CHAPTER 2

GENERAL BASIN DESCRIPTION

2.1 HIWASSEE RIVER BASIN OVERVIEW

The Hiwassee River basin is located in the southwestern corner of North Carolina's Blue Ridge Province of the Appalachian Mountains, west of the Eastern Continental Divide (Figure 2.1). The headwaters of the Hiwassee River originate in North Carolina and northern Georgia (Figure 2.2). The waters of the basin flow north to northwest into Tennessee. The Hiwassee River is one of the major rivers flowing into the Tennessee River. The Tennessee River in turn flows into the Mississippi River and eventually into the Gulf of Mexico. The largest rivers in the basin are the Hiwassee River and its tributaries, the Valley and Nottely Rivers. Many of the streams in the basin are located within the Nantahala National Forest. Overall water quality in this basin is excellent as most of the streams drain undisturbed and undeveloped mountain areas.

The Hiwassee River basin encompasses 640 square miles in portions of Clay and Cherokee Counties. The largest town in the upper watershed, where land use is mainly forest and agricultural, is Hayesville. Based on 1990 census data, the population of the basin was 26,723 people. The percent population growth over the ten year period from 1980 to 1990 was 7.1% versus a statewide average of 12.7%. The overall population density is 43 persons per square mile versus a statewide average of 123 persons per square mile. While the resident population may be low, the basin experiences significant seasonal population fluctuations from recreation and tourism.

The basin contains approximately 986 miles of freshwater streams and rivers. Figure 2.3 provides a general view of the North Carolina portion of the basin and the basin's relationship to the Little Tennessee and Savannah River basins.

The Hiwassee River is completely regulated by the Tennessee Valley Authority (TVA) for the production of hydroelectric power. The river is impounded three times in North Carolina to form Chatuge Lake, Hiwassee Lake and Apalachia Lake. Mission Dam on the Hiwassee River near the Clay/Cherokee County line below Chatuge Lake, is the only dam that does not form an impoundment. Chatuge Lake is a large reservoir straddling the North Carolina/Georgia state line. Hiwassee Lake is one of sixteen lakes selected throughout the state as representative of minimally impacted lakes. Apalachia Lake, located immediately downstream of Hiwassee Lake, is a run-of-the-river reservoir located within the Nantahala National Forest. It is considered oligotrophic and fully supporting its designated uses.

The first major tributaries of the Hiwassee River downstream of Chatuge Lake (subbasin 04-05-01), are Tusquitee Creek and Fires Creek. Both the Town of Andrews and the Town of Murphy are located in this subbasin. The entire Fires Creek catchment has been designated as Outstanding Resource Waters and most of the Tusquitee Creek watershed is classified as High Quality Waters. The Fires Creek Wildlife Management Area is part of the Nantahala National Forest. Tributary streams in these watersheds that have received Excellent biological ratings include Big Tuni Creek, Johnson (Mill) Creek, Albone Creek, Coldspring Branch, Little Fires Creek and Leatherwood Branch.

The few water quality problems encountered in the upper Hiwassee River subbasin are due primarily to nonpoint source run off. These problems are seen on Brasstown Creek below Mission dam. This creek originates in north Georgia and is impacted by nonpoint source run off,

