

CHAPTER 2

GENERAL BASIN DESCRIPTION

2.1 BROAD BASIN OVERVIEW

The Broad River Basin encompasses a 1,506 square mile watershed drained by 1,472 miles of streams and rivers. The headwaters of the Broad and its major tributaries are located within the mountain and flow towards the foothills before entering the piedmont ecoregion southeast and east of Lake Lure. Figure 2.1 provides a general map of the North Carolina portion of the basin, including major hydrology, municipalities and county boundaries.

The three major tributaries to the Broad River are the Green River, the Second Broad River, and the First Broad River. These rivers flow into the Broad River before it enters South Carolina on its way to the Atlantic Ocean. There are five lakes in the basin, all of which are man-made. Several areas in the basin are classified for water supply use and approximately 30% of the streams are supplementally classified as trout waters to protect for the propagation and maintenance of that fishery.

The basin encompasses all of Cleveland, Polk and Rutherford counties, as well as portions of Buncombe, Henderson and Gaston counties. There are 29 municipalities in the basin including Lake Lure, Rutherfordton, Spindale, Forest City, Shelby and Kings Mountain.

The Broad River basin has an estimated population of 169,001 people based on 1990 census data. The entire basin has experienced moderate population growth between 1970 and 1990, with higher levels of growth occurring in the extreme eastern and western portions of the basin. In the eastern part of the basin in the Kings Mountain area, the population increase may be related to the high growth of the Charlotte area. In the western part of the basin, which is characteristically more mountainous, increases may be related to second home development or settlement of retirees.

Over 60% of the land in the Broad River basin is covered in forests. Based on data from the USDA Natural Resources Conservation Service, the most significant landcover change between 1982 and 1992, was a 71% increase in the amount of urban land. In 1992, approximately 20% of the land in the basin was covered by cultivated or uncultivated crop or pastureland.

Agriculture is an important industry in the basin. According to the NC Department of Agriculture (1996), revenues are higher for crop production than for livestock production for the counties that are either wholly or partly in the basin. Crops grown include, but are not limited to, sorghum, barley, oats, corn, soybeans, wheat and hay. There are twelve registered livestock operations within the basin, including cattle, poultry and swine.

The Broad River Basin is home to 97 rare animal and plant species. Two aquatic animals that are listed as Threatened by the State of North Carolina are the Bog Turtle and the Squawfoot (a mussel). There are five Natural Heritage Program Priority Areas in the basin. These are: the Rollins/South Mountains Natural Area; Hickorynut Gorge; Green River Headwaters and Gorge; the Tryon Region and Pacolet River Gorge; and Pinnacle Mountain.

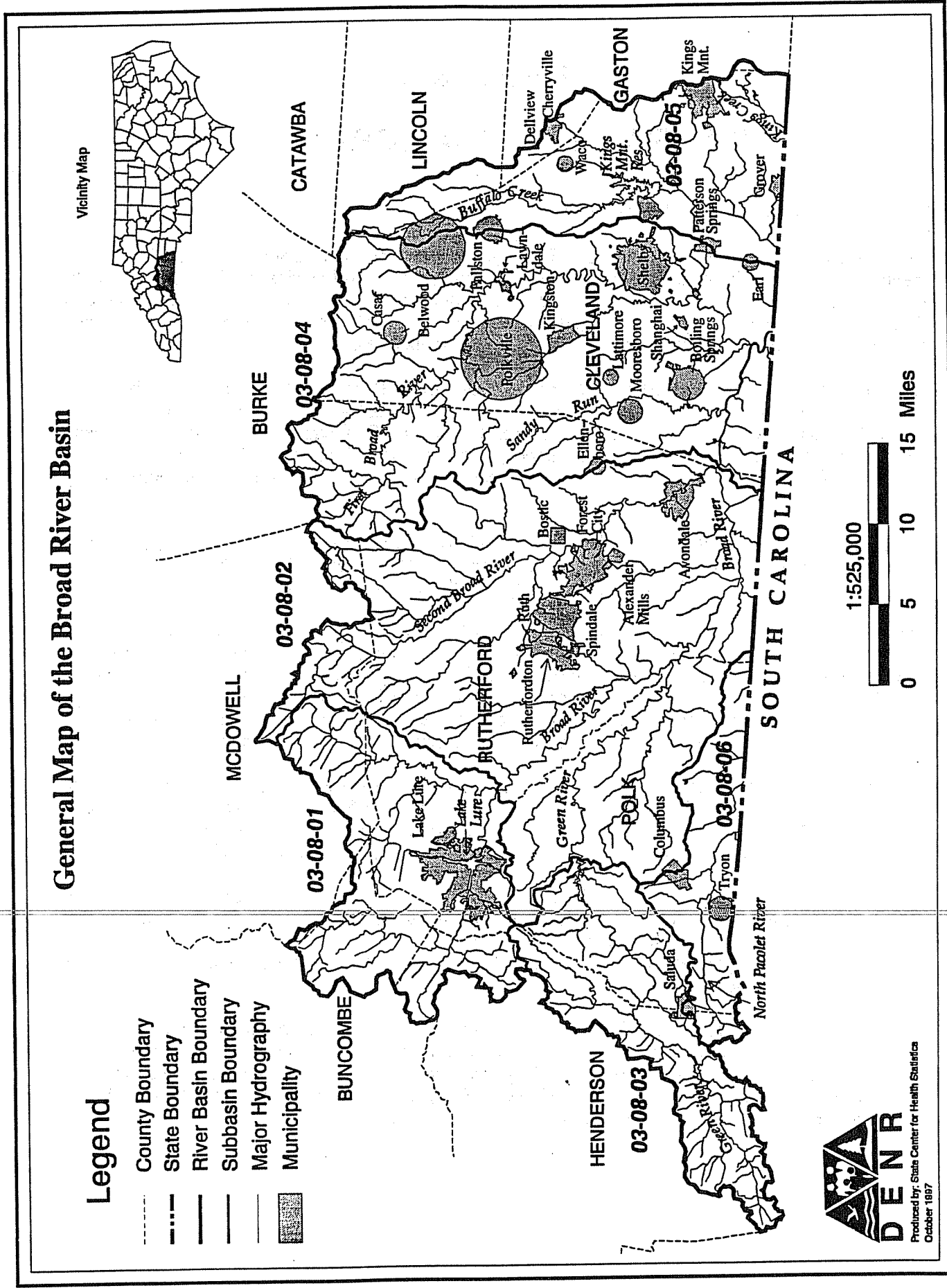


Figure 2.1 General Map of the Broad River Basin in North Carolina

2.2 COMPARISON OF STATE AND FEDERAL HYDROLOGIC AREAS IN THE BROAD BASIN

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS) use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under this approach, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov. 1995). This system divides the country into 21 regions, 222 sub-regions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the North Carolina portion of the Broad basin is made up of one hydrologic area referred to as a cataloging unit. Each cataloging unit is defined by an 8-digit number, and for the North Carolina portion of the Broad basin (or the 'Upper Broad') that number is 03050105. By contrast, DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. The Broad River basin is subdivided by DWQ into 6 subbasins. Table 2.1, below, compares the two systems. Maps of each subbasin are included in Chapter 4.

Table 2.1 Hydrologic Divisions in the Broad River Basin

<u>Watershed Name and Major Tributaries</u>	<u>Federal Cataloging Unit. 8-digit Hydrologic Units</u>	<u>DWQ Subbasin 6-digit codes Figure 2.1</u>
Upper Broad River and Lake Lure	03050105	030801
Second Broad River and tribs. + middle portion of Broad River	"	030802
Upper Green River	"	030803
First Broad River and tribs. + lower portion of Broad River in NC	"	030804
Buffalo Creek and tribs.	"	030805
North Pacolet River and tribs.	"	030806

These comparisons are presented to aid in the interpretation of land cover data summaries in Section 2.4. That section presents land cover information developed by the US NRCS which is summarized for the 8-digit cataloging unit in the basin.

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The Broad basin encompasses all or parts of Buncombe, Cleveland, Gaston, Henderson, Lincoln, McDowell, Polk and Rutherford counties and 29 municipalities as presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Council of Governments) and Districts of the North Carolina League of Municipalities.

