the Oconee basin, Lake Oconee and Lake Sinclair, provide good fisheries for largemouth bass, white bass, hybrid bass, crappie, sunfish, and catfish.

Below Lake Sinclair, the Oconee River between Milledgeville and Dublin contains the only known viable population of robust redhorse suckers. A memorandum of understanding between Georgia Power and state and federal agencies was drafted in 1995 to facilitate recovery of the species through a "prelisting" recovery approach.

Amphibians and Reptiles

As a result of this drainage occurring in both the Piedmont and Coastal Plain physiographic provinces, a high diversity of amphibian and reptile species exists. Many of these species may occur in the northern portion (Piedmont) or the southern portion (Coastal Plain), but not both. Consult range maps in appropriate field guides for more precise distribution.

The Oconee River basin is inhabited by 37 documented species of amphibians (17 salamanders and 20 frogs) that require freshwater for all or part of their life cycle (Williamson and Moulis, 1994). Two additional salamanders, *Plethodon glutinosus* (slimy salamander) and *Desmognathus aeneus* (seepage salamander), that omit an aquatic life-stage are nevertheless associated with riparian zones of the Oconee River basin and others. Further, four undocumented amphibians, *Rana grylio* (pip frog), *Rana hecksheri* (river frog), *Hyla gratiosa* (barking treefrog), and *Necturus punctatus* (dwarf waterdog) are quite likely to inhabit this region due to their occurrence in other portions of the greater Altamaha River drainage, of which the Oconee River basin is a part (Williamson and Moulis, 1994). Of these 43 amphibian species, four (*Desmognathus aeneus* [seepage salamander], *Hemidactylium scutatum* [four-toed salamander], *Necturus punctatus* [dwarf waterdog], and *Pseudotriton montanus* [mud salamander]) are considered of "Special Concern" by the Georgia Natural Heritage Program. None of these amphibian species are state or federally listed/protected. Six other amphibians found in the Oconee River basin region, including three of global rarity (*Rana capito* [goper frog], *Ambystoma cingulatum* [flatwoods salamander], and *Notophthalmus perstriatus* [striped newt]), are not included in the above discussion since their breeding, larval, and adult habitats typically do not incorporate stream drainages. These six species breed in isolated, rain-filled wetlands and move into upland situations following transformation.

Eleven turtle species, seven snake species, and the American alligator comprise the documented reptiles strongly associated with freshwater habitats (Williamson and Moulis, 1994) of the Oconee River basin and others. Four other species, *Apalone ferox* (Florida softshell), *Deirochelys reticularia* (chicken turtle), *Farancia erytrogramma* (rainbow snake), and *Regina rigida* (glossy crayfish snake), quite likely inhabit this region due to their occurrence in other portions of the greater Altamaha River drainage. Of these 23 reptile species, four (*Clemmys guttata* [spotted turtle], *Kinosternon baurii* [striped mud turtle], *Farancia erytrogramma* [rainbow snake], and *Alligator mississippiensis* [American alligator]) are considered of "Special Concern" by the Georgia Natural Heritage Program. *Clemmys guttata* is protected as "Unusual" under the state Protected Species List. The eastern indigo snake (*Drymarchon couperi*), federally listed as threatened, is seasonally associated with swamp edges and floodplains from late spring through early fall.

Aquatic and Wetland Vegetation

Although the Oconee River basin supports a diverse population of upland plants, wetland areas are limited and lakes and ponds occur only as a result of human activities. The Georgia Natural Heritage Program has identified six “Special Concern” wetland or aquatic plant species occurring in the Oconee River basin that are designated as unusual, rare, threatened, or endangered (Table 2-3).

2.2 Population and Land Use

2.2.1 Population

In 1995, the Oconee River basin had a population of slightly more than 400,000 residents, almost 6 percent of the total state population. The heaviest concentration of the population resides in the upper end of the basin in Clarke, Barrow, Jackson, and portions of Hall and Walton counties (approximately 50 percent of the total basin population). The number of basin residents is expected to grow to a population of about 500,000 by the year 2020; growing to more than 700,000 by the year 2050.

Population distribution in the basin at the time of the 1990 Census by Census blocks is shown in Figure 2-9. A summary of 1990 population estimates by HUC units based on census tract/block centroids (EPA Geographic Information Query System) for Georgia by HUC is shown in Table 2-4.

2.2.2 Employment

Employment in the basin is about 5.0 percent of Georgia’s total employment, and job growth is expected to average about 0.8 percent per year over the decades between 1995 and the year 2050. Manufacturing jobs now constitute about a quarter of the basin’s total jobs, down from 33 percent in 1975. Manufacturing jobs are not expected to account for nearly as high a percentage of total basin jobs in the decades to come (largely due to increases in productivity). Jobs in the service sector now account for about 16 percent of the total jobs in the basin, but this is expected to grow to near 30 percent of the total basin jobs in 2050. Government sector jobs (i.e., city, county, state, and federal) now stand at about 26 percent of the total basin jobs (about 42,000 jobs), and this percentage is expected to grow to around 31 percent of the total by 2050.

2.2.3 Land Cover and Use

Land use/land cover classification was determined for the Oconee River basin based on high-altitude aerial photography for 1972-1976 (U.S. Geological Survey, 1972-1978). In 1991 land cover data were developed based on interpretation of Landsat TM satellite image data obtained during 1988-1990, leaf-off conditions. These two coverages differ significantly. Aerial photography allows identification of both land cover and land uses. Satellite imagery, however, detects primarily land cover, and not land use, such that a forest and a wooded subdivision may, for instance, appear similar. Satellite interpretation also tends to be less accurate than aerial photography.

