CLEVELAND COUNTY WATER SUPPLY SURVEY

North Carolina Department of Natural Resources
and Community Development

Division of Water Resources
Water Supply Assistance

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Prepared in Cooperation with the
Cleveland County Board of Commissioners,
Town of Boiling Springs, Town of Fallston, Town of Grover,
City of Kings Mountain, Town of Lawndale, Midpines Community,
City of Shelby, Upper Cleveland County Sanitary District,
Piedmont Metropolitan Water District

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CLEVELAND COUNTY WATER SUPPLY SURVEY

SECTION I
EXECUTIVE SUMMARY

The Cleveland County Board of Commissioners requested the North Carolina Division of Water Resources (DWR) to provide information on water resources in the county and projections of future water needs. A water supply survey was then begun by the Division in cooperation with the Commissioners. The objectives of the survey work plan were:

1. Conduct surveys to determine the current water use specific to industrial-commercial, agricultural, residential, and other purposes within the county.

2. Based on the results of the water use surveys, project the future water needs for individual water systems at 10-year intervals to the year 2020.

3. Review existing groundwater and surface water records and provide information on water quality and availability.

4. Compare the results of projected future water needs to current water availability at 10-year intervals to the year 2020 to determine if future water needs will exceed existing supplies.

Survey Findings

Water use inventories were conducted within the county to determine the current water use and the projections of future needs (Table I-1). The existing and projected water needs for each municipality/system are summarized on Table I-2 and information on water supply alternatives is provided in Appendix B. The estimated unadjusted surface water availability and the reported production for municipal wells in the county is summarized in Table I-3.

- Water need projections for the county indicate that by the year 2020 a total of more than 33 million gallons per day (MGD) will be needed.

- Kings Mountain Reservoir safe yield and streamflow information indicate that the total available yield of existing surface water supplies within the county is approximately 50 MGD.

- Overall, the quality of both surface water and groundwater in Cleveland County is good. Some localized problems in surface water quality have been noted. Groundwater quality is generally good, however, in some areas there may be higher than desirable concentrations of iron or manganese.

- Long range forecasting by the Business Industry Development Division of the North Carolina Department of Commerce indicates that potential for industrial location in Cleveland County is good. Local government officials believe there will be no changes in the water use patterns of self-supplied industries or any new industries.

- Agriculture and irrigation water use averaged about 1.9 MGD during 1986 with maximum daily use of about 3.2 million gallons in June and July.

- Instream flow requirements should be considered in the planning for future developments and surface water use in order to avoid water quantity conflicts and shortages, and water quality problems.

- The Town of Boiling Springs future water needs projected for 1990 will exceed existing well system supply.

- The Town of Fallston well system supply is about 1.2 times the projected 2020 water need.

- The Town of Grover has a well system with a current supply greater than the 2020 projected need, and is also connected to the Kings Mountain water system.

- The Midpines Community Water System well system supply is about equal to their projected 2020 water needs.

- Piedmont Metropolitan Water District, created in 1988, has a projected water need (including the Towns of Earl and Patterson Springs) of 0.5 MGD in 1990. A water supply for this District has not been selected.

- The existing raw water supplies available to Kings Mountain, Shelby, and Upper Cleveland County Sanitary District water systems are adequate to meet their 2020 water needs.

- The Towns of Belwood, Casar, Lattimore, Lawndale, and Mooresboro are connected to the Upper Cleveland County Sanitary District water system which has an adequate supply to meet their 2020 water needs.

- The Town of Waco plans to connect to the Upper Cleveland Sanitary District in the very near future.

- Alternatives available for water supply systems to consider in meeting local demand shortfalls may include:

  Demand management:

  - Year round - water conservation education, leak detection and repair, plumbing code implementation and enforcement;

  - Seasonal - develop a water shortage response plan;

  - Short term - storage, time of use rates.

  Increase raw water supply availability by:

  - Participation in a regional water system;

  - Capital improvements such as reservoirs, off stream storage, wells, etc.