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

County	% of county in basin *	Lead Regional Organization	NC League of Munic. Dist.	Municipality
Buncombe	5%	Region B	XII	
Cleveland	100%	Region C	XI	Belwood Boiling Springs Casar Earl Fallston Grover Kingstown Kings Mountain Lattimore Lawndale Mooresboro Patterson Springs Polkville Shelby # Waco
Gaston	1%	Region F	XI	Cherryville Kings Mountain
Henderson	30%	Region B	XII	
Lincoln	2%	Region F	XI	
McDowell	4%	Region C	XI	
Polk	100%	Region C	XII	Columbus # Saluda Tryon
Rutherford	100%	Region C	XI	Alexander Mills Bostic Chimney Rock Village Ellenboro Forest City
				Lake Lure Ruth Rutherfordton # Spindale

* percentages are approximate # - denotes county seat
Region B = Land of the Sky Regional Council
Region C = Isothermal Planning & Economic Development Commission
Region F = Centralina Council of Governments

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is derived 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. According to the NRCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. The inventory is considered accurate to the 8-digit cataloging unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of these data was recently released.

Table 2.3 summarizes acreage and percentage of land cover from the 1992 and 1982 NRI for the basin. Land cover identified by the NRI as occurring in the Broad River basin include cultivated cropland, uncultivated cropland, pastureland, forest land, urban and built-up lands, and other. Table 2.4 provides a detailed description of each land use type identified.

Land cover in the basin, as presented in Table 2.3, is dominated by forest which in 1992 accounted for 61% of the total area. Between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 71% increase. During that same time period the amount of cultivated cropland decreased by 52%, uncultivated cropland increased by 26% and the 'other' category, which includes rural transportation, water areas and federal lands, increased by 43%.

Table 2.3 Estimated Acreage by Broad Land Use for the Broad River Basin in 1992 and 1982. (Source: USDA, NRCS, 1994)

1992 NRI

LAND COVER	Upper Broad 03050105		% Change from '82 - '92
	Acre (1000s)	%	
Cult. Crop	52.5	5	-52%
Uncult. Crop	18.8	2	+26%
Pasture	129.0	13	+9%
Forest	592.9	61	-3%
Urban/Built-up	85.8	9	+71%
Other	87.3	9	+43%
Totals	966.3	99.0	
DWQ Subbasins	03-08-01 thru 03-08-06		

1982 NRI

LAND COVER	Upper Broad 03050105	
	Acre (1000s)	%
Cult. Crop	108.8	11
Uncult. Crop	14.9	2
Pasture	118.2	12
Forest	613.1	63
Urban/Built-up	50.1	5
Other	61.2	6
Totals	966.3	99.0

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

<u>Land Cover Type (No.)</u>	<u>Land Cover Description</u>
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) Other:	This category includes rural transportation, water areas and federal lands. 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). Water consists of small water bodies (water bodies less than 40 acres in size and streams less than one-half mile wide) and census water (large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width).

2.4.2 Population and Growth Trends in the Basin

The Broad River basin has an estimated population of 169,00 people based on 1990 census data. Table 2.5 presents census data for 1970, 1980, and 1990 for each of the subbasins. It also includes land and water areas and population densities (persons/square mile of land area) by subbasin. Figure 2.2 shows the percent population growth by subbasin. The entire basin has experienced moderate population growth between 1970 and 1990, with higher levels of growth occurring in the extreme eastern and western portions of the basin. In the eastern part of the basin in the Kings Mountain area, the population increase may be related to the high growth of the Charlotte area, whereas in the western part of the basin, which is characteristically more mountainous, increases may be related to second home development or settlement of retirees.

Of the three counties that are located entirely within the Broad River basin, Polk and Rutherford counties are expected to grow by 21% and 12%, respectively, by the year 2020 (NC Department of Administration). Of the municipalities in the basin, the most significant population changes between 1990 and 1995 were seen in Shelby (+8%), and Lake Lure (+13%) (Office of State Planning, 1996).

Figure 2.3 demonstrates population density by census block group for the Broad basin. The majority of the basin is rural, but there are pockets of more densely populated areas. These pockets are centered around Rutherfordton, Forest City, Shelby, and Kings Mountain. The eastern portion of the basin in Cleveland County is generally more densely populated than other areas.

In using these data, it should be noted that the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. 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 to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming 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 may change for each census so comparisons between years must be considered approximate.

2.5 AGRICULTURAL ACTIVITIES IN THE BROAD RIVER BASIN

Agriculture is a very important industry in the Broad River basin. Based on a 1996 report from the North Carolina Department of Agriculture, there are a total of 3,359 farms in counties that overlap the Broad River Basin (see Table 2.6). These farms comprise a total of 432,603 acres with the overall average farm size for all of the counties being 118 acres. In 1993, cash receipts for agricultural products in these counties, including both livestock and crop production, totaled \$340,991,000. The following sections focus more specifically on livestock operations and crop production in the Broad basin.

Table 2.5 Broad River Basin Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION CHANGE (%)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS		
	1970	1980	1990	1970-80	1980-90	1970-90	1970	1980	1990	Total Land and Water Area (Acres)	(Sq. Miles)	Land Area (Sq. Miles)
03-08-01	4,640	7,449	5,659	60	-24	21	25	40	31	117,552	183.675	1.195
03-08-02	47,197	54,704	57,440	15	5	21	92	106	112	328,415	513.148	1.086
03-08-03	4,793	6,476	8,186	35	26	70	35	47	60	87,495	136.711	0.583
03-08-04	50,495	55,847	56,063	10	0	11	118	131	131	272,892	426.394	1.27
03-08-05	26,861	34,317	34,047	27	0	26	150	192	191	115,613	180.645	2.733
03-08-06	6,454	6,755	7,606	4	12	17	88	92	104	46,608	72.825	0.174
Totals	140,440	165,548	169,001	18	2	20	93	110	112	968,575	1,513.4	7.041
												1,506