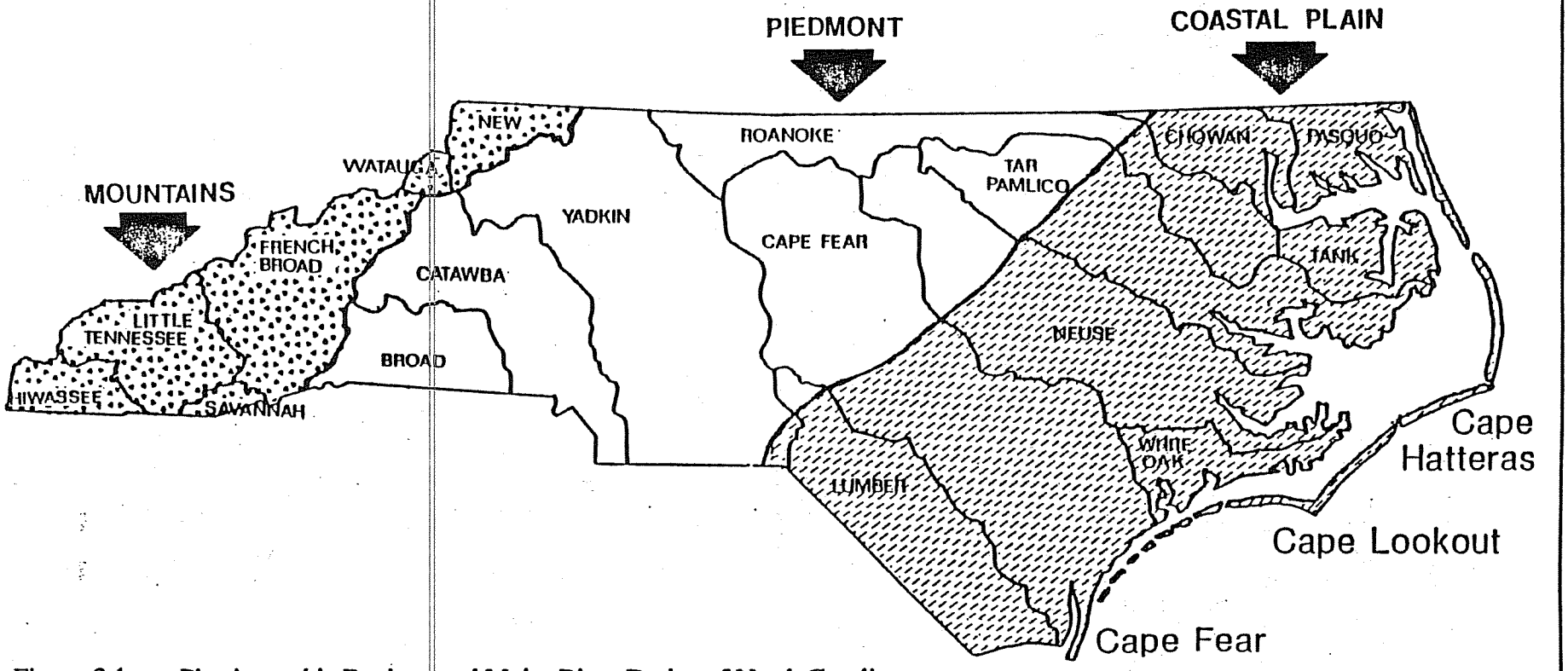

Figure 2.1 Physiographic Regions and Major River Basins of North Carolina

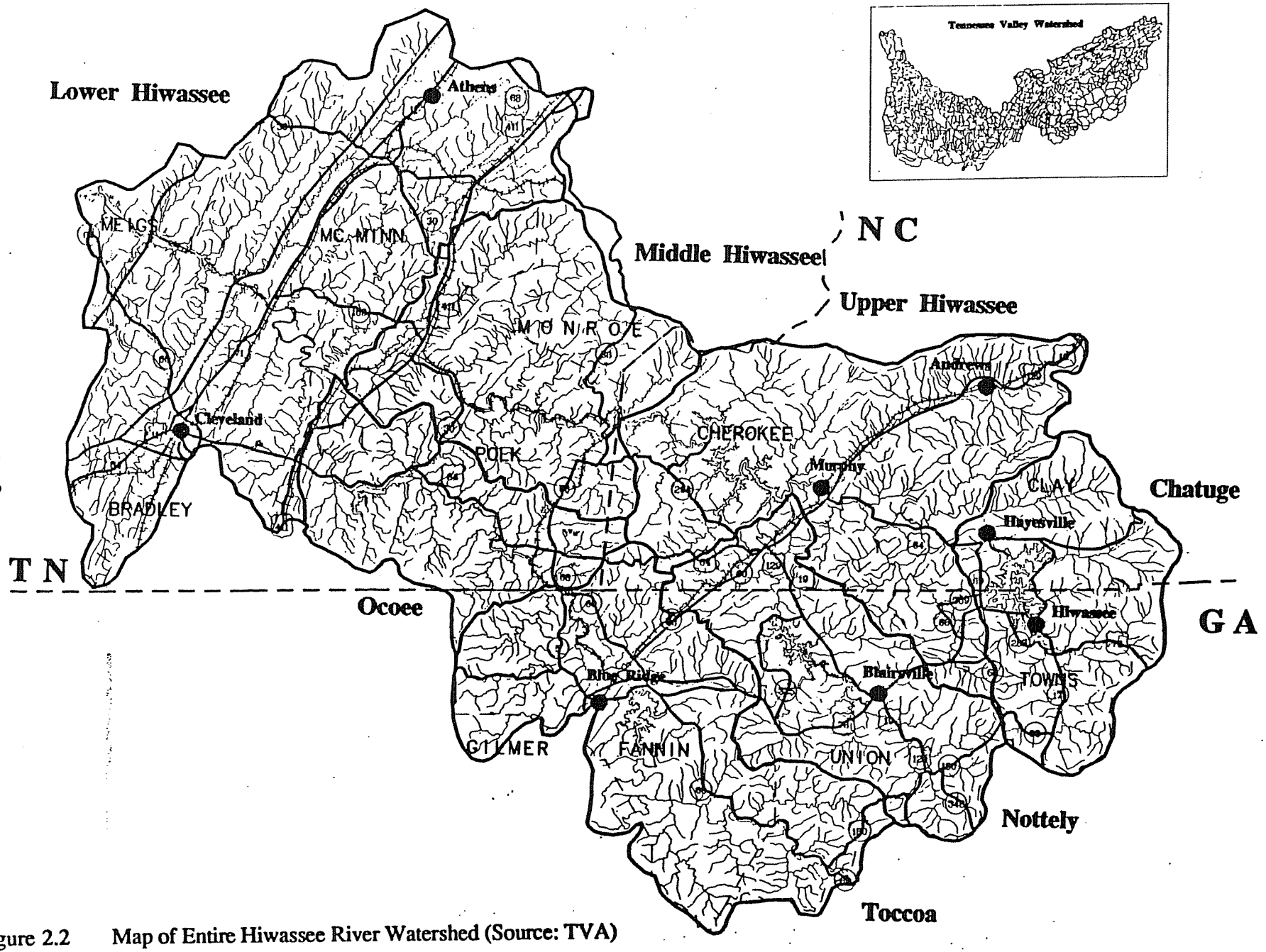

Figure 2.2 Map of Entire Hiwassee River Watershed (Source: TVA)

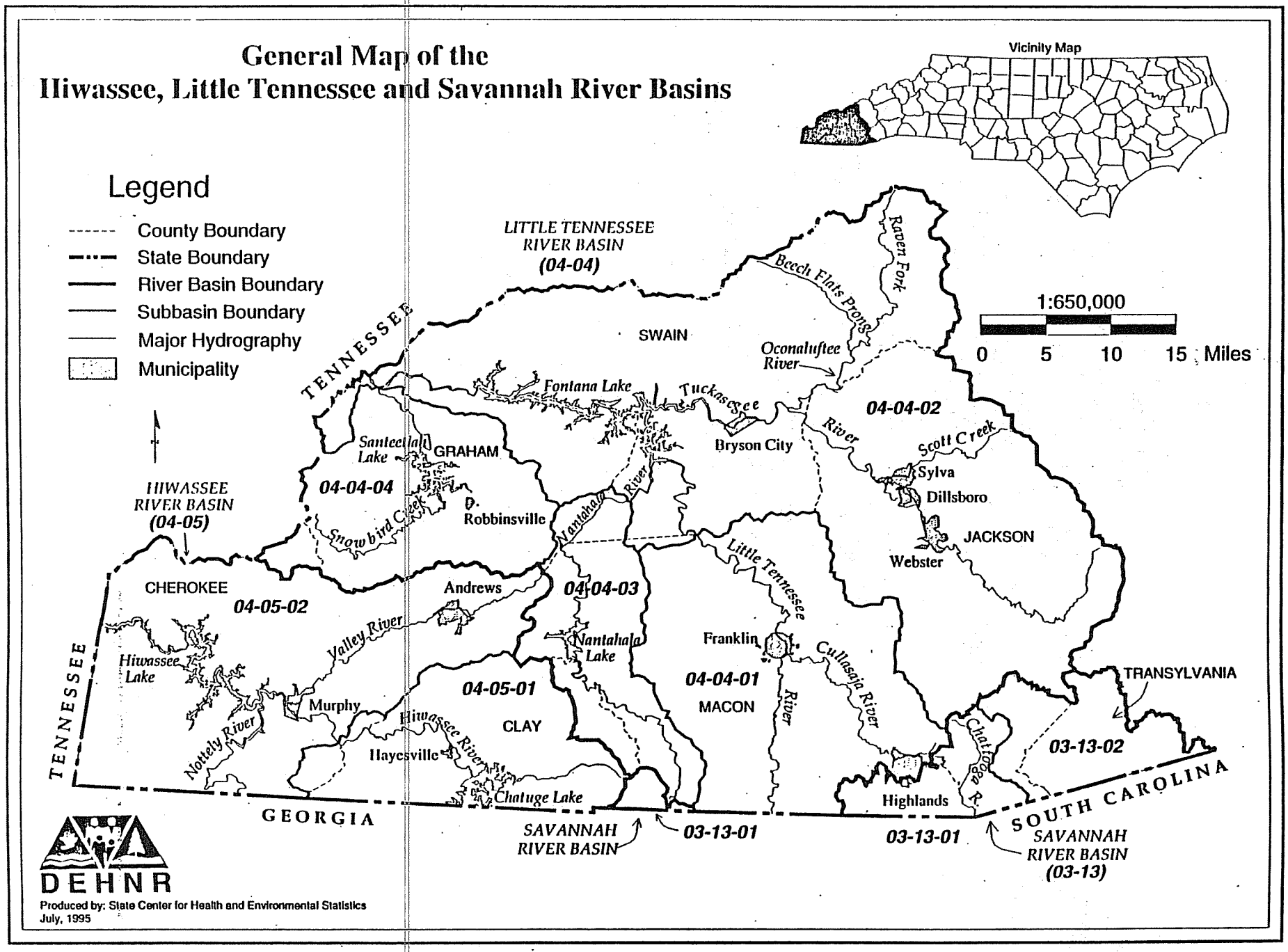

Figure 2.3 General Map of the Hiwassee River Basin in Relation to Neighboring River Basins

as it flows along NC 66 for most of its length. It also receives effluent from the Young Harris Water Pollution Control Plant in Georgia. The next downstream major tributary of the Hiwassee is Peachtree Creek, which was given an Excellent biological rating.

The Valley River (subbasin 04-05-02) is the largest tributary to the Hiwassee River. The Valley River flows in a southwesterly direction from Topton through Andrews, Marble, and Tomatla to its confluence with the Hiwassee River just below Murphy. Land use here is primarily agricultural and forest, with some urban areas in the Valley River watershed between Andrews and Murphy, along US 19/129. A special study of the upper Valley River in 1994 revealed unexpected water quality problems in the Valley River near Andrews. There was evidence of sediment problems in the headwater areas, which includes Junaluska Creek. There was also evidence of toxicity problems on the Valley River between Stewart Road and a site about 3 miles below Andrews. There was no evidence that the Andrews WWTP (the largest discharger in the area) contributed to these problems. In fact, the site above the WWTP showed the most severe water quality problems. There are no permitted dischargers upstream of the Andrews WWTP. There are two small tributaries of the Valley River that are classified as HQW (Britton Creek) or ORW (Gipp Creek).

There are a number of high quality and outstanding resource waters in the basin, as discussed later in this chapter. The Hiwassee River basin is well known for its trout fishery waters. In the Hiwassee River basin, there are eleven aquatic species that are listed by North Carolina as either Endangered, Special Concern, or Significantly Rare.

The basin is characterized by steep slopes and erodible soils. These steep slopes limit the amount of land area suitable for development and crop production. Much of the watershed is undeveloped or lies within the Nantahala National Forest. While most of the land is forested (approximately 45.6% private forest lands and 33.5% public forest lands), many retirement and second home developments are being built in the area. Most development occurs in river valleys and near streams due to the more level ground found in valleys. Development in or near stream corridors increases the chances for the sedimentation and erosion problems.

Slopes of less than 12% are desirable for development purposes and, in the absence of public sewer lines, soil depth of three feet or more over bedrock is desirable for construction of onsite septic systems. It is estimated that just 18% of lands in North Carolina's mountains meet these desirable characteristics (Clay et. al., 1975). Statistics provided by the US Department of Agriculture's Natural Resources Conservation Service indicate that cultivated cropland is shrinking as developed lands are increasing. Major industries in the basin include silviculture and tourism.

2.2 BASIN HYDROLOGY

The watershed is divided into 2 major hydrologic areas (*8-digit hydrologic units*) by the U.S. Water Resources Council and the U.S. Geological Survey (USGS). These major hydrologic areas are further subdivided by DWQ for management purposes into 2 subbasins denoted by 6-digit numbers (04-05-01 and 04-05-02). Table 2.1 presents the USGS hydrologic units and DWQ's corresponding subbasins.

Table 2.1 Hydrologic Divisions in the Hiwassee River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ Subbasin 6-digit codes Figure 2.3
Chatuge Lake, Hiwassee River, Valley River, Nottely River, Hiwassee Lake, Apalachia Lake	06020002	04-05-01, 04-05-02
Ocoee Drainage	06020003	04-05-02

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The basin encompasses three municipalities and all or portions of Clay and Cherokee counties as presented in Table 2.2. Both counties are included in the planning region of the Southwestern North Carolina Planning and Economic Development Commission.