Table I-1 Total Water Use and Projected Water Needs by Purpose in Cleveland County

Purpose	Water Use in Million Gallons Per Day (MGD)				
	1986/1987	1990	2000	2010	2020
Municipal/District	12.8	15.5	17.4	20.9	25.1
Self-Supplied Industries	5.8	6.0	6.0	6.0	6.0
Irrigation/Livestock Watering	1.9	2.0	2.0	2.1	2.1
Rural-Domestic	1.7	1.5	1.1	0.8	0.5
Total	22.2	25.0	26.5	30.7	33.7

Source: North Carolina Division of Water Resources water use inventory data and projections

Table I-2 Summary of Existing and Projected Municipal Water Needs in Cleveland County

City or Town/System	Average Daily Flow in MGD 1986/1987	1990	2000	2010	2020
Boiling Springs	0.217	0.278	0.299	0.322	0.339
Fallston	0.035	0.048	0.058	0.068	0.076
Grover	0.106	0.198	0.212	0.225	0.235
Kings Mountain	6.000	6.140	6.800	7.590	8.900
Midpines Community Water System	0.025	0.031	0.036	0.041	0.045
Shelby	5.931	7.260	7.930	9.580	11.380
SUBTOTAL	12.314	13.955	15.335	17.826	20.975
Piedmont Metropolitan Water District					
Earl	(a)	0.015	0.018	0.022	0.024
Patterson Springs	(b)	0.048	0.055	0.063	0.071
Rural Areas	(a)	0.340	0.620	0.793	1.177
Industrial	NR	0.100	0.300	0.500	0.600
SUBTOTAL	--	0.503	0.993	1.378	1.872
Upper Cleveland County Sanitary District					
Belwood	(c)	0.036	0.038	0.043	0.049
Casar	(c)	0.020	0.022	0.024	0.028
Lattimore	(a)	0.016	0.018	0.020	0.025
Mooresboro	(c)	0.026	0.029	0.031	0.034
Polkville	(c)	0.136	0.158	0.182	0.208
Waco	(d)	0.024	0.030	0.036	0.042
Rural Areas	0.439	0.834	0.835	1.334	1.814
SUBTOTAL	0.439	1.092	1.13	1.67	2.20
Lawndale (e)	0.037	0.047	0.056	0.065	0.074
COUNTY TOTAL	12.79	15.597	17.514	20.939	25.121

Notes:
(a) Individual wells
(b) Individual wells and Norfolk Southern Railroad
(c) Upper Cleveland County Sanitary District and individual wells
(d) Individual wells and CSX Railroad
(e) Lawndale is a two well system which also has three unmetered connections with The Upper Cleveland County Sanitary District (UCCSD). Water obtained from the UCCSD is included in the rural area total.

NR - No Record

Source: 1986-1987 Water use data collected by NCDWR; projections by NCDWR.

Table I-3 Existing Water Supply Availability for Municipalities and the Upper Cleveland County Sanitary District in Cleveland County

Location	Unadjusted Water Supply Availability (a)		
	Surface Water		Ground Water Well
	Reservoir (MGD)	Stream (MGD)	Production (MGD)
Kings Mountain (Kings Mountain Reservoir)	20 (b) 46-53 (c)	--	--
Upper Cleveland County Sanitary District (UCCSD) (First Broad River)	--	19 (d)	--
Shelby (First Broad River)	--	30 (d)(e)	--
Boiling Springs	--	--	0.22
Fallston	--	--	0.10
Grover	--	--	0.08
Midpines	--	--	0.05
Lawndale	--	--	0.09
Subtotals:	20 (b)	30 (d)	0.54
Total:			50.5

Notes:
(a) Surface water supply unadjusted for sediment and flood storage, minimum release requirements, losses due to evaporation and seepage, recreation, and other instream flow needs.
(b) Reported by City of Kings Mountain
(c) Estimated by NC DWR, 1988.
(d) US Geological Survey, 1974. About 14.7 percent of mean annual flow at the water intake.
(e) Less net withdrawal upstream by UCCSD

SECTION II
INTRODUCTION

Background and Objectives

In the fall of 1986, the Cleveland County Board of Commissioners requested the North Carolina Division of Water Resources (DWR) to provide technical assistance in estimating future water needs and information on water resources in the county. A water supply survey work plan was then developed by the Division in cooperation with the Commissioners. Meetings were held between DWR and the County Manager to coordinate the work. Water use inventories of the following eight water systems were conducted: Boiling Springs, Fallston Water Association, Grover, Kings Mountain, Lawndale, Midpines Community Water System, Shelby, and the Upper Cleveland Sanitary District. DWR in-office review of water resources data was conducted during the period 1987-1988. The objectives of the survey were:

1. Conduct on-site surveys to determine the current water use specific to industrial-commercial, agricultural, residential, and other purposes within the county.