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

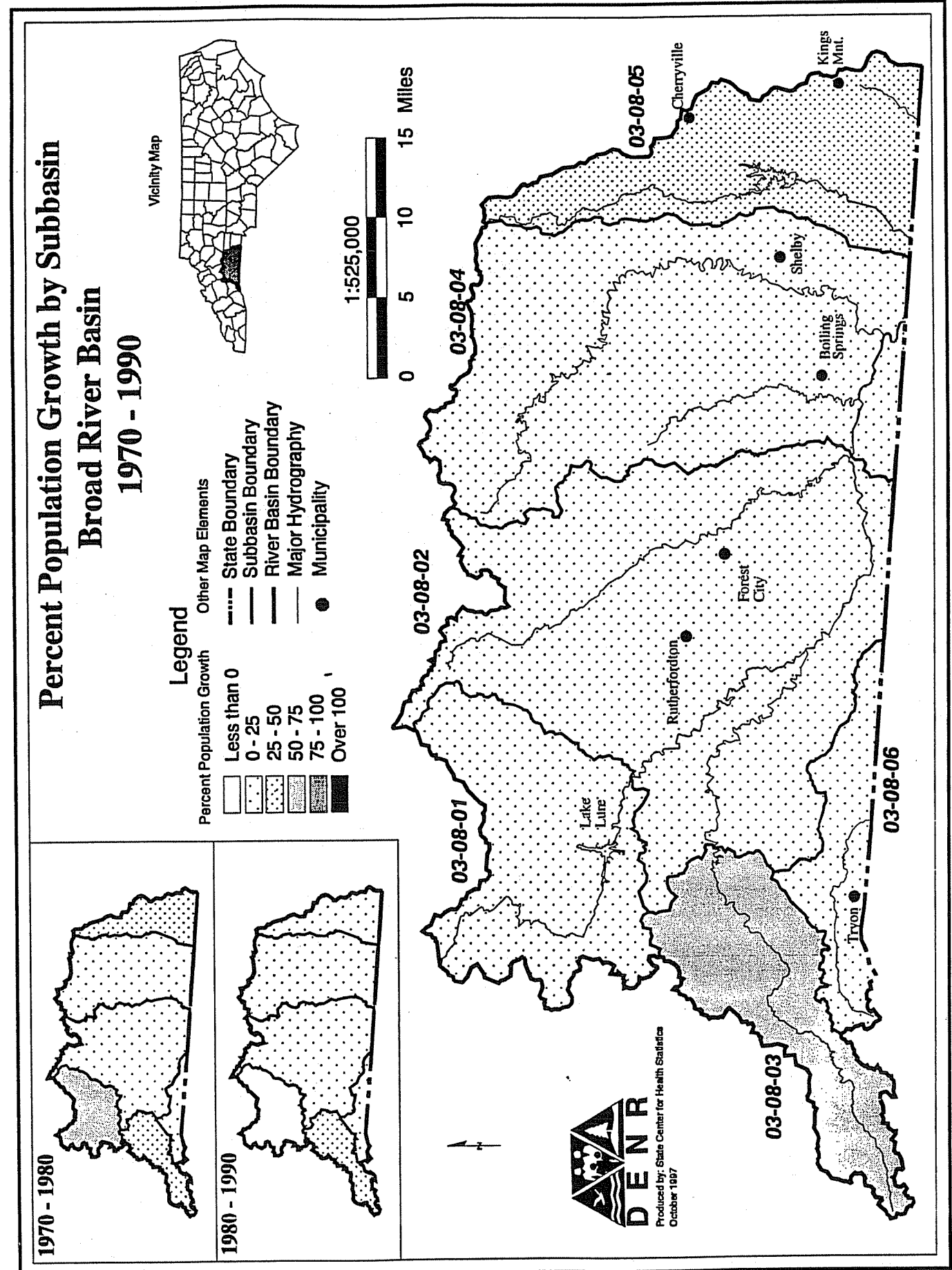


Figure 2.2 Percent Population Growth by Subbasin

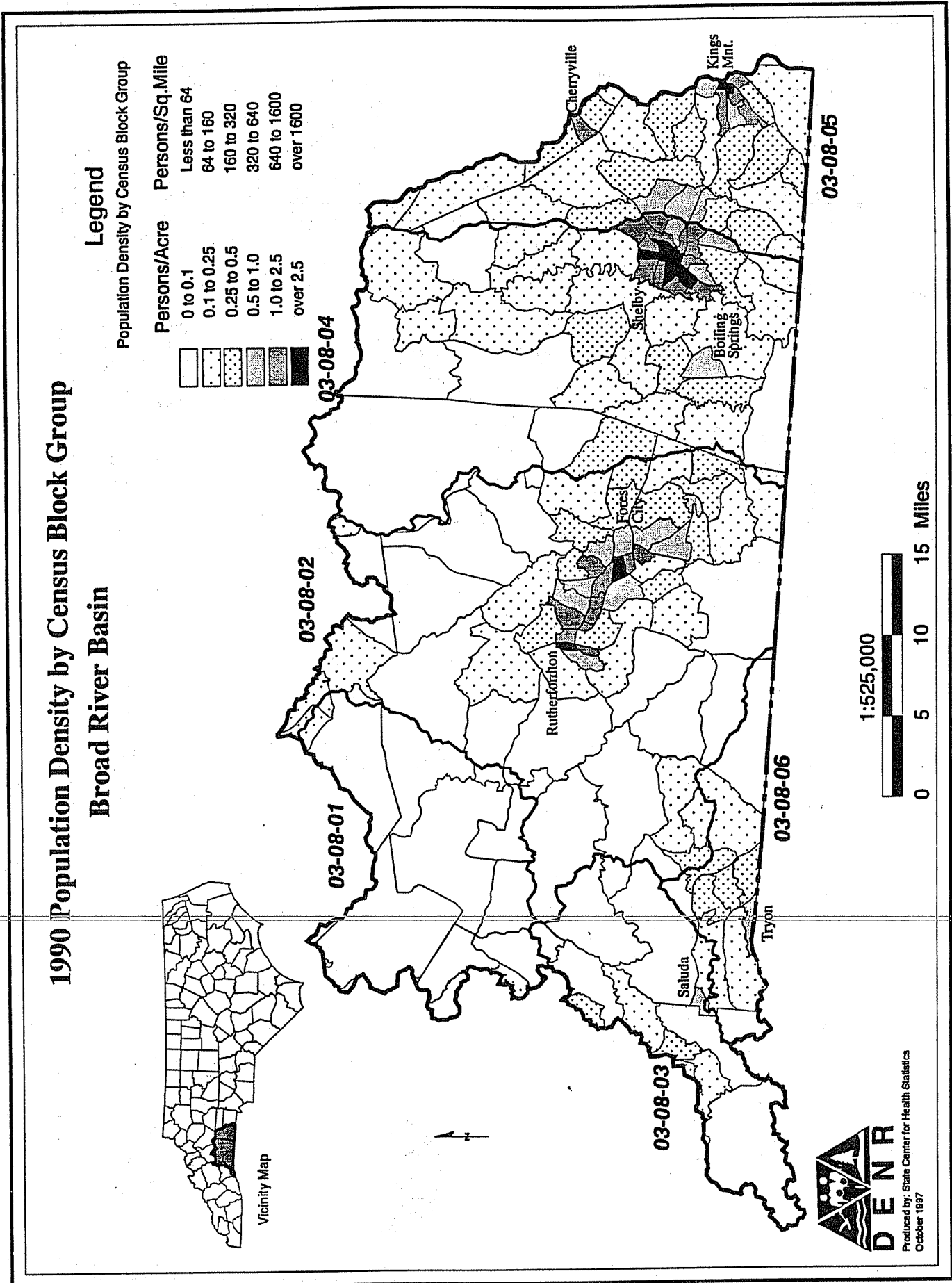


Figure 2.3 1990 Population Density by Census Block Group for the Broad River Basin

Table 2.6 Summary of 1993 Agricultural Statistics for Counties in the Broad River Basin
(Source: NC Department of Agriculture, 1996)

County (% in Basin)	Number of Farms	Acres of Land in Farms	Avg. Size of Farm (Acres)	Revenue from Crops	Revenue from Livestock	Total Cash Receipts
Buncombe (5%)	1,097	93,584	85	\$80,778,000	\$14,314,000	\$95,471,000
Cleveland (100%)	714	93,970	132	\$9,889,000	\$21,801,000	\$33,253,000
Gaston (1%)	293	34,717	118	\$4,362,000	\$7,982,000	\$12,663,000
Henderson (30%)	511	52,281	102	\$115,715,000	\$13,662,000	\$129,807,000
Lincoln (2%)	425	58,384	137	\$5,014,000	\$15,350,000	\$20,990,000
McDowell (4%)	194	21,218	109	\$25,445,000	\$2,720,000	\$28,199,000
Polk (100%)	161	23,140	144	\$5,247,000	\$3,320,000	\$8,908,000
Rutherford (100%)	464	55,309	119	\$6,128,000	\$5,234,000	\$11,700,000
TOTALS	3,859	432,603	118	\$252,578,000	\$84,383,000	\$340,991,000