Table 2.2 Local Governments and Local Planning Units within the Hiwassee River Basin

County	% of County in Basin	Municipality
Cherokee	100%	Murphy Andrews
Clay	90%	Hayesville

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is from the US Department of Agriculture (USDA), Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) of 1992 and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. It is considered accurate to the 8-digit hydrologic unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of this data was recently released.

Table 2.3 summarizes acreage and percentage of land cover from the 1982 and 1992 NRI for the Hiwassee River basin. Land cover in the basin is dominated by non-federal forest land (approximately 45.6%) and federal land (33.5%). Federal lands are primarily in the Nantahala National Forest and are therefore mostly forested lands. These two categories combined suggest that close to 80% of the basin is forested. The most dramatic land cover changes exhibited between 1982 and 1992 (Figure 2.4) were in the increase of urban/built-up lands (approximately 59% increase) and pasture lands (approximately 30% increase). Cultivated croplands decreased by approximately 81%. Descriptions of these land covers can be found in Table 2.4.

Land cover types in the Hiwassee River basin identified in a National Resources Inventory (NRI) conducted by USDA Natural Resource Conservation Service include cultivated and uncultivated croplands, pastureland, forest land, federal lands, urban and built-up lands, and other (rural transportation, small water areas and census waters).

Table 2.3 Estimated Acreage by Broad Land Use for the Hiwassee River Basin - 1982 versus 1992

(Source: USDA Natural Resource Conservation Service, 1992 NRI)

	Hiwassee River 06020002		Ocoee River 06020003			
LAND COVER	Acres	%	Acres	%	Total Acres	% of Total
Cult. Crop	2,200	0.5	0.0	0.0	2,200	0.5
Uncult. Crop	4,700	1.1	0.0	0.0	4,700	1.1
Pasture	32,100	7.8	1,400	15.6	33,500	8.0
Forest	184,800	44.8	7,400	82.2	192,200	45.6
Urban/Built-up	24,800	6.0	200	2.2	25,000	5.9
Federal Lands	141,300	34.4	0.0	0.0	141,300	33.5
Other	22,300	5.4	0.0	0.0	22,300	5.4
Totals	412,200	100.0	9000	100.0	421,200	100.0
% of Basin		97.9		2.1		100.0

(Source: USDA Natural Resource Conservation Service, 1982 NRI)

	Hiwassee River 06020002		Ocoee River 06020003			
LAND COVER	Acres	%	Acres	%	Total Acres	% of Total
Cult. Crop	9,900	2.2	1,400	15.6	11,300	2.9
Uncult. Crop	5,100	1.2	0.0	0.0	5,100	1.2
Pasture	24,700	6.0	0.0	0.0	24,700	5.9
Forest	195,400	47.4	7,600	84.4	203,000	48.2
Urban/Built-up	15,700	3.8	0.0	0.0	15,700	3.7
Federal Lands	139,000	33.8	0.0	0.0	139,800	33.1
Other	22,400	5.6	0.0	0.0	22,400	5.0
Totals	412,200	100.0	9000	100.0	421,200	100.0
% of Basin		97.9		2.1		100.0

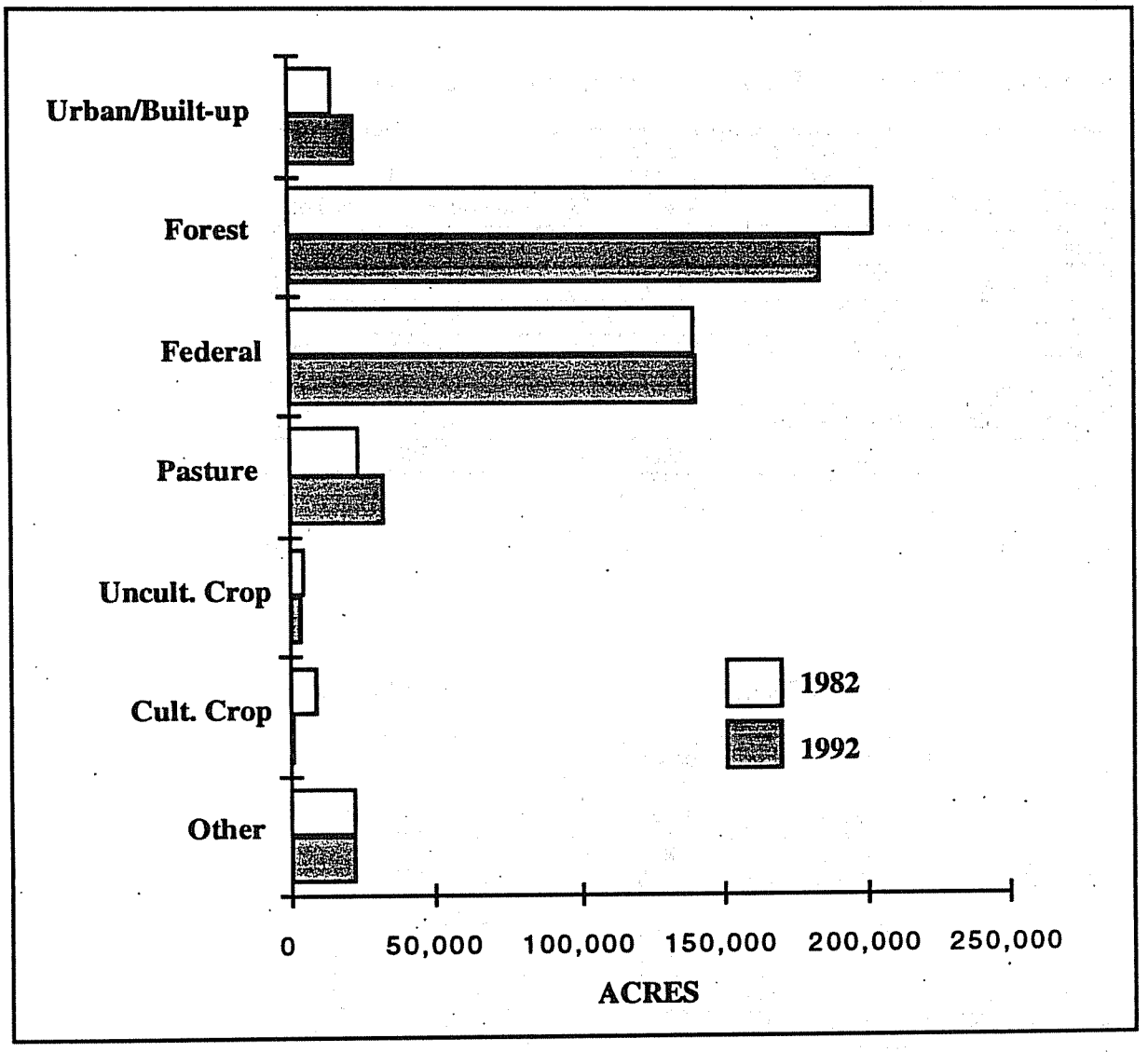

Figure 2.4 Summary of Land Cover for the Hiwassee River Basin

Table 2.4 Description of Land Cover Types (1992 NRI - USDA SCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for non-forest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
6) Federal Lands	All publicly owned federal land areas including National Forests.
7) Other	Rural Transportation: Consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes). Includes the following three categories Small Water Areas: Water bodies less than 40 acres in size and streams less than one-half mile wide. Census Water: Large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. Minor Land: Lands not in one of the other categories.

Several state agencies including the NC Department of Transportation and the Department of Environment, Health and Natural Resources are working with the state's Center for Geographic Information and Analysis (CGIA) to develop statewide land cover information based on recent satellite imagery. However, until these other land coverages become available, the 1992 NRI data is the most recent comprehensive data for the basin as a whole.

More recent land cover information is available in the Southern Appalachian Assessment Report (unpublished at time of printing). This land cover analysis was conducted by remotely sensed Landsat scenes into 17 classes of land cover. Hydrologic areas and watersheds were defined by the 8-digit Hydrologic Unit Code areas and ecological regions as defined by Omernik's Ecoregions of the Continental United States. The 17 classes were aggregated into 9 cover types (Table 2.5). Landsat image data was acquired between June 1990 and September 1994.

The Landsat data shows the majority of land cover in the basin to be in forest lands (Table 2.6). The SAA land cover data was obtained using different methodology than the NRCS land cover data, so comparisons cannot be made between the two datasets. The data was obtained to look at the entire Appalachian Mountain region, rather than at a statewide scale or river basin scale. However, the data is useful for showing breakdown of cover types by Landsat image data taken at a regional scale and applied to a river basin.