Table 2-3. Federal and State Protected Aquatic and Wetland Species in the Oconee River Basin

Common Name	Species	Federal Status	State Status	Ranking	Occurrence by HUC 03150101	Occurrence by HUC 03150102
Vertebrate Animals						
Altamaha Shiner	*Cyprinella xaenura*		E	Imperiled or critically imperiled in state; rare and local throughout range	✔	
Bald Eagle	*Haliaeetus leucocephalus*	De-listed	E	Imperiled in state because of rarity; apparently secure globally	✔	
Robust Redhorse Sucker	*Moxostoma robustum*		E	Imperiled or critically imperiled in state because of rarity	✔	✔
Plants						
Pool Sprite, Snorkelwort	*Amphianthus pusillus*	LT	T	Imperiled globally and in state because of rarity	✔	✔
Black-Spored Quillwort	*Isoetes melanospora*	LE	E	Critically imperiled globally and in state due to extreme rarity	✔	
Mat-Forming Quillwort	*Isoetes tegetiformans*	LE	E	Critically imperiled globally and in state due to extreme rarity	✔	✔
Oglethorpe Oak	*Quercus oglethorpensis*		T	Imperiled in state due to rarity; rare or imperiled globally	✔	
Hooded Pitcherplant	*Sarracenia minor*		U	Apparently secure globally and in state		✔
Silky Camellia	*Stewartia malacodendron*		R	Imperiled in state due to rarity; apparently secure globally		✔

E: Endangered T: Threatened R: Rare L: Listed P: Proposed U: Unusual

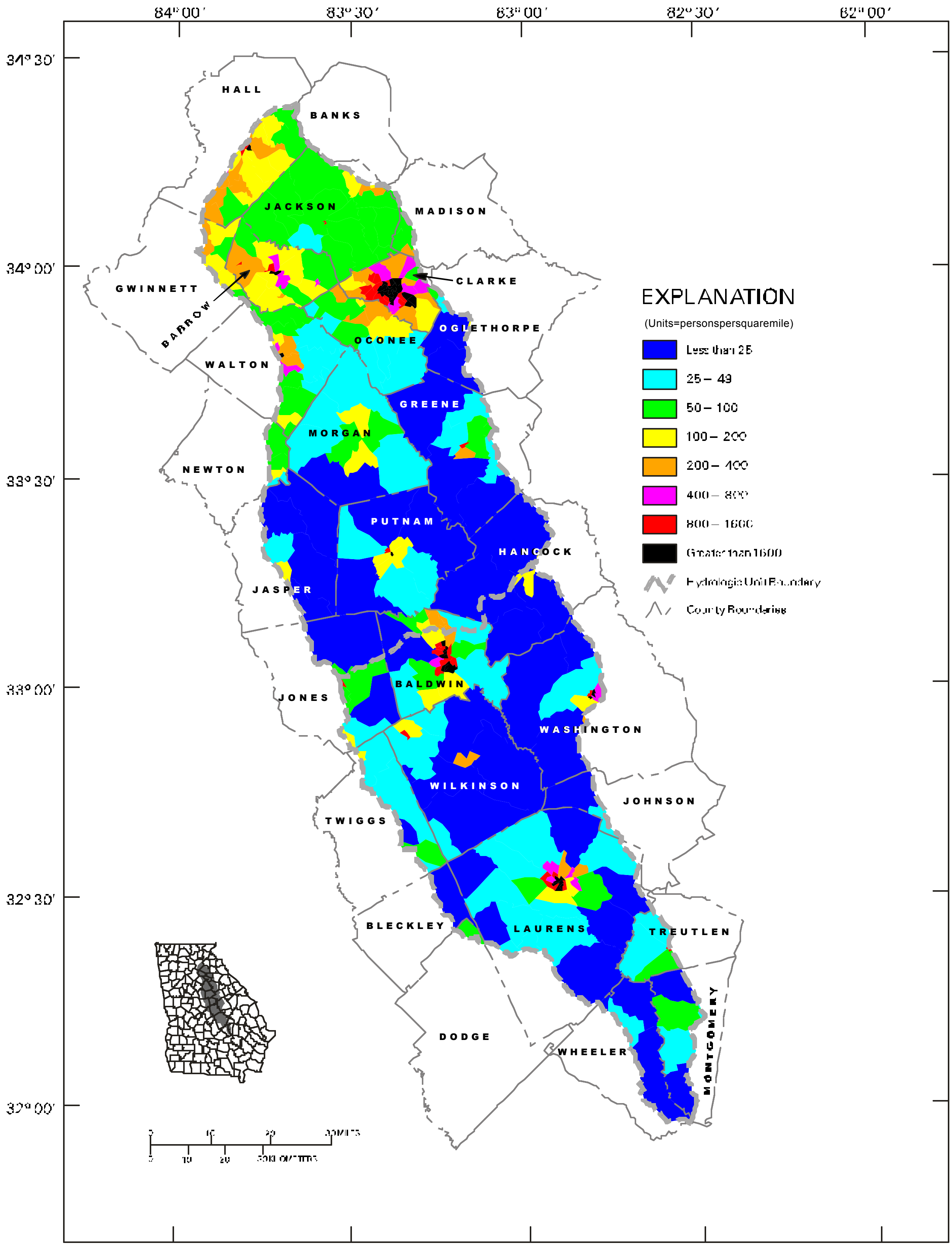

Figure 2-9. Population Density in the Oconee River Basin

Table 2-4. Population Estimates for the Oconee River Basin by HUC (1990)

HUC	Population	Housing Units
03070101	265,369	106,647
03070102	118,891	45,158
Total	*384,260*	*151,805*

The 1972-1976 land cover classification (Figures 2-10 and 2-11) indicated that 69.6 percent of the basin land area was forest, 24.4 percent was agriculture, and 2.2 percent was urban land use, with 3.8 percent in other land uses, including 2.7 percent wetlands.

The 1988-1990 land cover interpretation showed 66.1 percent of the basin in forest cover, 7.8 percent in wetlands, 1.8 percent in urban land cover, and 19.6 percent in agriculture (Figures 2-12 through 2-13). Statistics for 15 land cover classes in the Oconee basin for the 1988-1990 coverage are presented in Table 2-5 (EPD, 1996).

Forestry

Forestry is a major part of the economy within the basin. Markets for forest products afford landowners excellent investment opportunities to manage and sell their timber, pine straw, naval stores, and other products. Statewide, the forest industry output for 1997 was approximately $19.5 billion. The value added by this production, which includes wages, profits, interest, rent, depreciation, and taxes paid into the economy reached a record high $9.3 billion. Georgians benefit directly from 177,000 job opportunities created by the manufacture of paper, lumber, furniture, and various other wood products; consumers of these products also benefit. Other benefits of the forest include hunting, fishing, aesthetics, wildlife watching, hiking, camping, and other recreational opportunities, as well as important environmental benefits such as clean air and water and wildlife habitat.

According to the 1989 U.S. Forest Service's Forest Statistics for Georgia (Thompson, 1989), there are approximately 2,336,500 acres of commercial forest land in the basin, representing about 69 percent of the total land area (Table 2-6). Private landowners account for 77 percent of the commercial forest ownership, while the forest industry companies account for 18 percent. Governmental entities account for about 5 percent of the forest land (Figure 2-14).

The pine type is composed of 406,400 acres of plantations and 673,400 acres of natural stands.