2.5.1 Livestock Operations

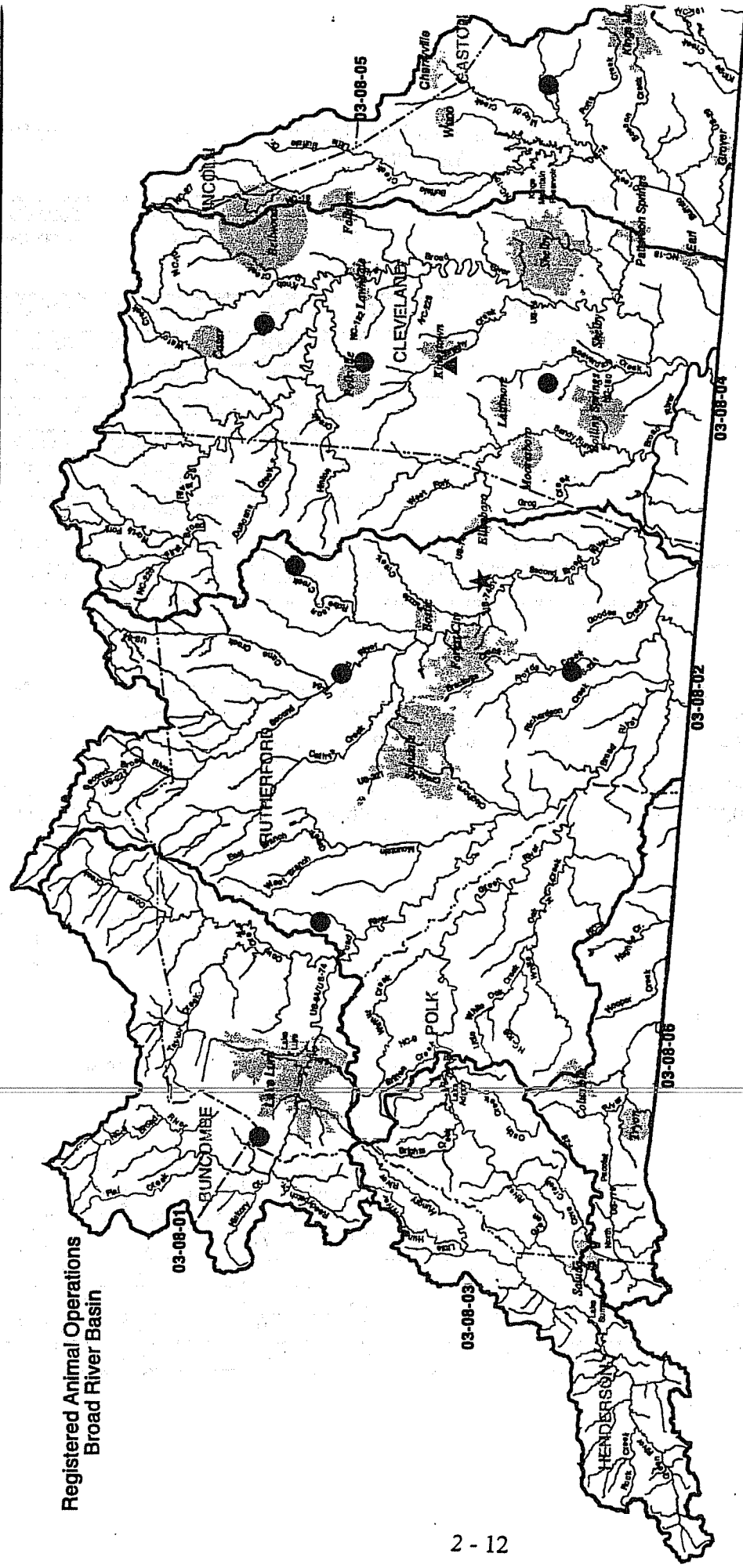
In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). The rule applies to new, expanding or 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 Broad River basin, there are a total of 11 registered livestock operations. Three of these are certified, meaning they have approved waste management plans (the remainder must have approved plans in place before the end of 1997). Table 2.7 provides more information related to these operations, including numbers of animals for cattle, poultry and swine. There are no registered livestock operations in subbasins 03 and 06. The majority of registered livestock operations in the basin are cattle, although there is one poultry operation and one swine operation. Locations of registered animal operations in the Broad basin are illustrated in Figure 2.4. This map is intended to provide a general idea of locations of registered operations in the basin.

Table 2.7 Registered Animal Operations in the Broad River Basin

Subbasin	Cattle - Total Animals	Cattle - Total Operations	Poultry - Total Animals	Poultry - Total Operations	Swine - Total Animals	Swine - Total Operations	Total Animals in Basin	Total Operations in Basin
030801	150	1	0	0	0	0	150	1
030802	620	4	25,000	1	0	0	25,620	5
030804	620	3	0	0	500	1	21,120	4
030805	400	1	0	0	0	0	400	1
TOTAL	1,790	9	25,000	1	500	1	47,290	11

Registered Animal Operations
Broad River Basin



Legend

- Municipality
- County Boundary
- Hydrography
- River Basin / Subbasin Boundary
- Swine Operation
- Cattle Operation
- Poultry Operation



1 : 440,000

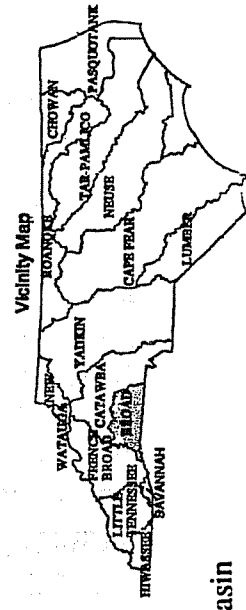


Figure 2.4 Location of Registered Livestock Operations in the Broad River Basin

2.5.2 Crop Production

According to the NC Department of Agriculture (1996), there are a variety of crops grown in the Broad River basin (based on data from counties that overlap that basin). As was indicated in Table 2.6, the amount of money in the basin made on crops was approximately 3 times as much as was made on livestock production. A variety of crops are grown in the basin, but some of the more common ones include sorghum, barley, oats, corn, soybeans, wheat and hay.

2.6 NATURAL RESOURCES IN THE BROAD RIVER BASIN

2.6.1 Wetlands

Wetlands can be very important in watershed planning because they perform a variety of services beneficial to society. These systems are able to process sediments, nutrients, and other pollutants, provide wildlife habitat, store organic matter and provide other means to protect habitat as well as downstream and on-site water quality. Each of the actions that a wetland performs, regardless of human recognition of that action, is called a function. When these actions are declared important to society as a whole, they are called values. Some wetland values are ubiquitous to most wetland types, such as wildlife habitat. However, wetland values are ultimately tied to specific wetlands because they depend on site specific factors such as landscape position, size, soil type, and land use.

DWQ has regulated wetland fill activities since the mid-1980's under provisions of Section 401 of the federal Clean Water Act. Under this section, the state regulated wetlands fill activities through the issuance of 401 water quality certifications. In 1989, the EMC passed a rule directing DWQ to review wetland fill using a review sequence of avoidance, minimization and mitigation of wetland fill.

After extensive public review and debate, the NC Environmental Management Commission (EMC) passed rules to restructure its regulation of wetlands through the 401 Water Quality Certification Program on March 14, 1996. These rules became effective October 1, 1996. These rules do not reflect a new regulatory program, but instead, helped better define the state's regulatory approach to the 401 process. The 1996 rules also consider wetland values - whether or not the wetland is providing significant uses or if the activity would remove or degrade uses. The rules also specify mitigation ratios, locations and types to make the mitigation process more predictable for the regulated community. The general approach adopted in the rules has been used by DWQ for five years. DWQ's emphasis has been and continues to be on water quality and the essential role that wetlands play in maintaining water quality.

Tables 2.8 and 2.9 show wetland impacts by subbasin as well by wetland type. Most of the fill activities in the basin occurred in subbasin 05 which is in the eastern part of the basin and has the highest population density in the basin. Bottomland hardwood forests were the type of wetland that received the most impact.

Table 2.8 Wetland fill activities (in acres) in the Broad River Basin from 1994 to 1996

Subbasin	1994	1995*	1996*	Total
030801	0	0.02	0	0.02
030802	0	0.60	0	0.6
030803	0	0.09	0	0.09
030804	0.08	0.02	0	0.10
030805	0	0	1.36	1.36
030806	0.4	0	0	0.40
Total Acres	0.48	0.73	1.36	2.57
No. of Projects	2	9	2	13

* Note: The 1995 and 1996 databases have not been checked for errors.

Table 2.9 Fill activities (in acres) in the Broad River Basin by wetland type from 1994 to 1996

Wetland Type	1994	1995*	1996*	Total
Bottomland Hardwood	0.08	0.73	0.68	1.49
Freshwater Marsh	0.40	0	0	0.40
Headwater Forest	0	0	0.68	0.68
Total	0.48	0.73	1.36	2.57

* Note: The 1995 and 1996 databases have not been checked for errors.

Wetland Communities in the Broad River Basin

Wetlands in the Broad River basin exist across a range of landscapes, from river channels to isolated hillsides. One type of wetland found in or adjacent to rivers and streams is known as Rocky Bar and Shore. These wetlands are actually rock outcrops and gravel bars which are too rocky, too wet, or too severely flooded to support large trees. Shrubs and herbs such as alder, buttonbush, willow, dogwood, cane, waterwillow, jewelweed, and various sedges dominate the vegetation. High-quality examples of Rocky Bar and Shore occur along the Broad River and the Green River.

Montane Alluvial Forest wetlands are found in floodplains. These forested wetland communities are dominated by trees such as hemlock, sycamore, white oak, and tulip poplar, with ironwood, witch hazel, and black willow underneath. High-quality examples, which are very rare in North Carolina, occur along the Broad River, Green River, and Little Sugarloaf Creek.

At the edges of floodplains in the Broad River basin can be found wetland communities known as Low Elevation Seeps. These are often very small wetlands located at the bases of slopes; they are partially shaded by canopies of trees rooted in adjacent communities. Low Elevation Seeps seem to be very important foraging and breeding habitats for amphibians such as salamanders and frogs.

Similar to Low Elevation Seeps are wetlands called Hillside Seepage Bogs. These wetland communities are fed by groundwater seepage and typically have trees at the edges of the wet, open interior. Hillside Seepage Bogs, which are very rare in North Carolina, are characterized by well-developed *Sphagnum* moss mats and typical bog plant species.