Table 2.5 Description of Southern Appalachian Assessment Landsat Land Cover Types

Cover Type	Description
Forest	Represents all forest types including: hardwood, coniferous, and mixed.
Herbaceous	Represents all areas that are vegetated and contain a crown closure of less than 25% (not forested), and are not classified by USGS land use data as agricultural (cropland or pasture).
Barren	Represents all areas that are greater than 75% non-vegetated, and contain less than 50% synthetic surfaces. Exposed rock surfaces (quarries) fall into this land cover type.
Pasture	Represents all areas defined as agricultural pasture lands.
Cropland	Represents all areas defined as agricultural crop lands.
Wetlands	Represents all areas that are coded as lacrustine or palustrine in the National Wetlands Inventory data, but are not subclassified as open water or forested with bottomland hardwood species.
Developed	Represents all areas that are greater than 75% non-vegetated and contain greater than 50% synthetic surfaces from USGS land use data. Urban land cover falls into this type.
Water	Represents all areas in water.
Indeterminate	Represents all other categories that could not be determined during analysis and includes clouds, shadows, etc.

Table 2.6 Land Cover for the Hiwassee River Basin based on Southern Appalachian Assessment (1990 to 1994) Landsat Data.

Cover Type	Acres	% of Total
Forest	356,425	86
Herbaceous	5,594	1
Barren	86	<1
Pasture	31,208	8
Cropland	5,172	<1
Wetlands	228	<1
Developed	3,030	<1
Water	9,952	2
Indeterminate	0	0
Total	411,597	100

Table 2.7 shows, by county, the estimated percentage of lands within the basin that are within the Nantahala National Forest.

Table 2.7 Acreage and Percent of Counties Within National Forest Lands (USDA Forest Service).

County	Total Acres in County	Forest Land (acres)	% of County
Clay	136,902	65,716	48
Cherokee	289,171	93,163	32
Total	426,073	158,879	

According to land use information from TVA (unpublished), most of the land cover within the Hiwassee River basin that lies in northern Georgia (Towns and Union counties) is forested.

2.4.2 Population, Growth Trends and Tourism in the Basin

Population

There are two counties and three municipalities (Murphy, Andrews, and Hayesville) located in whole or in part in the basin. Based on 1990 census data, the population of the basin was 26, 723 people. Table 2.8 presents census data for 1970, 1980, and 1990 for both of the subbasins and the percent growth within each subbasin. It also includes land and water areas and population densities (persons/square mile) by subbasin based on the land area for that subbasin.

Figure 2.5 shows 1990 population densities by census block group for the Hiwassee River Basin. The overall population density is 43 persons per square mile versus a statewide average of 123 persons per square mile. Census block group boundaries do not generally coincide with subbasin boundaries so population figures are estimated. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has been made on the population percentage located in the subbasin. This is done by determining the percentage of the census block group area within the subbasin and then taking that same percentage of the total census block group population and assigning it to the subbasin. This method assumes that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this

method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change each ten years so comparisons between years are considered approximate.

Growth Trends

Figure 2.6 presents the percent population growth by subbasin. The percent population growth over the last ten year census period (1980 - 1990) was 7.1% versus a statewide average of 12.7%. During the last decade there has been an increase in the amount of urban and built-up lands (US Department of Agriculture, Natural Resources Conservation Service). While population in the basin is low, the population has grown significantly (27.7%) between 1970 and 1990.

Growth rates between 1980 and 1994 for the municipalities within the Hiwassee River basin show little growth (Figure 2.7). However, only approximately 15% of the population of Cherokee county was living in a municipality in 1994. Clay county had only 5.0% of its population located within a municipality (Office of State Planning). Much of the growth occurring within the basin is occurring along stream and river corridors in rural areas, which can have a more significant impact on water quality due to a lack of municipal regulations and a dependence on septic systems. As noted earlier, increases in population tend to offset land cover previously held in forest lands.

Table 2.9 shows projected population growth between 1990 and 2020 for the two counties within the basin. Both counties are projected to show a population increase. The municipalities within the basin are expected to continue to grow at a significant rate (Office of State Planning 1995).

Tourism

There are population fluctuations within the basin due to the influence of seasonal tourism. Second home development surrounding the municipalities within the basin, as well as development in the outlying areas has the potential to result in significant water quality impacts in the basin.

The development of a gambling casino on Reservation Lands within the Qualla boundary is expected to dramatically increase tourism not only on the reservation, but throughout the outlying areas as well. It is estimated that approximately 2 million additional visitors will be visiting the area as a result of the gambling casino (Willett and Eller 1995).

The NC Division of Community Assistance report (Willett and Eller 1995) estimates an additional 1,040,000 vehicles each year along six major traffic routes in western North Carolina. This dramatic increase in traffic will require significant changes to traffic flow patterns throughout the region. At present, there are six major thoroughfares (referred to as Corridor 1 through 6, see Figure 2.8) planned by the NC Department of Transportation for improving traffic flow. These thoroughfares are expected to relieve the present congestion experienced by travelers in the vicinity of the Cherokee Reservation. The projected increase in traffic on each of Corridor 1 through 6 can be found in Table 2.10.

Corridor 1 through Cherokee County will carry travelers through the Hiwassee River basin along US Hwy. 19/129, which parallels much of the Valley River. The development of the four-lane thoroughfare from Andrews to Almond (via Robbinsville) will provide access to Robbinsville and Graham County for economic development in the area (DOT 1996). Corridor 6 (US Hwy. 23/441) through Macon County will carry travelers through the upper Little Tennessee River basin along the upper Little Tennessee River to Dillsboro. Both of these Corridors are expected to drastically increase traffic flow (approximately 309,400 vehicles annually) over the mountains from the region of Atlanta, Georgia.

Table 2.8 Hiwassee River Basin Population (1970, 1980, and 1990), Percent Population Change and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
04-05-01	5,236	6,839	7,445	26	35	38	128,717	201	6	195
04-05-02	15,694	18,102	19,278	36	41	44	282,981	442	11	431
Totals	20,930	24,941	26,723	33	40	43	400,896	643	17	626

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

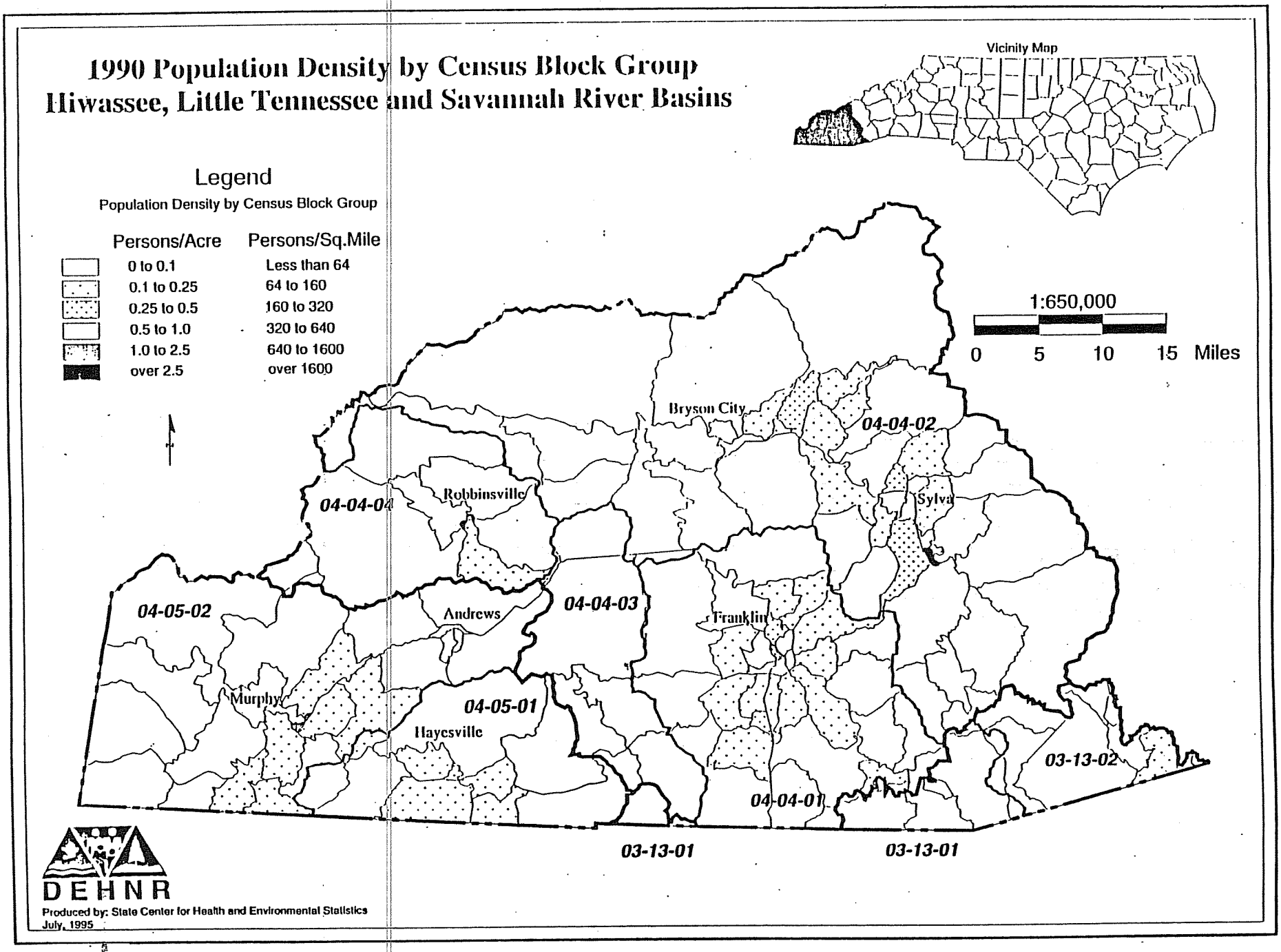

Figure 2.5 1990 Population Density by Census Block Group for the Hiwassee River Basin