For the period from 1982 through 1989, there was a statewide trend of loss of forest acreage resulting from both conversion to urban and related uses and clearing for agricultural uses. For the entire counties within the basin, there was little change since the area classified as commercial forest land decreased only 1,053 acres from 3,749,556 acres to 3,748,503 acres. The area classified as pine type decreased 88,337 acres (5 percent) from 1,952,028 acres to 1,863,691 acres. The area classified as oak-pine type increased 25,055 acres (5 percent) from 492,730 acres to 517,785 acres. Upland hardwood acreage increased 51,367 acres (5 percent) from 914,152 acres to 965,519 acres. Lowland hardwood acres increased 10,862 acres (3 percent) from 390,646 acres to 401,508 acres.

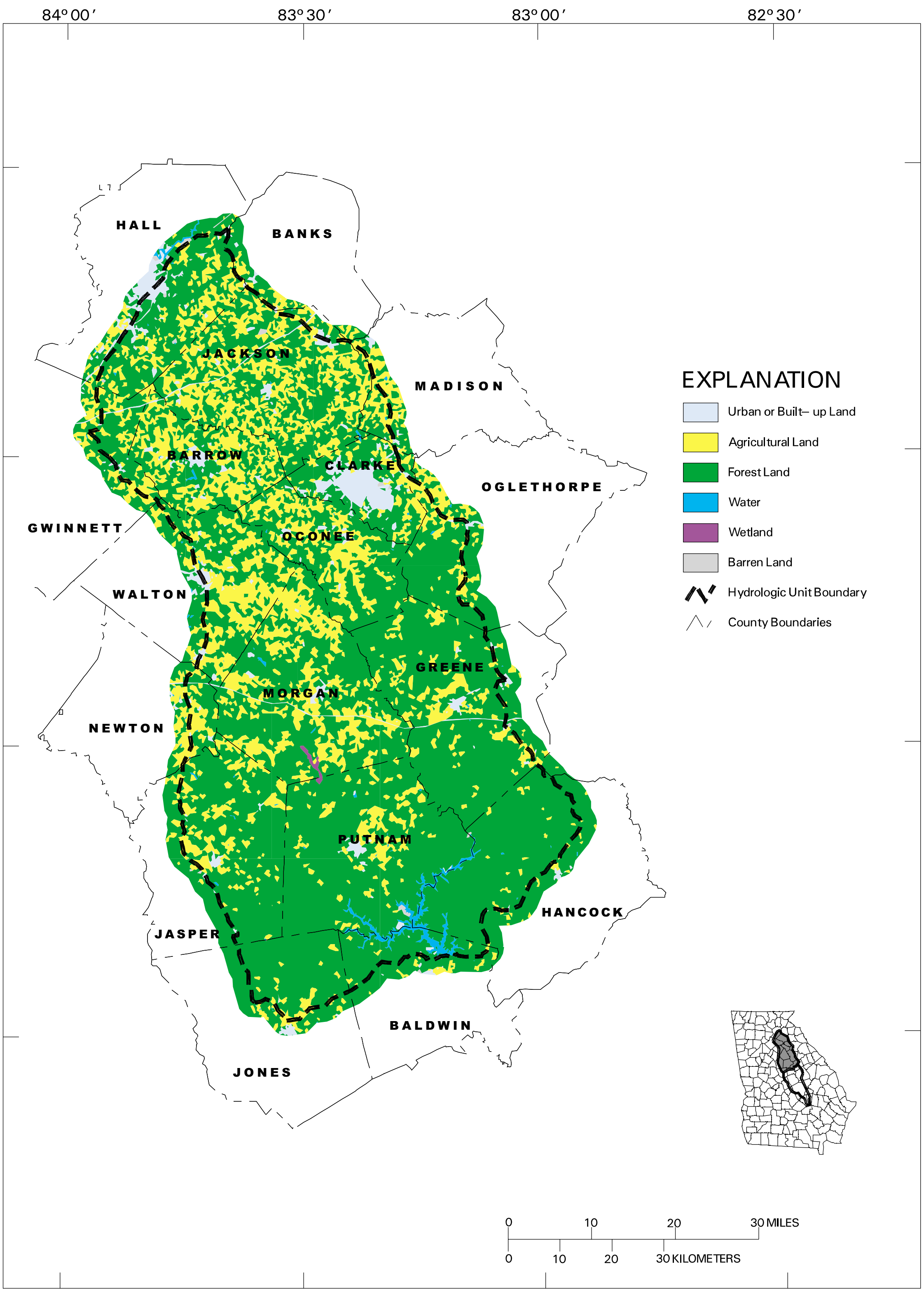

Figure 2-10. Land Use, Upper Oconee River Basin, HUC 03070101, USGS 1972-76 Classification Updated with 1990 Urban Areas