A unique wetland community called Spray Cliff occurs in the Broad River basin in association with waterfalls. Spray Cliff communities are constantly wet from the spray of waterfalls, and the plants -- mostly mosses, liverworts, algae, and vascular herbs -- that grow on patches of soil along the rock faces are adapted to moist environments more typical of the tropics. Spray Cliffs support many endemic bryophytes and rare plant species.

Bottomland hardwood and headwater wetlands perform valuable water quality functions including flood water storage, nutrient and sediment retention and nutrient transformation. However, their effectiveness is diminished if the stream waters can no longer inundate adjacent floodplains or if nutrient loads exceed the assimilative capacity of the wetland. As these wetlands are lost upstream, the potential for erosion, flooding, sedimentation, algal blooms, and fish kills increase downstream. Those wetlands adjacent to intermittent streams are especially important in filtering nonpoint pollution from agricultural and urban runoff.

2.6.2 Rare Aquatic and Wetland Species

The Broad River Basin is home to 97 rare animal and plant species. Of this total, aquatic or wetland environments directly support four rare animal species and sixteen rare plant species. Table 2.10 lists the rare aquatic and wetland-dwelling animals found in the Broad River basin. Figure 2.5 shows the general location of where these animals are found.

Table 2.10 Rare Aquatic and Wetland-dwelling Animal Species in the Broad River Basin
(Source: NC Natural Heritage Program)

MAJOR TAXON	COMMON NAME	SCIENTIFIC NAME	LISTING STATUS:	
			STATE	FEDERAL
Reptile	Bog Turtle	<i>Clemmys muhlenbergii</i>	T	FSC/ PT(S/A)
Fish	Santee Chub - Piedmont population	<i>Cyprinella zanema</i> pop. 1	SR	
Mollusk	Squawfoot	<i>Strophitus undulatus</i>	T	
Butterfly	Baltimore	<i>Euphydryas phaeton</i>	SR	

Abbreviations: E = Endangered; T = Threatened; PT (S/A) = Proposed Threatened due to Similarity of Appearance; FSC = Federal Species of Concern; SR = Significantly Rare.

Endangered species are those species in danger of becoming extinct. Threatened species are likely to become endangered within the foreseeable future. Federal Species of Concern are species for which further biological research and field study are needed before they are considered candidates for listing as threatened or endangered species. Significantly Rare species are those whose numbers in the state are small and whose populations need monitoring.

Bog Turtle (*Clemmys muhlenbergii*) State Threatened, Federal Species of Concern and Proposed Threatened due to Similarity of Appearance

The bog turtle is recognized by the bright orange patches on the side of its head. As its name suggests, the bog turtle makes its home in sphagnum moss bogs, marshy meadows, and wet pastures. Burrowing into soft mud, this small and secretive turtle can remain buried for considerable periods of time. In the Broad River basin, bog turtles are found in areas known as Hillside Seepage Bogs and Wet Pastures.

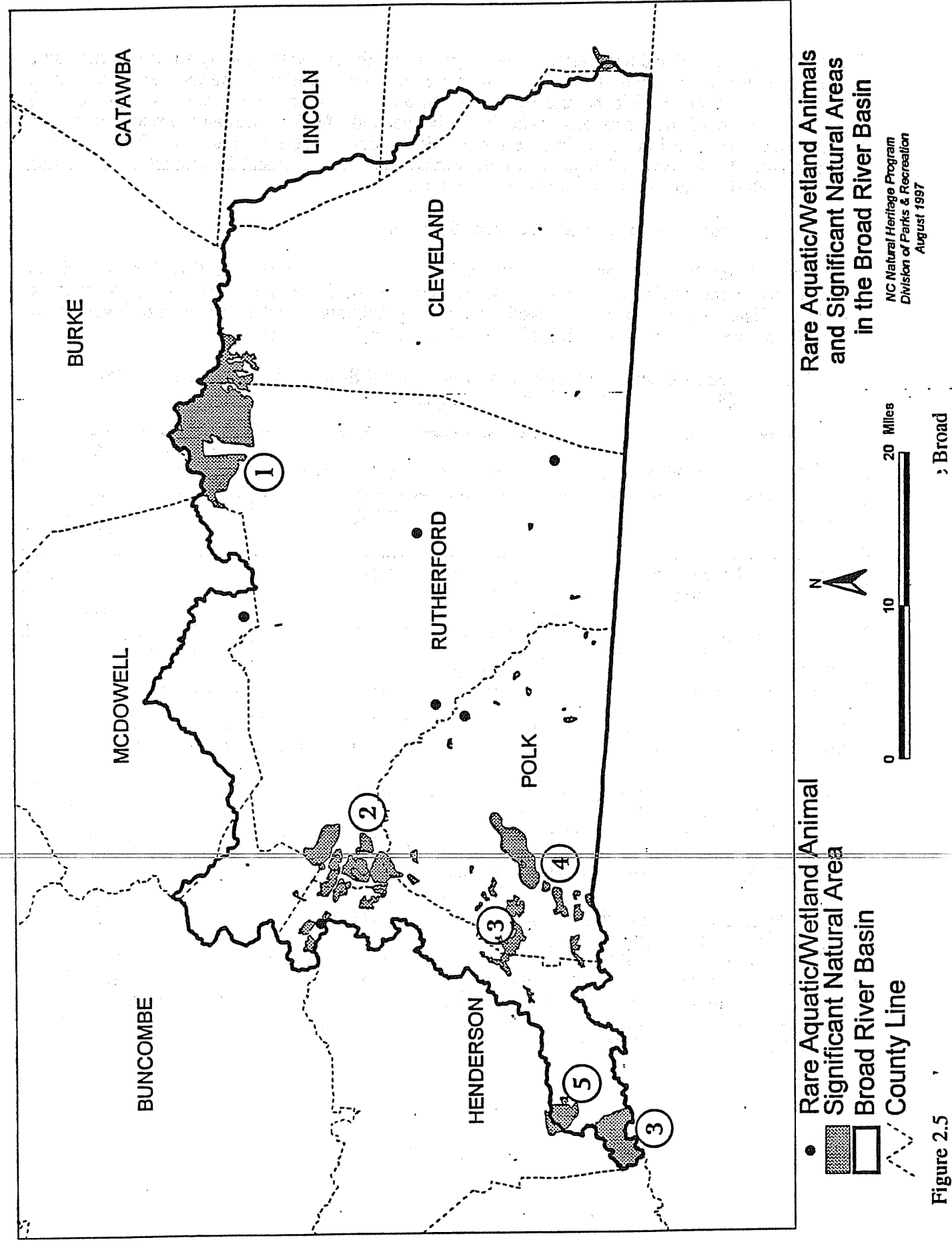


Figure 2.5

Santee Chub - Piedmont population (*Cyprinella zanema* pop. 1) State Significantly Rare

This species is endemic to portions of North and South Carolina. The North Carolina population is actually composed of two distinct entities, a Piedmont population in the Broad and Catawba River drainages and a separate population in the Coastal Plain. The Piedmont population usually inhabits streams of moderately fast velocity over pebbles and gravel.

Squawfoot (*Strophitus undulatus*) State Threatened

The squawfoot is found throughout both the Atlantic and the Mississippi drainages. On the Atlantic slope it is known from the Savannah River in South Carolina to the St. Lawrence River in Canada. It is present in most of the Piedmont drainages in North Carolina. Although a very wide-ranging species, the squawfoot has become quite rare in many areas where it was once considered extremely common during the last century.

Baltimore (*Euphydryas phaeton*) State Significantly Rare

The baltimore, a black checkerspot butterfly whose wings have several rows of cream-colored spots fringed by red-orange crescents, lives in the mountains and foothills of North Carolina. It usually inhabits bogs and wet meadows where the caterpillar food plants, primarily turtleheads (*Chelone* spp.), are found.