2. Based on the results of the water use surveys, project the future water needs for individual water systems at 10-year intervals to the year 2020.

3. Review existing groundwater and surface water records and provide information on water quality and availability.

4. Compare the results of projected future water needs to current water availability at 10-year intervals to the year 2020 to determine if future water needs will exceed currently existing supply.

General Description of the County

Geographic Characteristics

The area of Cleveland County is about 468 square miles. The major streams within the county are the Broad River, First Broad River, Buffalo Creek, and Sandy Run (Figure II-1). The First Broad River and Sandy Run Creek flow into the Broad River south of Boiling Springs just above the South Carolina border, and Buffalo Creek flows across the state border joining the Broad River near Interstate Highway 85. The average runoff in the county ranges from 0.8 to 1.0 million gallons per day per square mile of contributing drainage area.

The northern third of the county is characterized as hilly in the east to semi-mountainous with elevations in excess of 2800 feet above mean sea level (MSL) in the west. The southern two-thirds of the county is characterized by a flat to gently rolling plateau sloping downward to the south to elevations less than 600 feet MSL at the South Carolina border.

Monthly average temperature and precipitation data for the National Oceanic and Atmosphere Administration (NOAA) Climatological Station at Shelby are shown in Table A-1. The average monthly temperature is approximately 59° F, with generally the coldest month being January and the hottest July. Average

annual precipitation is 48 inches, with minimum rainfall generally occurring in the months of October and November and maximum rainfall in July.

Population

Cleveland County has fourteen municipalities located within eleven townships as illustrated in Figure II-2. Total population for the county in 1987 was 86,290, of which 38 percent or 3,046 was located within municipal corporate limits. The remaining 62 percent, or 53,244, lived in the rural and suburban areas of the county. The distribution of municipal and rural/suburban population in the county for the period 1950-1987 is shown on Table A-2.

Municipal population increased by 5 percent and rural and suburban population increased 30 percent during the seventeen year period 1970-87. By comparison, the total county population increased by 19 percent from 72,556 to 86,290 during the same period. Townships with the highest population growth from 1970 to 1980 were Rippys, Warlick, and Sandy Run, with increases of 73, 54, and 30 percent, respectively.

Population information for the townships, municipalities, and rural/suburban areas shown in Tables A-3 and A-4 is based on U.S. Census data collected every ten years from information provided by the North Carolina Office of State Budget and Management and local governments. Populations numbers for rural/suburban areas were determined by subtracting the total municipal population from county population for each year of record.

Forecasts of population in Cleveland County to the year 2020 are listed in Table A-5. The population trends for the county since 1950 and forecasts to the year 2020 are illustrated in Figure II-3.

Employment-Labor Force

Although the county population is projected to grow slowly, there may be a faster increase in the size of the labor force (Table A-6). This is due to projected changes in the age distribution of the population and possible increases in participation rates (i.e., the percentage of a given age-sex group that is working or looking for work). The increased employment may not all occur in Cleveland County, but to the extent that employment opportunities can be created within the county, out-commuting may be reduced.

The net out-commuting for Cleveland County was 1,175 persons in 1960, increasing slightly to 1,211 in 1970, and more than doubling to 2,628 in 1980 (Table A-7). Seven thousand two hundred and fifty seven people left the county daily to work while 4,629 entered Cleveland County in 1980. Nearly half of the out-commuters worked in Gaston County, while in-commuters came chiefly from Rutherford and Gaston Counties in North Carolina and Cherokee County in South Carolina. No data on commuting patterns after 1980 is available.