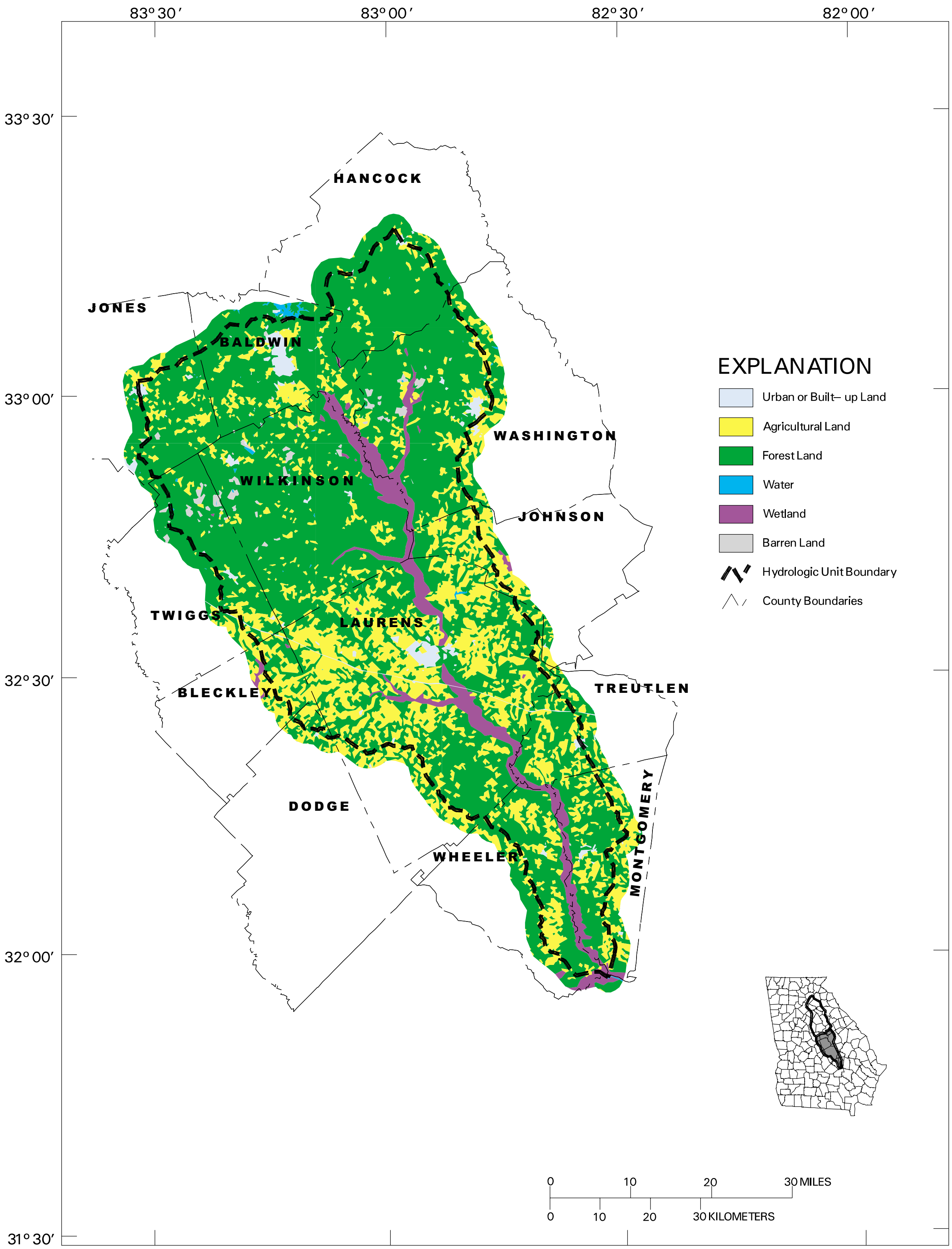

Figure 2-11. Land Use, Lower Oconee River Basin, HUC 03070102, USGS 1972-76 Classification Updated with 1990 Urban Areas