2.6.3 Natural Heritage Priority Areas

The North Carolina Natural Heritage Program (NHP) compiles a list of Significant Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the state (DENR 1997). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's significance. The sites included on this list are the best representatives of the natural diversity of the state, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure 2.5 shows the Significant Natural Heritage Areas (SNHA) in the Broad River basin. Sites that directly contribute to the maintenance of water quality in the Broad basin are highlighted below. The numbers correspond to the numbers on the map. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

1. Rollins/South Mountains Natural Area

Of national ecological significance, the 17,000-acre Rollins/South Mountains Natural Area contains an impressive array of high-quality natural communities, rare animal populations, and three Federally-listed and twenty State-listed rare plants. This intact forested area, tucked into the northeast corner of Rutherford County and stretching into Cleveland and McDowell counties, shelters the watershed (the headwaters of the First Broad River) that supplies drinking water to the town of Shelby. The Rollins/South Mountains Natural Area is enhanced by its proximity to other protected natural areas, including South Mountains State Park, and Morganton, Broughton, and Deaf School Watersheds. State funding from the Natural Heritage Trust and the North Carolina Clean Water Management Trust Fund has laid the foundation for the eventual acquisition of the Rollins/South Mountains Natural Area by the N.C. Wildlife Resources Commission. In addition to protecting the water supply for the town of Shelby, the Rollins/South Mountains Natural Area will serve as recreation lands and gamelands for the citizens of North Carolina.

2. Hickorynut Gorge

Located near Asheville on the edge of the Blue Ridge Escarpment, Hickorynut Gorge is an area of exceptional ecological significance. Its variety of high-quality natural communities and abundance of rare plants and animals is due in part to the area's geology; geologic faults, caves, mafic rock,

sheer cliffs, peaks, hoodoos, waterfalls, and granitic domes characterize the landscape around the Gorge as it drops 1800 feet from the mountains to the Piedmont. The Hickorynut Gorge area is composed of a number of individual sites that have been identified as having special ecological significance in themselves, and several of the most crucial Significant Natural Heritage Areas are listed below:

- Rumbling Bald and Shumont Mountain
- World's Edge/Sugarloaf Mountain (part Registered Natural Heritage Area)
- Broad River Natural Area
- Bald Mountain/Rainbow Falls
- Bat Cave (part Registered Natural Heritage Area)
- Cane Creek Mountain
- Chimney Rock Natural Area (part Registered Natural Heritage Area)
- Cloven Cliffs/The Pinnacles
- Little Bearwallow Mountain

3. Green River Headwaters and Gorge

The Green River Headwaters and Gorge is composed of two sets of Significant Natural Heritage Areas, those in the headwaters of the Green River, and those downstream in the Narrows of the gorge. The assemblages of plants, animals, and natural communities along the Green River are among the highest quality occurrences in North Carolina. The headwaters are buffered by intact, good quality forest communities which help to protect the integrity of the Green River. Additionally, the 4000-acre headwaters area is valuable for its landscape role connecting an adjacent natural area in South Carolina (Mountain Bridge) to Stone Mountain and Pinnacle Mountain to the north. At the Narrows, the gorge is 1000 feet deep, and the ravines and coves support floristically rich communities. The following Significant Natural Heritage Areas constitute the highest quality sites along the Green River and should be considered for preservation both for water quality and ecosystem functions:

- Cove Creek/Bradley Falls Natural Area (Dedicated Nature Preserve)
- Green River Gorge (Dedicated Nature Preserve)
- Green River Headwaters
- Laurel Branch Creek Gorge/Ravines and Slope
- Lower Hungry River Gorge

4. Tryon Region and Pacolet River Gorge

A collection of Significant Natural Heritage Areas in south-central Polk County is noted for the natural communities and rare plants associated with the high-pH amphibolite and granitic-gneissic geologic substrate of the region. Well-developed rich forests on slopes of Tryon Peak and unique cliff communities are interspersed with caves, streams, ridges and valleys. Dominated by White Oak Mountain, the Tryon Region encompasses several high-quality natural areas, several of which are listed below:

- White Oak Mountain/Tryon Peak
- Tryon Reservoir/Twin Lakes/Big Fall Creek Natural Area
- Cedar Cliff/Warrior Mountains (part Registered Natural Heritage Area)
- Melrose Mountain
- Pearsons Falls Glen/Pacolet River Bluffs (part Registered Natural Heritage Area)

Water Supply Watersheds and High Quality Waters Broad River Basin

Legend

- State Boundary
- River Basin Boundary
- Subbasin Boundary
- Major Hydrography
- County Boundary
- Municipality
- Water Supply Intake
- HQW
- WS-II
- WS-III
- WS-IV

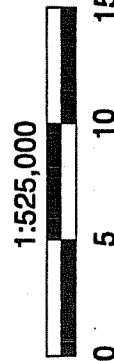
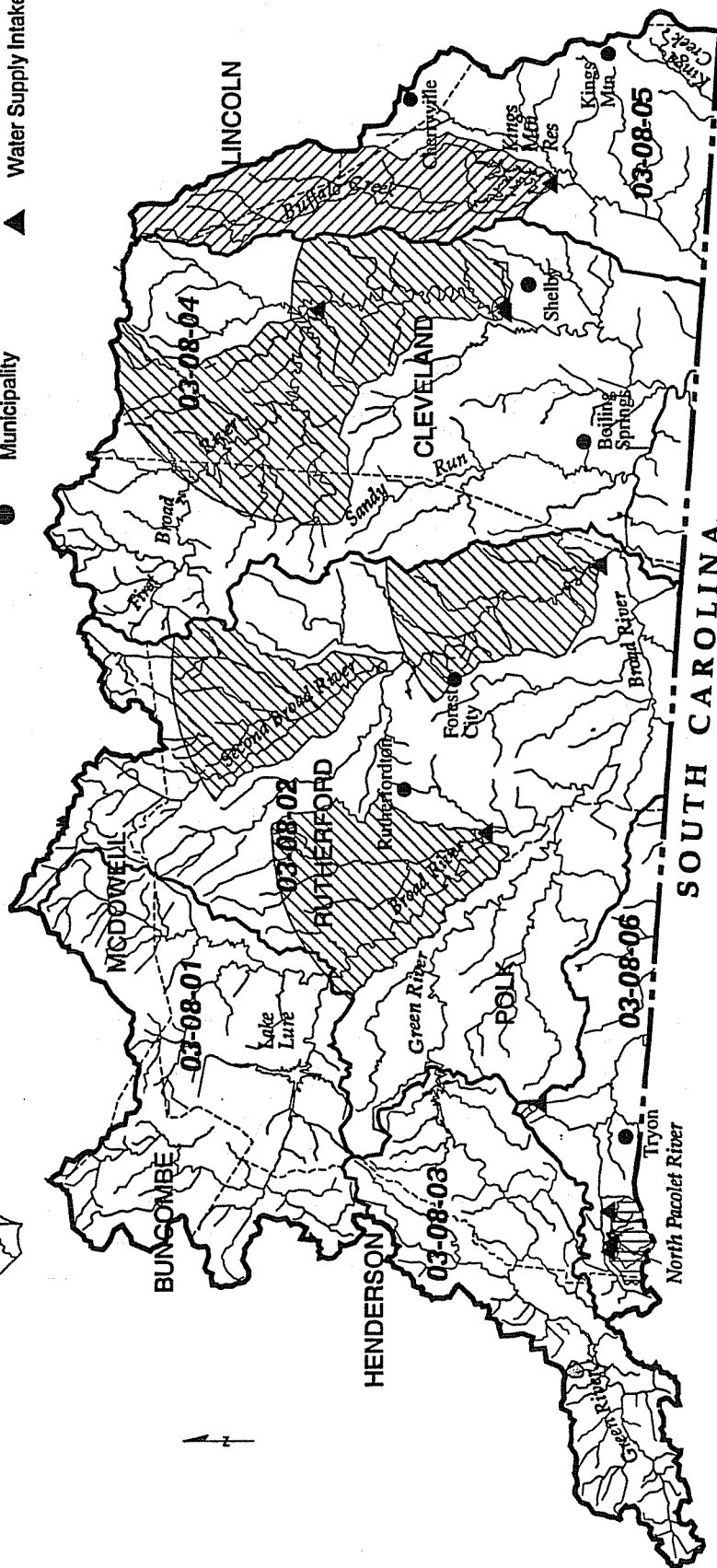
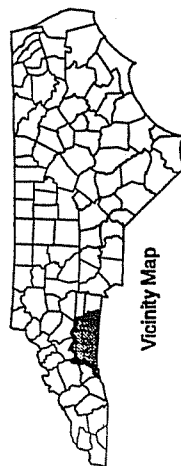


Figure 2.6 Water Supply Watersheds and High Quality Waters in the Broad River Basin

In general, the Protected Area boundary for each of these water supplies will be reduced in size. However, the proposal allowed local governments the option to: reduce the Protected Area size where water supply watershed ordinances are required; keep their current area of implementation; or as previously allowed, increase the area of water supply protection implementation within the local government's jurisdiction within the WS-IV run-of-the-river water supply watershed.