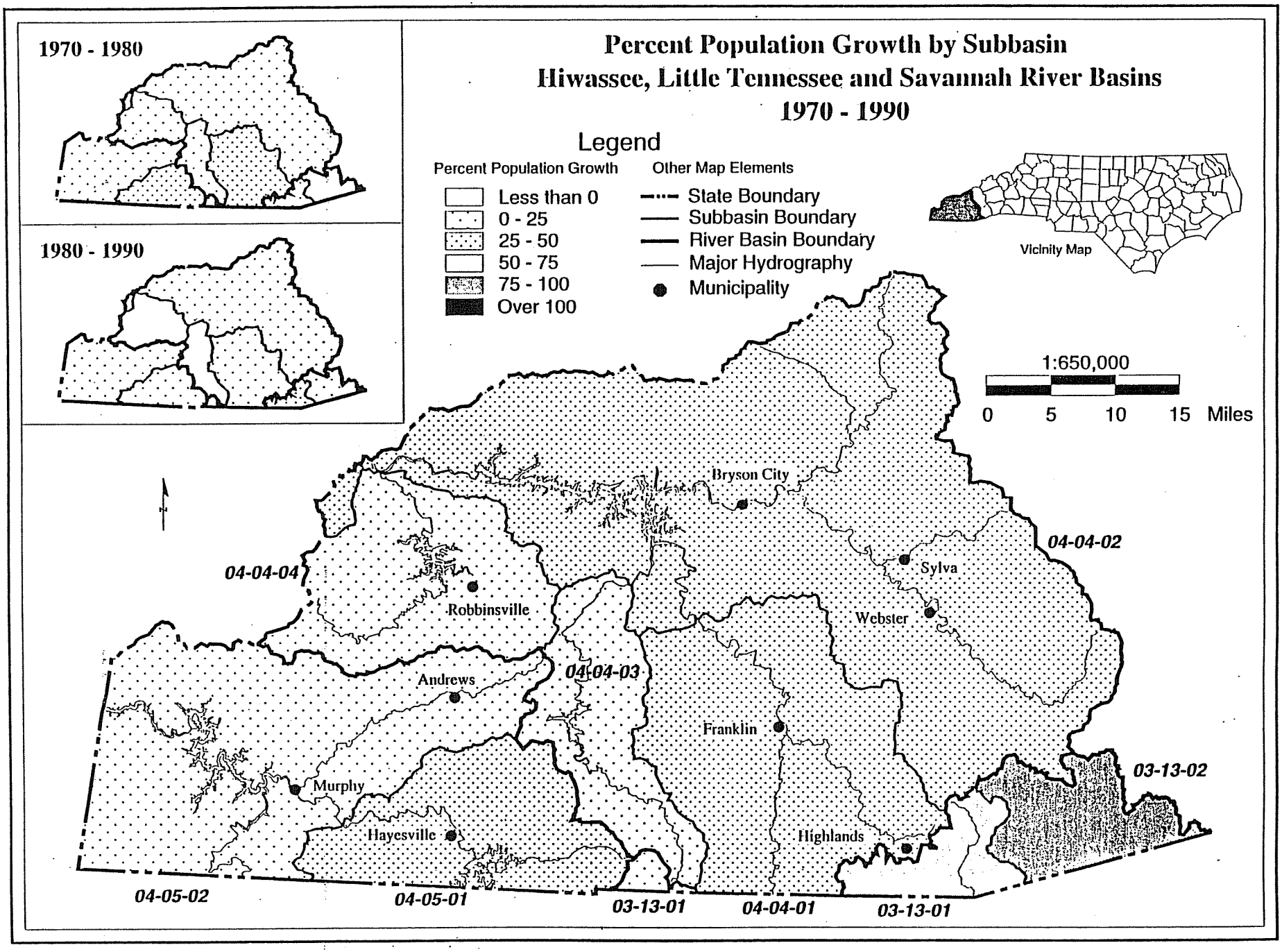

Figure 2.6. Percent Population Growth by Subbasin

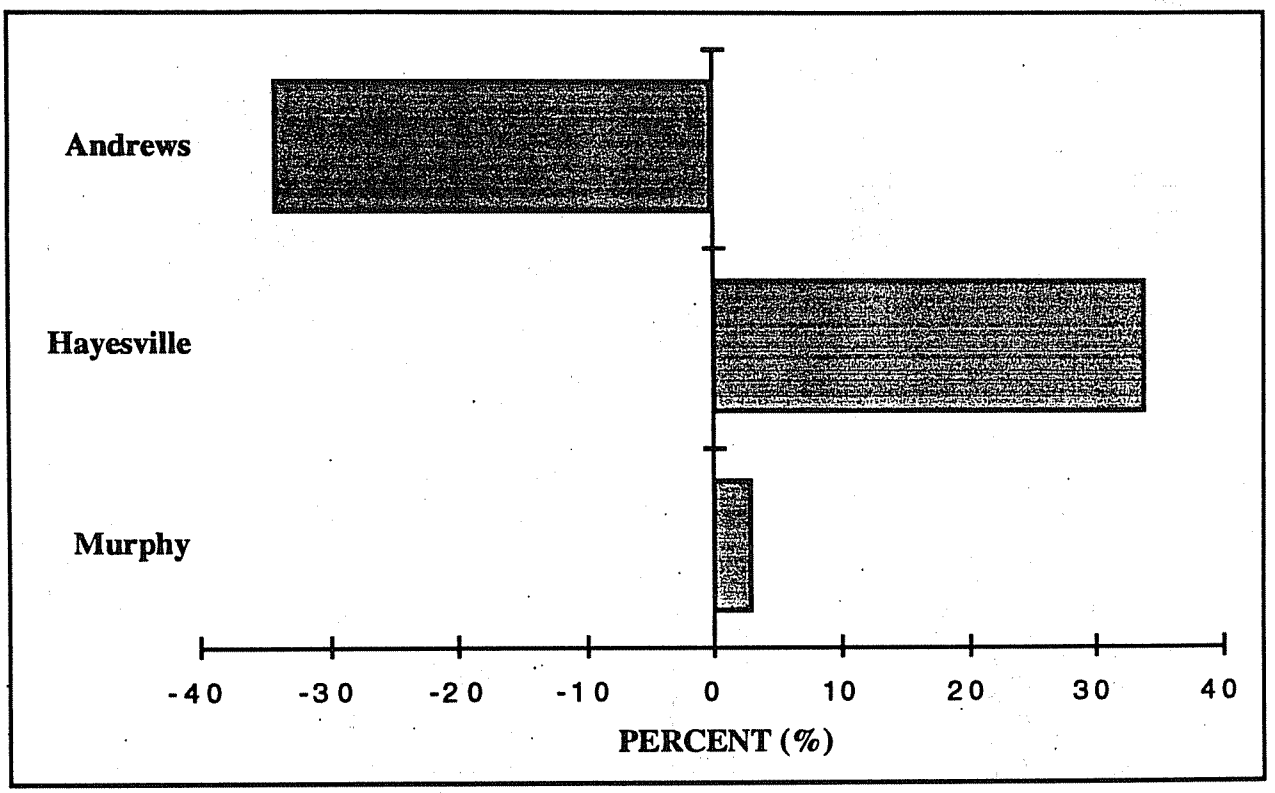

Figure 2.7 Percent Population Change for Municipalities in the Hiwassee River Basin - 1980 - 1994.