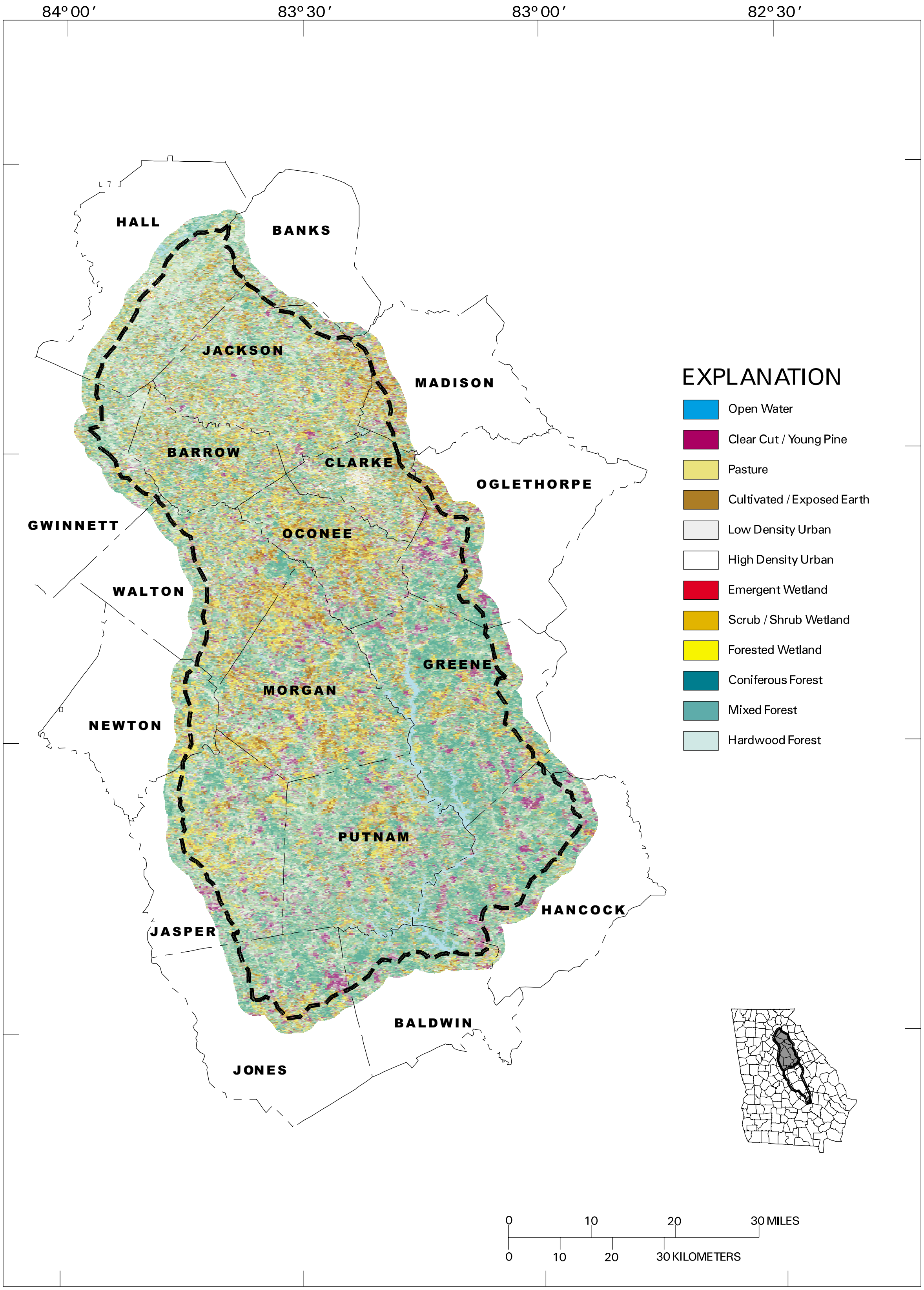

Figure 2-12. Land Cover 1990, Upper Oconee River Basin, HUC 03070101

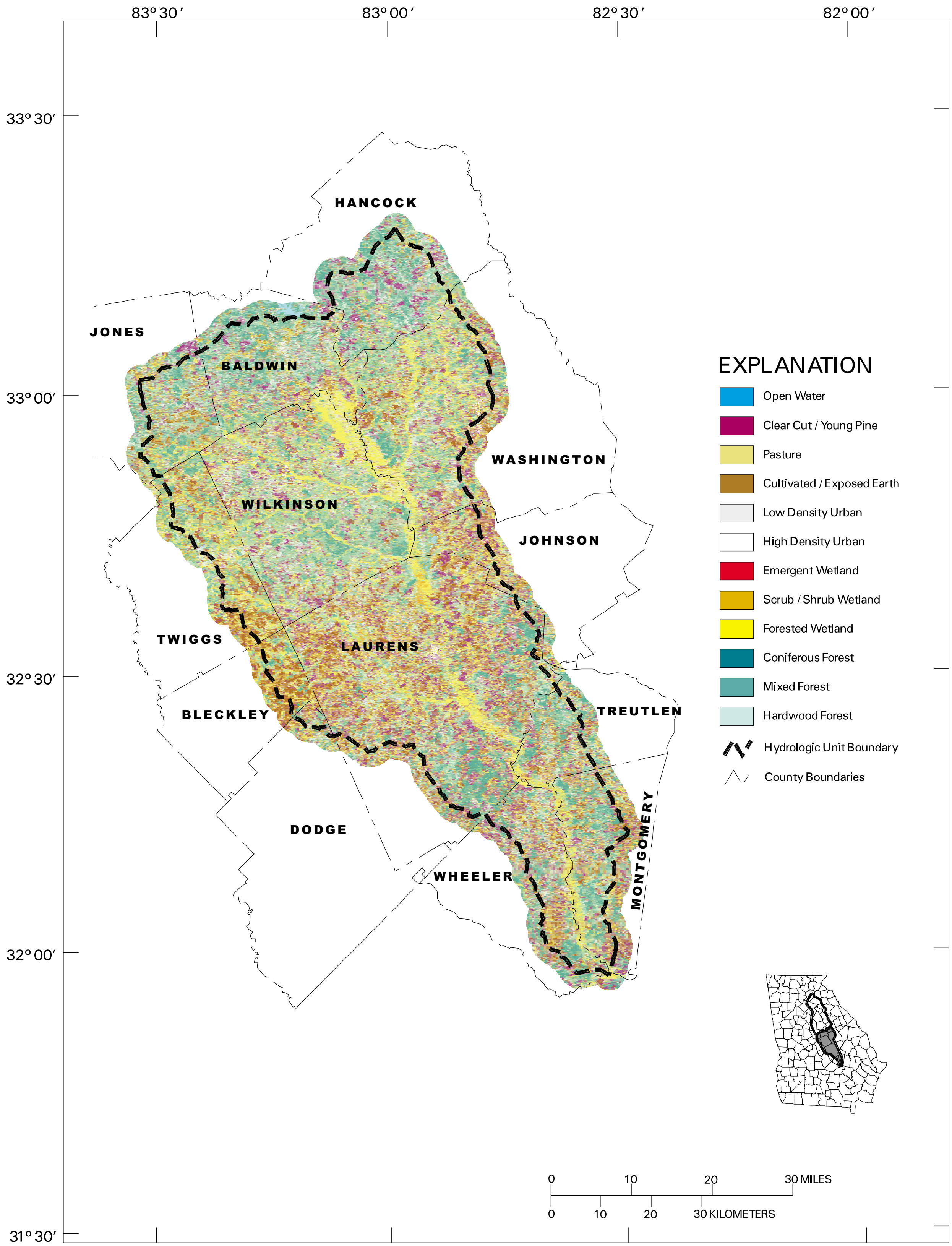

Figure 2-13. Land Cover 1990, Lower Oconee River Basin, HUC 03070102

Table 2-5. Land Cover Statistics for the Oconee River Basin, 1988-1990

Class Name	%	Acres
Open Water	1.5	52,223.4
Clear Cut/Young Pine	9.8	335,733.2
Pasture	11.5	392,142.1
Cultivated/Exposed Earth	8.1	275,807.4
Low Density Urban	1.5	51,467.6
High Density Urban	0.3	11,163.5
Emergent Wetland	0.1	2,895.3
Scrub/Shrub Wetland	1.1	36,132.4
Forested Wetland	6.6	226,097.3
Coniferous Forest	17.2	586,396.3
Mixed Forest	23.5	801,581.8
Hardwood Forest	18.8	640,538.0
Salt Marsh	0.0	0.0
Brackish Marsh	0.0	0.0
Tidal Flats/Beaches	0.0	0.0
Total	*100.0*	*3,412,179.0*

Table 2-6. Forestry Acreage in the Oconee River Basin

County	All Land (acres)	Non-Forest	Commercial Forest	Pine	Oak-pine	Upland Hardwood	Lowland Hardwood
Baldwin	164,800	45,900	118,800	84,600	11,200	12,000	11,100
Barrow	104,100	55,300	48,800	23,600	5,900	16,300	3,000
Bleckley	19,500	7,100	12,500	4,100	3,700	0	4,700
Clarke	78,000	42,300	35,700	14,700	11,000	10,100	0
Dodge	7,700	2,800	4,900	4,900	0	0	0
Greene	199,700	39,400	160,400	115,900	10,500	34,000	0
Gwinnett	44,500	34,000	10,500	3,500	100	7,000	0
Hall	106,100	26,600	79,500	17,000	9,200	53,400	0
Hancock	212,900	22,800	190,100	129,800	27,900	25,200	7,200
Jackson	211,100	89,300	121,900	28,800	43,100	45,900	4,100
Jasper	125,600	31,800	93,800	41,900	23,900	27,900	0
Johnson	21,600	11,100	10,500	5,300	0	2,600	2,600
Jones	120,900	24,000	96,900	59,300	15,800	11,400	10,400
Laurens	435,000	169,500	265,500	99,600	26,300	78,800	60,700
Madison	19,000	7,400	11,600	3,900	3,900	0	3,900
Montgomery	81,700	24,900	56,800	22,500	2,700	19,700	12,000
Morgan	223,300	83,500	139,800	67,400	32,400	34,900	5,200
Newton	29,000	18,300	10,700	10,700	0	0	0
Oconee	119,300	52,700	66,600	28,300	8,400	25,500	4,400
Oglethorpe	63,200	7,500	55,700	18,200	3,400	15,400	18,600
Putnam	219,900	56,900	163,000	79,000	38,200	45,700	0
Treutlen	52,200	20,200	32,100	18,700	2,700	5,400	5,200
Twiggs	73,200	18,700	54,500	29,200	4,000	21,300	0
Walton	105,300	50,300	55,000	9,900	6,600	35,100	3,300
Washington	160,100	26,900	133,200	46,300	23,100	52,400	11,500
Wheeler	90,000	31,500	58,500	27,400	10,800	5,800	14,300
Wilkinson	288,900	39,500	249,400	88,300	32,300	74,100	54,900
Total	*3,376,700*	*1,040,200*	*2,336,500*	*1,079,800*	*356,800*	*663,000*	*236,900*