Table 2.13 Local Governments in the Broad River Basin with Jurisdiction in a Water Supply Watershed

Water Supply	Classification	Local Government	User	% of Watershed Covered by Local Government	% of Local Government Jurisdiction in Watershed
Buffalo Creek	WS-III	Cleveland Co.	Kings Mountain	60	9
Buffalo Creek	WS-III	Bellwood	Kings Mountain	6	31
Buffalo Creek	WS-III	Fallston	Kings Mountain	2	57
Buffalo Creek	WS-III	Waco	Kings Mountain	1	57
Buffalo Creek	WS-III	Gaston Co.	Kings Mountain	2	0
Buffalo Creek	WS-III	Lincoln Co.	Kings Mountain	30	6
First Broad R.	WS-IV	Cleveland Co.	Shelby	93	9
First Broad R.	WS-IV	Fallston	Shelby	2	43
First Broad R.	WS-IV	Lawndale	Shelby	2	100
First Broad R.	WS-IV	Shelby	Shelby	3	15
First Br.-CCSD	WS-IV	Cleveland Co.	Shelby/Cl. Co.	75	12
First Br.-CCSD	WS-IV	Casar	Shelby/Cl. Co.	2	69
First Br.-CCSD	WS-IV	Polkville	Shelby/Cl. Co.	2	93
First Br.-CCSD	WS-IV	Rutherford Co	Shelby/Cl. Co.	21	3
Colt Creek	WS-II	Henderson Co	Tryon	11	0
Colt Creek	WS-II	Polk Co.	Tryon	89	1
Big Fall Creek	WS-II	Polk Co.	Tryon	100	1
Fork Creek	WS-II	Polk Co.	Tryon	100	1
Horse Creek	WS-III	Polk Co.	not used	100	0
Broad River	WS-IV	Rutherford Co	Rutherfordton	100	11
Broad River	WS-IV	Rutherfordton	Rutherfordton	0	4
Second Br. R.	WS-IV	Rutherford Co	Cone Mill Corp.	90	8
Second Br. R.	WS-IV	Alexander Mills	Cone Mill Corp.	1	56
Second Br. R.	WS-IV	Bostic	Cone Mill Corp.	2	99
Second Br. R.	WS-IV	Ellenboro	Cone Mill Corp.	1	46
Second Br. R.	WS-IV	Forest City	Cone Mill Corp.	6	50
Second Br. R.	WS-IV	Rutherford Co	Forest City	100	8

CCSD = Cleveland County Sanitary District

Table 2.14 Water Supplies that have been proposed for a revised Protected Area

Water Supply	Current Size of Protected Area (acres)	Size of Proposed Protected Area (acres)	Difference Between Current and Prop. (acres)
Broad River	38,590	16,440	22,150
Second Br. R. (Forest City)	29,015	20,935	8,080
Second Br. R. (Cone Mills)	31,453	13,246	18,207
First Broad River (Cl. Co. Sanitary District)	48,327	18,706	29,621

2.8 WATER USE IN THE BROAD RIVER BASIN

2.8.1 State Water Supply Plan Database

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). As of September 1997, 15 of an expected 16 systems that are in the Broad River basin are represented in the State Water Supply Plan database. The following summary of current and future population and water use is based on these 15 water systems.

Table 2.15 presents the 1992 and projected service population for these systems through the year 2020. Based on this table it may be expected that the population serviced by these systems will increase by 63% percent over the next few decades. Rutherfordton and Spindale are not listed because they receive their water from Duke Power. Duke Power has not yet provided information for this database, but will be doing so in 1998.

Table 2.15 1992 and Projected Service Populations for Water Suppliers in the Broad River Basin that have provided information to the NC Division of Water Resources. (SOURCE: SWSP Database, Division of Water Resources, DENR, Not Published)

System Name	Pop. 1992	Pop. 2000	Pop. 2010	Pop. 2020
Boiling Springs	2,744	3,300	3,600	3,900
Cleveland County	20,541	45,000	50,000	55,000
Fallston	572	600	620	630
Grover	700	735	772	810
Kings Mountain	9,700	9,991	10,412	10,716
Lawndale	648	597	592	581
Shelby	19,200	21,800	24,300	26,700
Columbus	1,623	1,733	1,834	1,892
Saluda	565	678	717	758
Tryon	5,400	5,830	6,170	6,436
Alexander Mills	331	341	351	361
Bostic	362	370	380	390
Forest City	9,436	9,948	10,293	10,550
Lake Lure	675	717	741	760
Sandy Mush	3,047	3,203	3,314	3,397
TOTAL	75,544	104,843	114,096	122,881

Based on the information submitted, total average daily use is 19 million gallons per day (MGD). Approximately 31% of the total amount of water supplied goes to residences, while 54% is used for industrial and commercial purposes (the remainder is unaccounted for).

As Figure 2.7 illustrates, overall projected water use is expected to increase modestly in the next two decades approaching a high of 30 MGD. The forecast between 1992 and 2020 is for a 55% increase in water use.

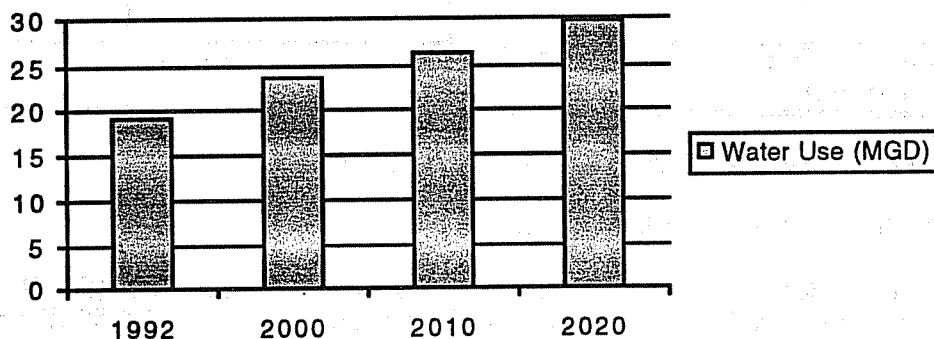


Figure 2.7 Total Projected Water Use in MGD for Water Suppliers in the Broad River Basin. (Source: SWSP Database, Division of Water Resources, Not Published.)

2.8.2 US Geological Survey Water Use Information

The US Geological Survey (USGS) maintains a water use database that characterizes whether the source of the water is surface or ground water. This information indicates that 85% of the population in the Broad basin is served by surface water, while 15% receive water from groundwater sources.

2.8.3 Water Withdrawal and Interbasin Transfer Registration

In 1991, the General Assembly passed G.S. 143-215.22H requiring all persons withdrawing a total of one million gallons per day or more to register that withdrawal with the Division of Water Resources. The law also mandates that interbasin transfers of one million gallons per day or more in any given day (G.S. 143-215.22G) be registered. The law was amended in 1993 to include groundwater, to add a penalty for non-compliance, to add required information, and to exempt water systems with approved local water supply plans. All new withdrawals must be registered within six months of the initial withdrawal and all withdrawals must be updated at least every five years. The law states that any person who withdraws one million gallon per day or more must register and as a result, many water suppliers with multiple facilities were required to register all of their facilities because the sum of the withdrawals equaled one million gallon per day or more. In addition to being registered, interbasin transfers of two million gallons per day or more must also obtain a certificate from the Environmental Management Commission under G.S. 143-215.22I.

The term "interbasin transfer" is used to define transfers of surface water between any of the 38 defined river subbasin boundaries. The river basin boundaries that apply to these requirements are designated on a map entitled "Major River Basins and Sub-basins in North Carolina", which was

filed in the Office of the Secretary of State on April 16, 1991. Figure 2.8 illustrates the portion of this map that includes the Broad River basin and includes the location of the two registered interbasin transfers that are associated with the Broad River basin. As indicated on the map, there is one transfer from the French Broad basin into the Broad basin (0.103 MGD) and one transfer from the Broad basin into the Catawba River basin (0.683 MGD). Overall, these transfers result in a net export of 0.580 MGD out of the Broad River basin. The flows are based on 1992 Local Water Supply Plans and registered withdrawal/transfer information. Some additional transfers may occur from undocumented consumptive losses (i.e. septic, lawn irrigation) for public water systems having service areas in more than one sub-basin.