Table 2.9 Projected Population Changes by County for Counties in the Hiwassee River Basin (NC Dept. of Administration)

County	1990 Population	2020 Population	% Change (1990 - 2020)
Clay	6,658	7,111	7%
Cherokee	19,767	20,956	6%

Corridor 2 (US Hwy. 441) allows travelers access to the Cherokee Indian Reservation from Gatlinburg and eastern Tennessee. US Hwy. 441 is the route through the Great Smoky Mountains National Park and provides access to the Blue Ridge Parkway (already the most visited National Park and the most traveled national parkway in the U.S.). It is anticipated that an additional 119,080 vehicles will annually travel through the Great Smoky Mountains National Park.

Corridors 3 and 4 are anticipated to increase annual vehicular traffic by 583,440 vehicles from Haywood and Jackson Counties and beyond. Corridor 3 (US Hwy. 19) is a narrow, curving and, in places, steep road from Maggie Valley, Waynesville, and I-40. This route is already congested in peak tourist seasons and accidents are frequent. Corridor 4 (US Hwy. 23/74) will serve as a main route for travelers from Waynesville, Asheville and I-40.

Corridor 5 is expected to bring an additional 28,080 vehicles on US107 through the Savannah River basin and the community of Cashiers.

US Hwy. 19 is expected to be improved to a multi-lane road through the Cherokee Indian Reservation and to 4 - 5 miles on either side of the Reservation. In addition, due to the increased traffic flow expected as a result of the gambling casino, Business 441 on Reservation lands may be widened. The feasibility study is now being conducted on the US Hwy. 19 improvements (DOT 1996).

Improved, multi-lane roads provide opportunities for quicker and easier access to rather remote areas of the state. However, during construction of these roads there are also increased risks for sediments to enter surface waters. Also, Anakeesta rock formations are frequently found in this region of the state. These rock formations can also significantly impact water quality if not handled properly. Chapter 4 provides more detail on water quality problems associated with Anakeesta rock formations and Chapter 5, Section 5.6.2 describes the N.C. Department of Transportation road construction policies in areas with Anakeesta rock formations. When roads are built along streams or rivers, there is also the increased potential for toxic and synthetic substances to enter these waters as runoff from roads.

2.5 IMPORTANT NATURAL RESOURCES

2.5.1 Waterfalls

The Hiwassee River basin has only two significant waterfalls (Adams 1994). These are the Leatherwood Falls (located on the Fires Creek Wildlife Management Area of the Nantahala National Forest in Clay county) and the Falls on the Tellico River (located in the Nantahala National Forest in Cherokee county). Because the Hiwassee River basin is located near an area of the state that receives the highest amount of annual rainfall it is somewhat surprising that there are not more waterfalls. The low number of large waterfalls can be explained by the rock type and topography within the basin. Although the mountain slopes are steep, the river valleys are broad. When the flow of these streams is great enough to create waterfalls, the water has already fanned out into the valley below (Adams 1994).

2.5.2 Lakes

The North Carolina portion of the Hiwassee River basin has three notable lakes: Chatuge Lake, Hiwassee Lake, and Apalachia Lake. The Tennessee Valley Authority (TVA) regulates water releases from these lakes for the production of hydroelectric power. These lakes offer opportunities for camping, hiking, swimming and boating. Discussion on water quality of these lakes are included in Chapter 4.

2.5.3 Rare Aquatic Faunal Species

In the Hiwassee River Basin, there are eleven aquatic animal species that are listed by North Carolina as either Endangered, Threatened, Special Concern, or Significantly Rare (Table 2.11). One species, the Littlewing Pearlymussel, is listed as endangered under federal listings. Endangered species are those species that are in danger of becoming extinct. Threatened species are considered likely to become endangered within the foreseeable future. Species of Special Concern have limited numbers and vulnerable populations and are in need of monitoring. Significantly Rare species are those whose numbers are small and whose populations need monitoring (NC DEHNR, 1996).

The knotty elimia (*Goniobasis interrupta*)is a mollusk that is endemic to the Hiwassee River basin. Little is known about the life history or ecology of this rare freshwater gastropod, but it has been observed in streams with rocky substrates and medium to fast flowing water. The knotty elimia has an olive-colored conical shell.

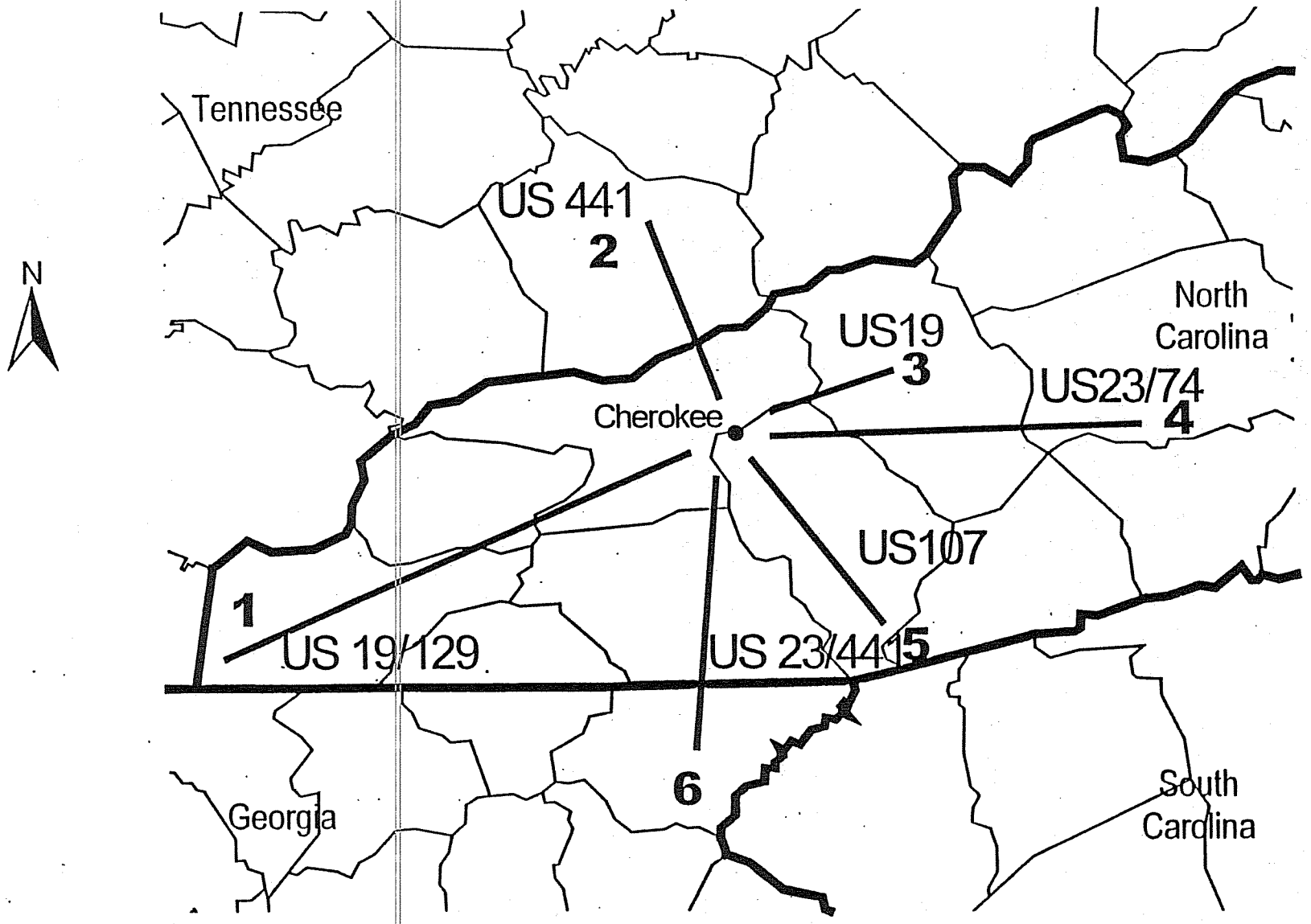

Figure 2.8 Major Traffic Routes to the Cherokee Indian Reservation Casino

Table 2.10 Projected Increase in Traffic along Major Corridors as a Result of the Cherokee Indian Reservation Gambling Casino

Month	Volume Increase							
	Percentage	Corridor 1	Corridor 2	Corridor 3	Corridor 4	Corridor 5	Corridor 6	Total
January	3.7	2,694	4,406	5,445	16,142	1,039	8,754	38,480
February	3.7	2,694	4,406	5,445	16,142	1,039	8,754	38,480
March	4.9	3,567	5,835	7,211	21,378	1,376	11,593	50,960
April	6.2	4,514	7,383	9,124	27,049	1,741	14,669	64,480
May	8.6	6,261	10,241	12,656	37,520	2,415	20,348	89,441
June	11.1	8,081	13,218	16,335	48,427	3,117	26,263	115,441
July	13.6	9,901	16,195	20,014	59,334	3,819	32,178	141,441
August	13.6	9,901	16,195	20,014	59,334	3,819	32,178	141,441
September	11.1	8,081	13,218	16,335	48,427	3,117	26,263	115,441
October	13.6	9,901	16,195	20,014	59,334	3,819	32,178	141,441
November	6.2	4,514	7,383	9,124	27,049	1,741	14,669	64,480
December	3.7	2,694	4,406	5,445	16,142	1,039	8,754	38,480
Totals	100.0	72,800	119,080	147,160	436,280	28,080	236,600	1,040,000

Source: DCA study, September, 1995.