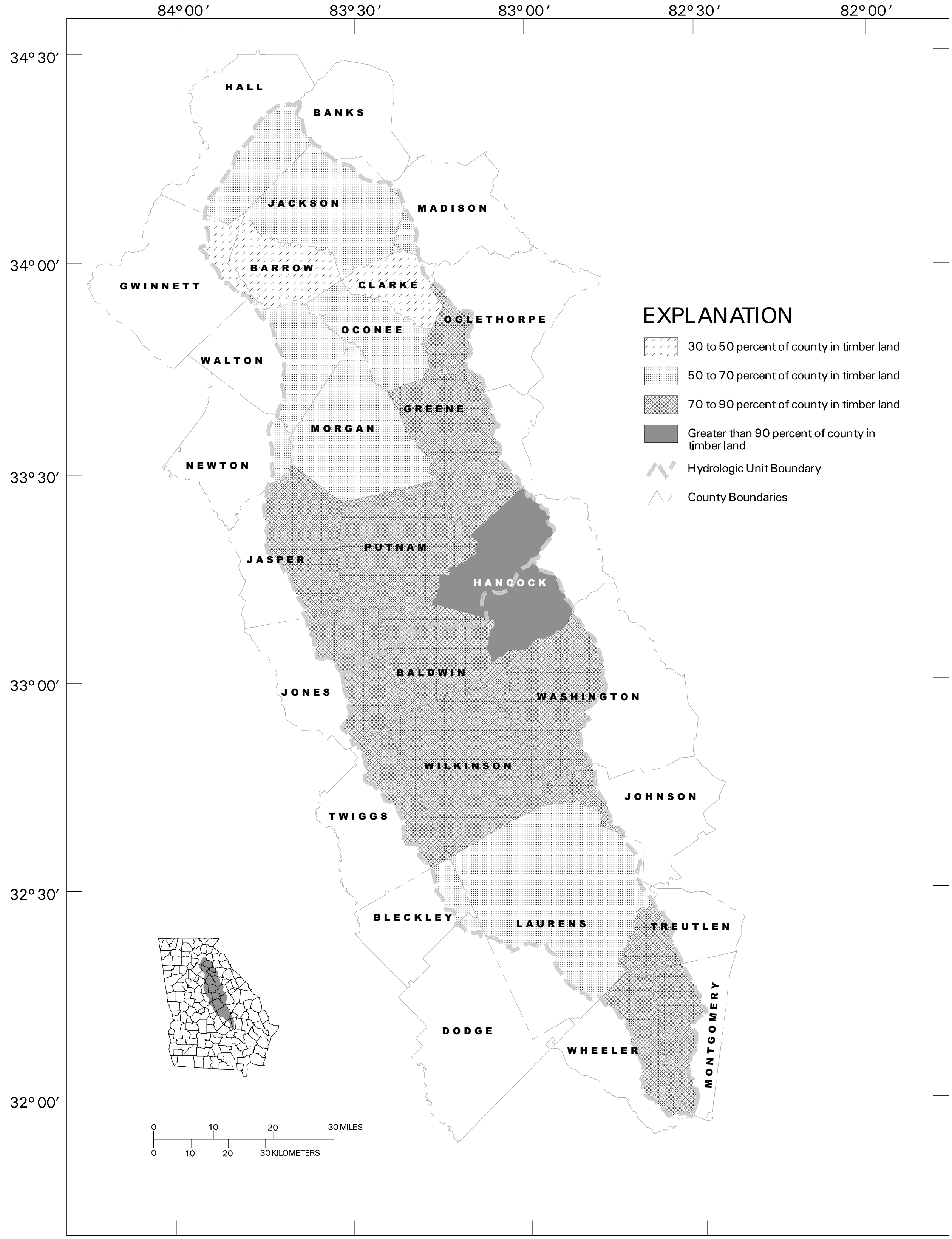

Figure 2-14. Silvicultural Land in the Oconee River Basin

Agriculture

Agriculture in the Oconee River basin is a varied mixture of animal operations and commodity production. Total farmland in the basin (Figure 2-15) has decreased every agricultural census year from 1974 to 1987 (U.S. Bureau of the Census, 1981a,b,c). By 1992, the total amount of land in farms in the basin had fallen to 717,000 acres. Much of the land in farms in the Upper Oconee basin is in pasture (350,000 acres) contrasted by extensive cropland in the Lower Oconee basin (175,000). More than 240,000 acres of cropland is harvested each year in the basin. The principal crops include corn, cotton, peanuts, and small grain (oats, rye, sorghum, soybeans, and wheat). Regionally famous Vidalia onions are also grown in portions of Laurens, Montgomery, Truetlen, and Wheeler Counties. The ranking of harvested acres among crops varies from year to year in response to market conditions, government subsidy programs, and the weather.

Livestock and poultry production in the Oconee River basin is relatively intense, particularly in the Upper Oconee River basin. Approximately 200,000 head of cattle, 72,000 head of swine, and 163,000,000 broilers and layers are currently being raised on farms in the basin (Table 2-7). Morgan and Jackson Counties rank first and second, respectively, among Georgia counties in cattle production, with 38,000 head in Morgan County and 28,000 head in Jackson County. Two other counties, Hall and Madison, also rank among the top 10 cattle producing counties in the state. The heart of Georgia's dairy industry is located in the Upper Oconee basin as well, primarily in Putnam, Morgan, and Greene Counties. Clarke, Oconee, and Oglethorpe Counties contain the heaviest concentration of hog production in the basin, with Oglethorpe ranking among the state's top 15 producing counties. Finally, Madison, Hall, and Jackson Counties host the largest concentrations of poultry operations in the basin, with each county ranking among the top 10 producing counties in the state.

2.3 Local Governments and Planning Authorities

Many aspects of basin management and water quality protection depend on decisions regarding zoning, land use, and land management practices. These are particularly important for the control of nonpoint pollution—pollution that arises in storm water runoff from agriculture, urban or residential development, and other land uses. The authority and responsibility for planning and control of these factors lies with local governments, making local governments and jurisdictions important partners in basin management.

The Department of Community Affairs (DCA) is the state's principal department with responsibilities for implementing the coordinated planning process established by the Georgia Planning Act. Its responsibilities include promulgation of minimum standards (Figure 2-15) for preparation and implementation of plans by local governments, review of local and regional plans, certification of qualified local governments, development of a state plan, and provision of technical assistance to local governments. Activities under the Planning Act are coordinated with the Environmental Protection Division (EPD), Regional Development Centers, and local governments.