2.9 MINIMUM STREAMFLOW REQUIREMENTS

DWR, working with the Wildlife Resources Commission (WRC), provides minimum flow recommendations for dams to maintain downstream aquatic habitat. These requirements are then included in a project's dam safety permit issued by the Division of Land Resources. The authority for requiring a minimum release is included in the Dam Safety Law (G.S. 143-215.31(b)). Minimum flows for maintaining stream classification and water quality standards are based on water quality rules developed by DWQ. The rules for determining minimum flows to maintain aquatic habitat also include provision for existing water supply reservoirs which list several factors which must be considered in re-evaluating a minimum releases. The rules also limit the impact of any new minimum flow on an existing water supply reservoir's safe yield to no more than ten percent reduction.

DWR's Water Resources Planning Section (WRPS) is conducting a number of instream flow studies in the Broad River Basin. The WRPS 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). Studies in the Broad River basin are described below.

First Broad River

In 1994, the Division of Water Resources performed Instream Flow Incremental Methodology (IFIM) studies at three sites on the First Broad to evaluate impacts on aquatic habitat of expansions of the existing intakes for the Cleveland County Sanitary District (CCSD) and the City of Shelby. These intakes are located at drainage areas of 145 and 226 mi², respectively. The study results were also used to evaluate a dam proposal farther upstream. Investigation into the possible development of a portion the First Broad River drainage into a reservoir for water supply purposes is still in the early stages.

Cleveland County Sanitary District

The Cleveland County Sanitary District (CCSD) is planning for the expansion of their 6.0 million gallon per day (mgd) water treatment plant. The CCSD has proposed construction of a 10 mgd raw water pump station on land between the confluence of First Broad and Knob Creek. The proposed facility would pump from First Broad and Knob Creek. The drainage area at the proposed site is 181 mi². The CCSD also has considered a dam upstream of their current intake to provide on-stream storage.

City of Shelby

In 1991, the Division of Water Resources participated in a habitat study with the consultant for the City of Shelby regarding the expansion of the City's withdrawal capacity on the First Broad from 10 mgd to 18 mgd. A minimum flow of 25 cfs passing the intake was required to protect aquatic habitat downstream. The Division of Water Resources calculated a "with project" 7Q10 and provided this to the Division of Environmental Management (now the Division of Water Quality) to use in evaluating assimilative capacity for the City's wastewater treatment plant downstream (memo to Trevor Clements dated November 2, 1992).

Registered Interbasin Transfers for the Broad River Basin

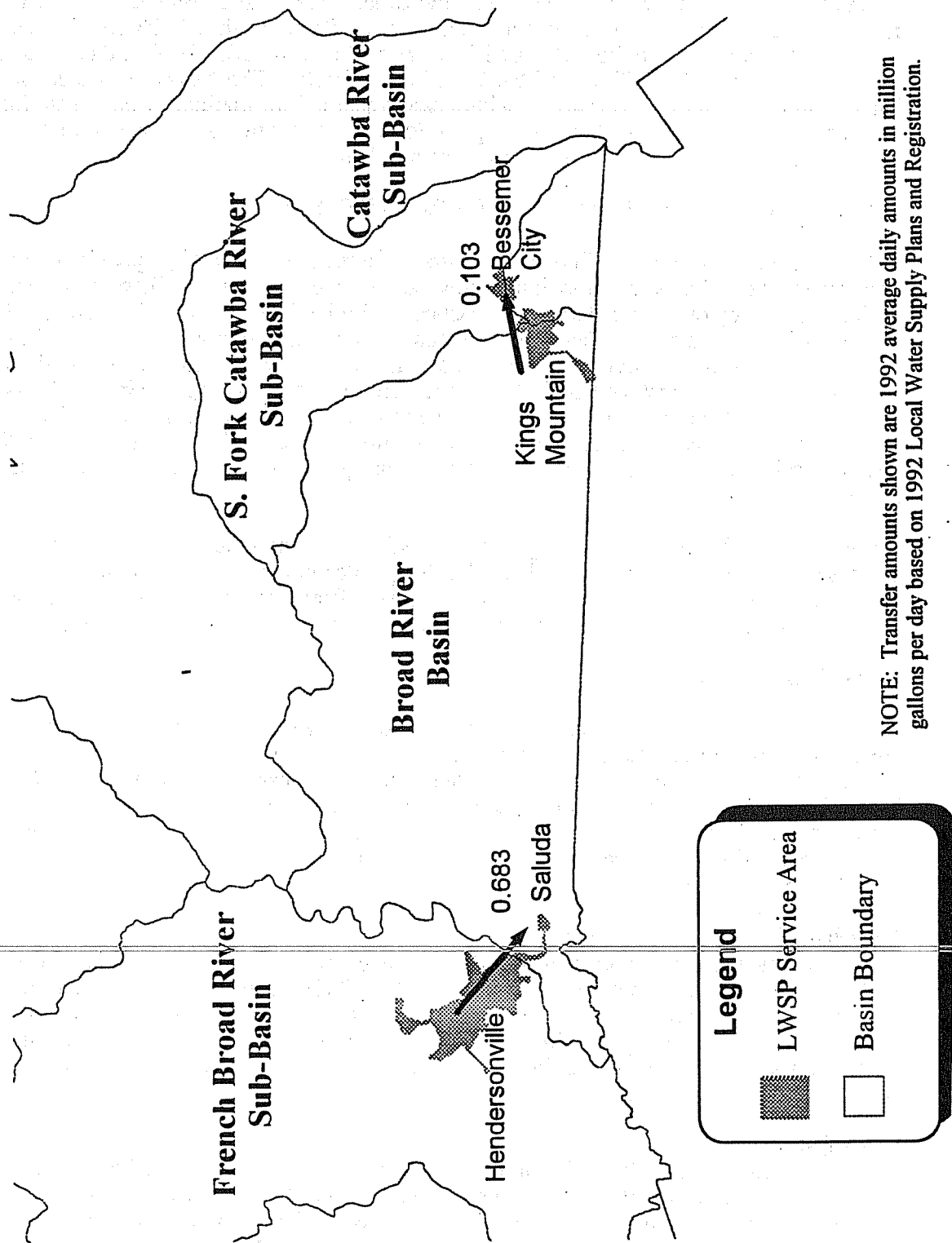


Figure 2.8 Registered Interbasin Transfers for the Broad River Basin

Hydropower

Northbrook Carolina Hydro L.L.C. operates the Stice Shoals hydropower facility on the First road upstream of the confluence with Shoal Creek. The Federal Energy Regulatory Commission (FERC) found Stice Shoals to be non-jurisdictional to FERC oversight. Stice Shoals has no minimum flow requirement.

Second Broad River

Forest City

The Town of Forest City has proposed a dam for on-stream storage on Roberson Creek, a tributary of the Second Broad, at the confluence with Heavens Creek. The Division of Water Resources is doing a field study to determine the minimum flow requirement for the proposed structure.

Hydropower

Two hydropower facilities are currently in operation on the Second Broad. Cliffside is located in the Town of Cliffside and has no minimum flow requirement. The FERC has not pursued licensing on the Cliffside project. The U.S. Geological Survey is considering removing the gage on Second Broad downstream of the Cliffside dam because sediment discharge from the Cliffside dam has buried the gage intake under 6 feet of sediment. Upstream of the Cliffside dam is the Caroleen project. Caroleen is located in the Town of Caroleen and operates in a run-of-the-river mode, i.e. instantaneous outflow equals instantaneous inflow.

Broad River

Hydropower

The Town of Lake Lure owns and operates a hydropower facility at the dam for Lake Lure. The project has no minimum flow requirement attached to its dam safety permit. A flow of 6.6 cfs, the 7Q10, is required at the Town's wastewater treatment plant located downstream of the dam.

Northbrook Carolina L.L.C. operates the Gaston Shoals hydropower facility near the confluence with Mikes Creek in South Carolina. The impoundment for the project reaches into North Carolina.

Green River

Hydropower

Northbrook Carolina Hydro L.L.C. operates the Turner Shoals hydropower facility at the dam for Lake Adger. The FERC found Turner Shoals to be non-jurisdictional to FERC oversight. Turner Shoals has no minimum flow requirement.

Duke Power operates the Tuxedo hydropower facility at the dam for Lake Summit. The FERC found Tuxedo to be non-jurisdictional to FERC oversight. Tuxedo has no minimum flow requirement.

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