Table 2.11 Rare Aquatic Species Recorded in the Hiwassee River Basin (Source: NC Natural Heritage Program)

Common Name	Scientific Name	Listing Status: State	Federal
Tangerine Darter	*Percina aurantiaca*	SR	
Olive Darter	*Percina squamata*	SC	
Hellbender	*Cryptobranchus alleganiensis*	SC	
Loggerhead Musk Turtle	*Sternotherus minor*	SC	
Sauger	*Stizostedion canadense*	SR	
Spike	*Elliptio dilatata* SC		
Hiwassee Crayfish	*Cambarus hiwasseensis*	SR	
Parrish Crayfish	*Cambarus parrishi*	SR	
Knotty Elimia*	*Goniobasis interrupta*	E	
Tennessee Heelsplitter	*Lasmigona holstonia*	E	
Littlewing Pearlymussel*	*Pegias fabula*	E	E

Listing abbreviations - E = Endangered, SC = Special Concern, SR = Significantly Rare
* - Signifies historic record; species has not been recorded in many years

Three rare freshwater mussels have been recorded in the Hiwassee River basin, and each of the species occupies different habitats. The littlewing pearlymussel (*Pegias fabula*), a small, chalky-white mussel, prefers to live in transition zones between riffles and pools in small to medium streams with low turbidity. The Tennessee heelsplitter (*Lasmigona holstonia*) generally prefers small streams. And the spike (*Elliptio dilatata*) is found in a range of habitats, from small streams to large rivers and in substrates from sand to gravel and cobble.

Despite habitat differences, freshwater mussels have similarities which may contribute to their declining populations across North Carolina. For example, they depend on a common diet of detritus, diatoms, phytoplankton, and zooplankton. In addition, they have similar life histories which involve parasitizing host fish for larval development. Mussels attach their larvae to the gills or fins of a specific fish species for two to six weeks. After the larvae have developed, they drop from the fish and metamorphose into juveniles. The survival of mollusk populations is directly linked to the health and presence of certain fish species.

The long-term survival of these Hiwassee mussel populations is questionable. The littlewing pearlymussel has not been observed in the Hiwassee River basin for many years. The Tennessee heelsplitter was last observed in the Hiwassee River basin in 1991, but there are few previous records of the species. And although populations of spikes are still found in the basin, they are susceptible to pollution -- especially from coal mines or sedimentation -- which has a major impact on their populations.

The two rare crustaceans recorded in the Hiwassee River basin are Hiwassee crayfish (*Cambarus hiwasseensis*) and Parrish crayfish (*Cambarus parrishi*). Although they both exist in swiftly flowing, well-oxygenated rivers and are endemic to the Upper Hiwassee basin, they rarely occupy the same habitat. These rare crayfish are vulnerable to habitat destruction from sedimentation, water pollution (including acid rain), and impoundments.

Three rare freshwater fishes in the Hiwassee basin are the sauger (*Stizostedion canadense*), tangerine darter (*Percina aurantiaca*), and olive darter (*Percina squamata*). Sauger is a big-stream species that prefers deeper, slower water than either of the darters. The adult tangerine darter prefers swiftly flowing streams, but juvenile darters prefer shallow, silty, edge-of-stream environments. The olive darter exists primarily in fast riffle areas with boulder or rubble substrates.

The loggerhead (or stripeneck) musk turtle (*Sternotherus minor*) is a small turtle with a gray-brown shell. It spends most of its time in streams and rivers, and it feeds on aquatic insects and snails. The stripeneck musk turtle's limited range in North Carolina makes it vulnerable to even minor habitat destruction.

The hellbender (*Cryptobranchus alleganiensis*) is a very large aquatic salamander (often 18 to 20 inches long) with wrinkled, fleshy folds of skin on either side of its body. The hellbender feeds on crayfish in large streams with cool, clean and fast-flowing water, which it needs for cutaneous respiration. It is a myth that hellbenders are poisonous. Pollution and siltation have damaged much of the hellbender's habitat, making this amphibian species rare in North Carolina.

Other non-aquatic threatened and endangered species of amphibians, mammals, and plants occur along the streambanks. These non-aquatic species may be affected by water quality degradation in the basin.

The Hiwassee River basin contains natural communities of high quality and rarity. High-quality wetland communities that exist in the Hiwassee River basin include: high elevation seeps, southern Appalachian bogs, swamp forest-bog complex, floodplain pools, and piedmont/low mountain alluvial forests. Of particular importance are the mountain bogs, which are disappearing due to nutrient input, plant succession, drainage for agriculture, groundwater pumping, impounding for ponds, and other development pressures. Mountain bogs often contain rare plants and animals, including the state Threatened bog turtle (*Clemmys muhlenbergii*) and the federally Endangered green pitcher plant (*Sarracenia oreophila*).

2.5 ANIMAL OPERATIONS

2.5.1 Registered and Certified Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H. 0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See Appendix II for additional information on rule requirements). The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993.

In the Hiwassee River basin there are a total of 25 registered livestock operations. None of these are yet certified. They must develop an approved waste management plan before the end of 1997. The majority of these operations are located in the area of Hayesville and Murphy. All operations are for cattle (includes dairy) with the exception of three operations (one swine, one horse, and one poultry operation).

Table 2.12 summarizes the estimated total capacity of animals for livestock operations as of February 1995. This includes both registered and unregistered facilities. Figures are presented for each subbasin. These numbers are small compared to state totals (<1% for swine and dairy populations and 6% for poultry capacity). However, if animal operations are not managed properly there is the potential for localized water quality problems due to animal waste.

Table 2.12 Estimated Animal Populations in the Hiwassee River Basin (Source: NCDA Veterinary Division, February 1995)

Subbasin	Swine 1994	Swine 1990	Swine Change(%)	Dairy 1994	Poultry Capacity
Upper Hiwassee River (04-05-01)	516	493	5%	546	86,105
Lower Hiwassee River (04-05-02)	214	435	-51%	736	1,056,739
Totals	730	928		1,282	1,142,844

2.7 SURFACE WATER CLASSIFICATIONS AND STANDARDS IN THE HIWASSEE RIVER BASIN

All surface waters in the state are assigned a primary water classification, and they may also be assigned one or more supplemental classifications. Classifications are assigned to protect the various uses of the waters, such as swimming, aquatic life propagation or water supplies. For each classification, there is a set of water quality standards that must be met in order to protect the uses. Chapter 5 provides a brief description of the Surface Waters Classifications and Standards Program. Appendix II provides a more detailed summary of the state's primary and supplemental classifications including, for each classification, the best usage, water quality standards, stormwater controls and other protection requirements as appropriate. This information is derived from 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

The waters of the Hiwassee River basin have a variety of surface water quality classifications applied to them (Table 2.13). The majority of the waters are classified as C (77%) or WS-IV (22%). The supplemental classification of Tr applies to many of the waters in the basin. There are currently 28 waters in the Hiwassee River basin supplementally classified as HQW and 31 waters supplementally classified as ORW. There are 100 waters (3=WS-I, 11=WS-II, 85=WS-IV, 1=WS-V) designated as water supply watersheds in the Hiwassee River Basin. The location of HQW's, ORW's and Water Supply Watersheds can be found in Figure 2.9.

Table 2.13 Water Classification Statistics for Streams in the Hiwassee River Basin

	HQW	ORW	B	C	Tr	WS-I	WS-II	WS-IV
Length (miles)	49	57	.12	855	385	2.6	6.3	244
% of Total	4.5%	5.2%	.01%	77.1%	35	.23%	.57%	22.0%

The above stream length summaries were calculated by first identifying the blue lines (referred to as arcs) representing stream segments, and subsequently attributing them by their class. This was an iterative process as many of the arcs were redundantly attributed (e.g. 'HQW' and 'C'), and therefore measured twice. This explains why the sum of the percentages for the various classes is greater than 100 percent.

Stream length summaries do not include the length of arcs representing pond and/or lake shorelines. Therefore, the measurement of the length of a particular stream will stop when entering an impounded area (lake), and begin again where the stream flows out of the impoundment. The total number of acres and percent of total per category for the lakes of the Hiwassee River basin are presented in Table 2.14.