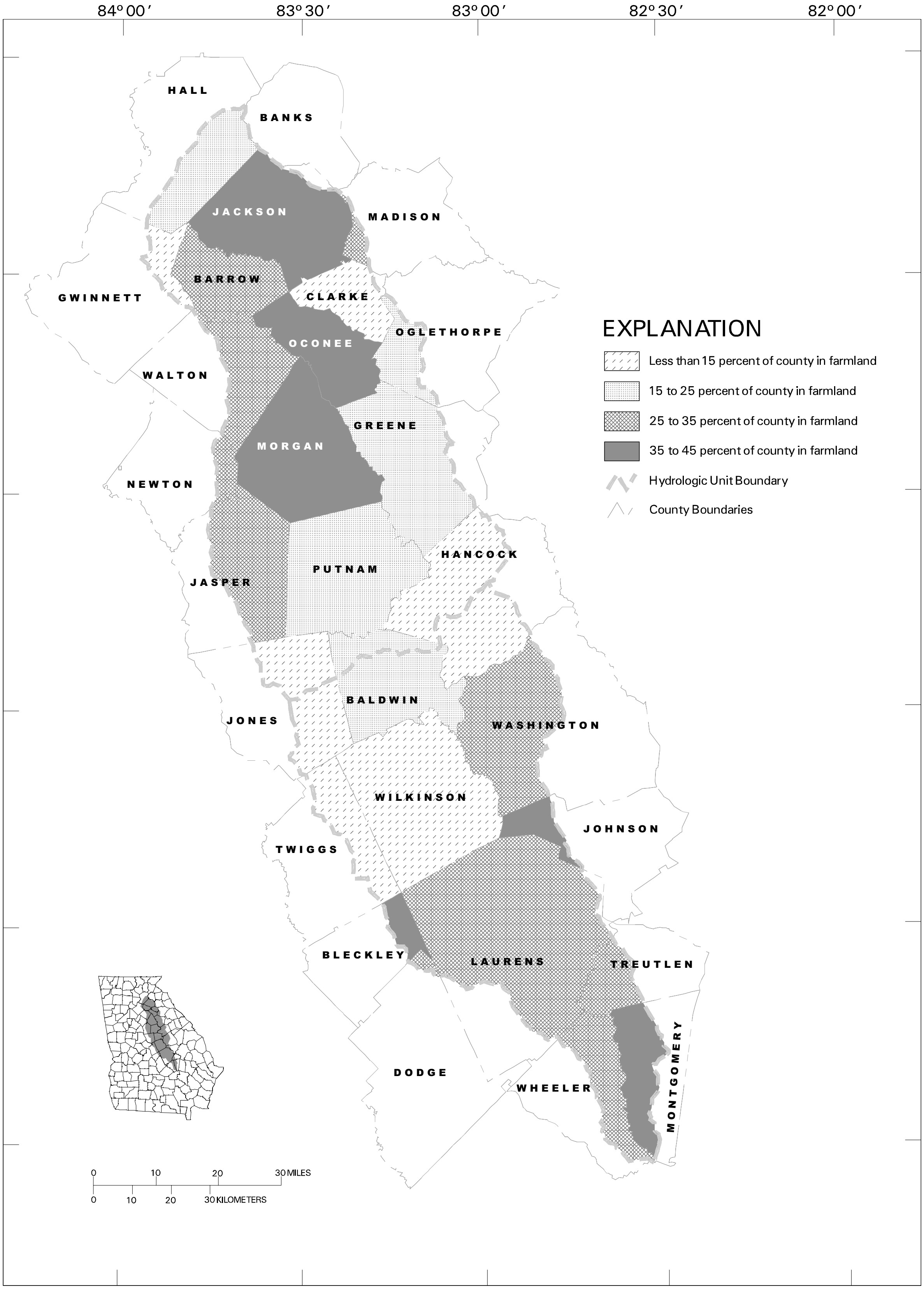

Figure 2-15. Agricultural Land in the Oconee River Basin

Table 2-7. Agricultural Operations in the Oconee River Basin, 1987-1991 (data supplied by NRCS)

Element	HUC 03070101	HUC 03070102	Total for Basin
Dairy Cows	20,810	1,130	21,940
Beef Cows	116,690	25,960	142,650
Hogs	45,450	15,340	60,790
Layer Hens (thousands)	2,816	17	2,833
Broilers (thousands)	134,040	1,922	135,962
Harvested Cropland (acres)	68,140	55,600	123,740
Total Agriculture (acres)	397,070	226,980	624,050

2.3.1 Counties and Municipalities

Local governments in Georgia consist of counties and incorporated municipalities. As entities with constitutional responsibility for land management, local governments have a significant role in the management and protection of water quality. The role of local governments includes enacting and enforcing zoning, storm water and development ordinances; undertaking water supply and wastewater treatment planning; and participating in programs to protect wellheads and significant ground water recharge areas. Many local governments are also responsible for operation of water supply and wastewater treatment facilities.

The Oconee basin includes part or all of 27 Georgia counties (Table 2-8 and Figure 2-2); however, only 6 counties are entirely within the basin, and 7 counties have a small fraction (< 20 percent) of their land area within the basin. Thus there are a total of 20 counties with significant jurisdictional authority in the basin. Municipalities or cities are communities officially incorporated by the General Assembly. Georgia has more than 530 municipalities. Table 2-9 lists the municipalities in the basin.

Table 2-8. Georgia Counties in the Oconee River Basin

Counties Entirely Within the Oconee Basin	Counties Partially Within the Oconee Basin	Counties with Less Than 20% Area Within the Basin
Barrow, Baldwin, Morgan, Putnam, Oconee, Wilkins	Clarke, Greene, Hall, Hancock, Jackson, Jasper, Jones, Laurens, Montgomery, Treutlen, Twiggs, Walton, Washington, Wheeler	Bleckley, Dodge, Gwinnett, Johnson, Newton, Madison, Oglethorpe

2.3.2 Regional Development Centers

Regional Development Centers (RDCs) are agencies of local governments, with memberships consisting of all the cities and counties within each RDC’s territorial area. There are currently 17 RDCs in Georgia. RDCs facilitate coordinated and comprehensive planning at local and regional levels, assist their member governments with conformity to minimum standards and procedures, and can have a key role in promoting and supporting management of urban runoff, including watershed management initiatives. RDCs also serve as liaisons with state and federal agencies for local governments in each region. Funding sources include members' dues and funds available through DCA. Table 2-10 summarizes the RDCs and the associated counties within the Oconee basin.

Table 2-9. Georgia Municipalities in the Oconee River Basin

HUC 03070101 (Oconee River above Lake Sinclair Dam)				
Apalachee	Carl	Good Hope	Maxwell	Shady Dale
Arcade	Cawthon	Gratis	Maysville	Siloam
Arkenton	Center	Greensboro	Monroe	Statham
Arnoldsville	Chestnut Mountain	High Shoals	Monticello	Stephens
Athens	Chicopee	Hillsboro	Neese	Swords
Auburn	Commerce	Hoschton	Newborn	Veazey
Bairdstown	Crawford	Hutchings	Nicholson	Watkinsville
Bishop	Devereux	Jefferson	Oconee Heights	Whitehall
Blackshear Place	Eastville	Kelly	Pendergrass	White Plains
Bogart	Eatonton	Lula	Penfield	Winder
Bostwick	Farmington	Machen	Round Oak	Winterville
Braselton	Farrar	Madison	Russell	Woodville
Buckhead	Gillsville	Mansfield	Rutledge	
Campton	Godfrey	Maxeys	Sanford	
HUC 03070102 (Oconee River below Lake Sinclair Dam)				
Ailey	Dudley	Ivey	Minter	Sparta
Allentown	East Dublin	James	Montrose	Stevens Pottery
Brewton	Glenwood	Jeffersonville	Mt. Vernon	Tennille
Coopers	Gordon	Linton	Ochwalkee	Toomsboro
Danville	Gray	Lothair	Oconee	Wriley
Deepstep	Griswold	Lovett	Rentz	
Dexter	Haddock	McIntyre	Rockledge	
Dublin	Hardwick	Milledgeville	Sandersville	

Table 2-10. Regional Development Centers in the Oconee River Basin

Regional Development Center	Member Counties with Land Area in the Oconee Basin
Atlanta Regional Commission	Gwinnett
Central Savannah River Area	Hancock, Johnson, Washington
Georgia Mountains	Hall
Heart of Georgia	Bleckley, Dodge, Laurens, Montgomery, Treutlen, Wheeler
Middle Georgia	Baldwin, Jasper, Jones, Putnam, Twiggs, Wilkinson
Northeast Georgia	Barrow, Clarke, Greene, Jackson, Madison, Morgan, Newton, Oconee, Oglethorpe, Walton

2.4 Water Use Classifications

2.4.1 Georgia's Water Use Classification System

The Board of Natural Resources was authorized through the Rules and Regulations for Water Quality Control promulgated under the Georgia Water Quality Control Act of 1964, as amended, to establish water use classifications and water quality standards for the surface waters of the state.

The water use classifications and standards were first established by the Georgia Water Quality Control Board in 1966. Georgia was the second state in the nation to have its water use classifications and standards for intrastate waters approved by the federal government in 1967. For each water use classification, water quality standards or criteria were developed that established a framework to be used by the Water Quality Control Board and later the EPD in making water use regulatory decisions.

In 1972 the EPD applied the water use classification system to interstate waters. Georgia was again one of the first states to receive federal approval of a statewide system of water use classifications and standards. Table 2-11 provides a summary of water use classifications and criteria for each use.

Congress made changes in the Clean Water Act in 1987 that required each state to adopt numeric limits for toxic substances for the protection of aquatic life and human health. To comply with these requirements, the Board of Natural Resources adopted 31 numeric standards for protection of aquatic life and 90 numeric standards for the protection of human health. Appendix B provides a summary of toxic substance standards that apply to all waters in Georgia. Water quality standards are discussed in more detail in Section 5.2.1.

Table 2-11. Georgia Water Use Classifications and Instream Water Quality Standards for Each Use

	Bacteria (fecal coliform)		Dissolved Oxygen (other than trout streams)[2]		pH	Temperature (other than trout streams)[2]	
Use Classification[1]	30-Day Geometric Mean[3] (no/100 ml)	Maximum (no./100ml)	Daily Average (mg/l)	Minimum (mg/l)	Std. Units	Maximum Rise above Ambient (°F)	Maximum (°F)
Drinking Water requiring treatment	1,000 (Nov-April) 200 (May-October)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Recreation	200 (Freshwater) 100 Coastal)	--	5.0	4.0	6.0-8.5	5	90
Fishing Coastal Fishing[4]	1,000 (Nov-April) 200 (May-October)	4,000 (Nov-April)	5.0	4.0	6.0-8.5	5	90
Wild River	No alteration of natural water quality						
Scenic River	No alteration of natural water quality						

[1] *Improvements in water quality since the water use classifications and standards had originally been adopted in 1972 provided the opportunity for Georgia to upgrade all stream classifications and eliminate separate use designations for "Agriculture," "Industrial," "Navigation," and "Urban Stream" in 1993.*

[2] *Standards for Trout Streams for dissolved oxygen are an average of 6.0 mg/L and a minimum of 5.0 mg/L. No temperature alteration is allowed in Primary Trout Streams, and a temperature change of 2 °F is allowed in Secondary Trout Streams.*

[3] *Geometric means should be "based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours." The geometric mean of a series of N terms is the Nth root of their product. Example: The geometric mean of 2 and 18 is the square root of 36.*

[4] *Standards are same as those for fishing with the exception of dissolved oxygen, which has site-specific standards.*

Upgrades For Georgia's Stream Classifications

In the late 1960s through the mid-1970s there were many water quality problems in Georgia. Many stream segments were classified for the uses of navigation, industrial, or urban stream. Major improvements in wastewater treatment over the years have allowed the stream segments to be reclassified to the uses of fishing or coastal fishing, which include more stringent water quality standards. The final two segments in Georgia were upgraded as a part of the triennial review of standards completed in 1989. All of Georgia's waters are currently classified as fishing, recreation, drinking water, wild river, scenic river, or coastal fishing.

2.4.2 Water Use Classifications for the Oconee River Basin

Waters in the Oconee River basin are classified as fishing, recreation, or drinking water. Most of the waters are classified as fishing. Those waters explicitly classified in Georgia regulations are shown in Table 2-12; all waters not explicitly classified are classified as fishing.

Table 2-12. Oconee River Basin Waters Classified in Georgia Regulations[1]

Waterbody	Description of Segment	Use Classification
Middle Oconee River	Georgia Hwy 82 to Athens Water Intake	Drinking Water
North Oconee River	Jackson County Road 432 to Athens Water Intake	Drinking Water
Oconee River	Georgia Hwy 16 to Sinclair Dam	Recreation
Oconee River	Sinclair Dam to Georgia Hwy 22	Drinking Water
Oconee River	Georgia Hwy 57 to U.S. Hwy 80	Drinking Water

[1] *Rules and Regulations for Water Quality Control, Chapter 391-3-6 (13). Waters within the Oconee River Basin not explicitly classified and listed above are classified as Fishing.*

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