Table 2.14 Water Classification Statistics for Lakes in the Hiwassee River Basin

Water Classification	B	C	WS-IV
Acres	4,552	5,504	86
% of Total	44.9%	54.3%	.85%

A complete listing of classifications for all surface waters in the basin can be found in a DWQ publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the Hiwassee River Basin". This has been reprinted in Appendix II. Pending reclassifications are discussed in Chapter 6.

2.8 WATER USE IN THE HIWASSEE RIVER BASIN

2.8.1 Local Government Water Supply Plans and General Water Use

The Division of Water Resources is compiling a State Water Supply Plan (SWSP) Database that contains information from Local Water Supply Plans pursuant to GS 143-355 (l) and (m). Currently (May 21, 1996) there are four water systems in the study area that are subject to GS 143-355 (l). Only one of these systems, the Town of Murphy, has submitted an approved plan that has been entered into the SWSP database. The following summary of current and future population and water use is based on this water system.

Table 2.15 presents the 1992 and projected serviced population and water use for Murphy through to the year 2020. Based on this table it may be expected that the population serviced by this system will increase by 5 percent over the next few decades.

Table 2.15 1992 and Projected Service Populations and Water Use for the Town of Murphy
(Source: Division of Water Resources)

	1992	2000	2010	2020
Water Use (in mgd)	0.687	0.687	0.778	0.993
Population	2,800	2,800	2,850	2,950

DWR's data for this water system indicates an average daily use of 0.687 MGD and a maximum daily usage of 0.946. It is important to note that Murphy uses a surface water source. In 1992 the average daily discharge for this water system was 0.50 MGD with a high monthly discharge of 0.573 MGD occurring in February and a low monthly discharge of 0.445 MGD occurring in April.

A 45 percent increase in water use is forecasted by the year 2020. The Town of Murphy reports an available water supply of 80.25 million gallons per day (MGD). The Town is not projecting a 2020 water supply deficit based on their current water supply sources.

USGS Water Use information for the Hiwassee River Basin (HUC# 06020002) indicates that the total water withdrawals for the basin was 10.14 MGD. Ground water sources supplied 1.66 MGD of this and the remaining 8.84 MGD was withdrawn from surface water sources. The water withdrawal profile for the basin is presented in Table 2.16.

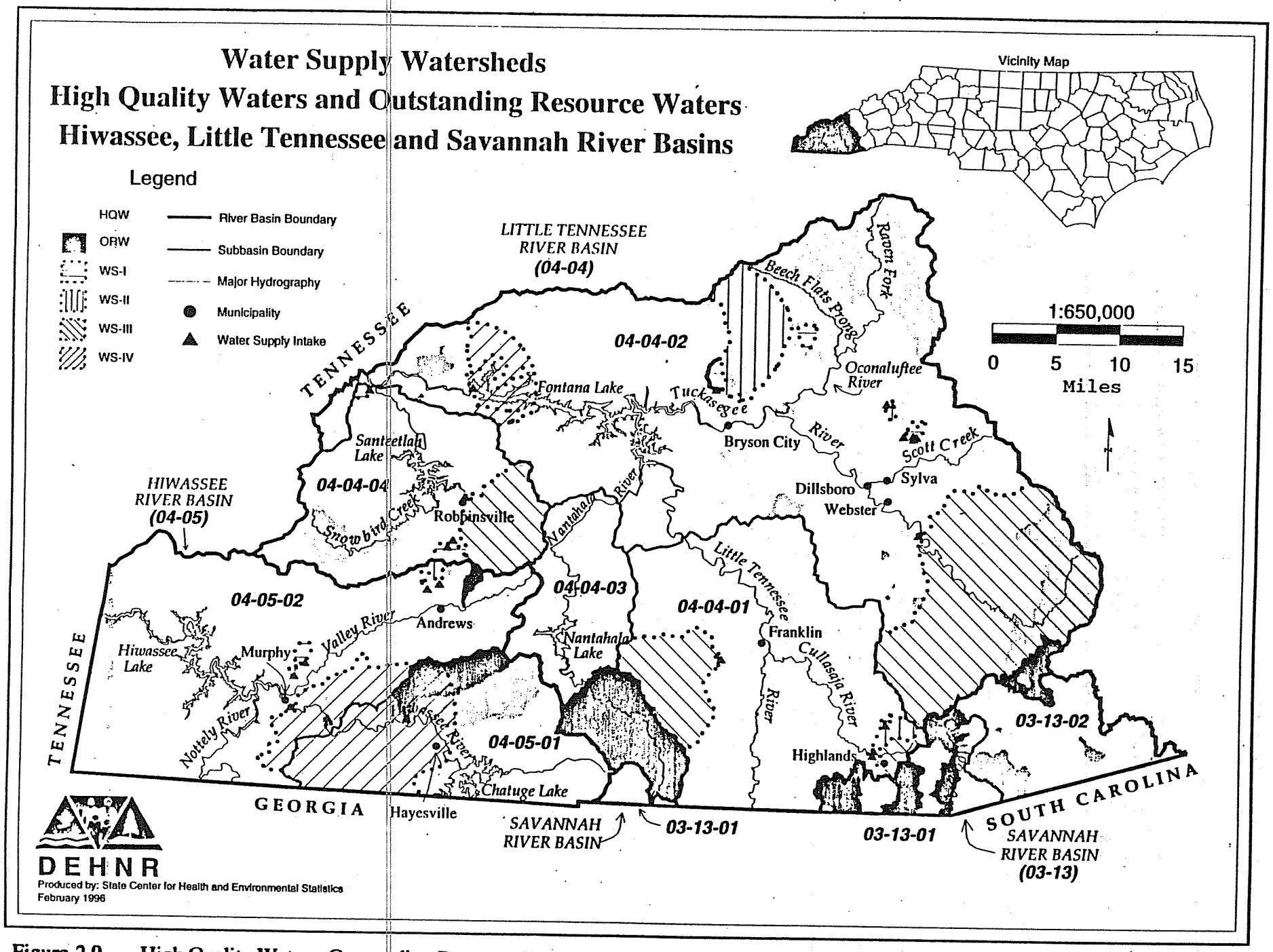

Figure 2.9 High Quality Waters, Outstanding Resource Waters in the Hiwassee River Drainage Area in North Carolina

Table 2.16 Hiwassee River Basin Water Withdrawals for 1990 (MGD) (Source: USGS)

Withdrawal Category	Ground Water	Surface Water	Total Water
Public Water Supply	0.31	1.12	1.43
Commercial Self Supply	0.04	0.00	0.04
Domestic Self Supply	1.07	0.00	1.07
Industrial Self Supply	0.05	0.02	0.07
Electric Power Self Supply	0.00	0.00	0.00
Mining Self Supply	0.00	0.00	0.00
Livestock Self Supply	0.19	7.22	7.41
Irrigation Self Supply	0.00	0.12	0.12
TOTAL	1.66	8.48	10.14

2.8.2 Water Withdrawal and Transfer Registration

DWR's Water Withdrawal and Transfer Registration Database for 1991 contains six surface water withdrawals. Four of these are operated by the Town of Murphy (Cherokee County). Murphy's water use was addressed in the preceding SWSP database section. The remaining two withdrawals were registered by the Town of Andrews from Dan Holland Lake and the Beaver Creek Impoundment. In 1990 the average (and maximum) withdrawal for this public water supply was 0.60 MGD. There are no 1993 Water Withdrawal and Transfer Registrations, pursuant to G.S. 143-215.22H, in the Hiwassee River Basin

2.9 MINIMUM STREAMFLOW REQUIREMENTS

DWR's Instream Flow Unit's activities involved the Hiwassee and Nottely Rivers in the Hiwassee River Basin. The Instream Flow Unit operates under the rules applied to the Dam Safety Law that require dams to release minimum stream flows to adequately maintain aquatic habitat (G.S. 143-215.24.0500).

Hiwassee River

The Division of Water Resources (DWR) conducted an Instream Flow Incremental Methodology (IFIM) study below Chatuge Lake on the Hiwassee River. The study's recommendations were provided as comments to the Tennessee Valley Authority (TVA) on their Lake Improvement Plan. The TVA's Lake Improvement Plan is a $50 million dollar program for improving dissolved oxygen and minimum releases at 16 hydropower dams. Eighty-three cubic feet per second (cfs) was selected by TVA as the daily average minimum flow target at the Chatuge Dam. An infuser weir is in place below the dam to improve low dissolved oxygen concentrations and to maintain a minimum flow when the hydropower facility is not generating.

Nottely River

DWR also conducted an IFIM study on the Nottely River in North Carolina downstream of Nottely Lake which is located just across the state line in Georgia. The study recommendations were provided as comments on the Environmental Impact Statement (EIS) for the TVA's Lake Improvement Plan. TVA installed a minimum flow turbine at the dam to release a constant 50 cfs.

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