The county has a diversified employment pattern, but manufacturing dominates, as shown in Table A-8. In December, 1987, manufacturing employed 14,850 out of 33,490 wage and salary workers in the county. Within the manufacturing sector, textiles was the principal employer with 5,470 workers. Other significant manufacturing industries include: apparel, machinery, metals, stone, clay, and glass.

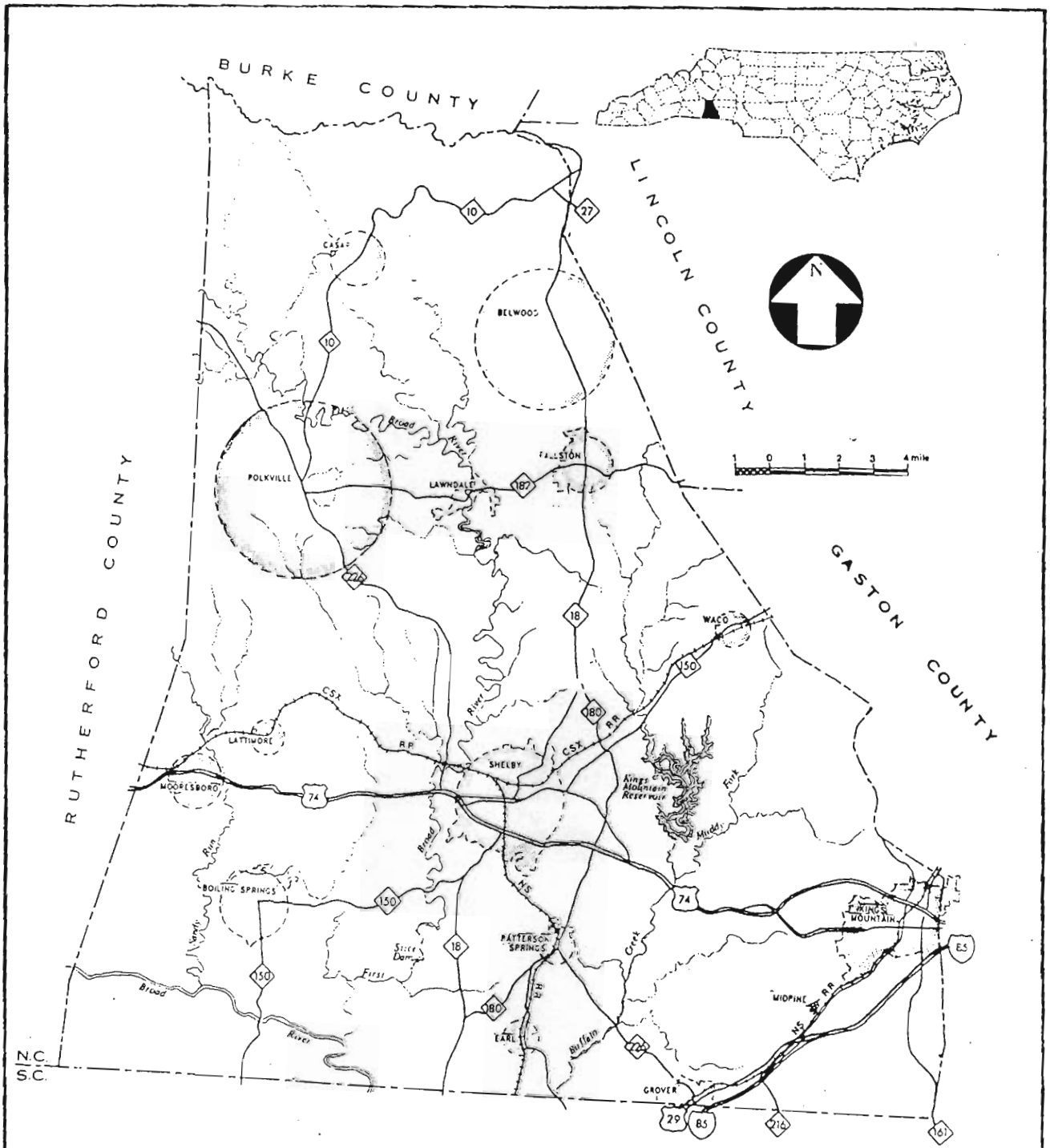
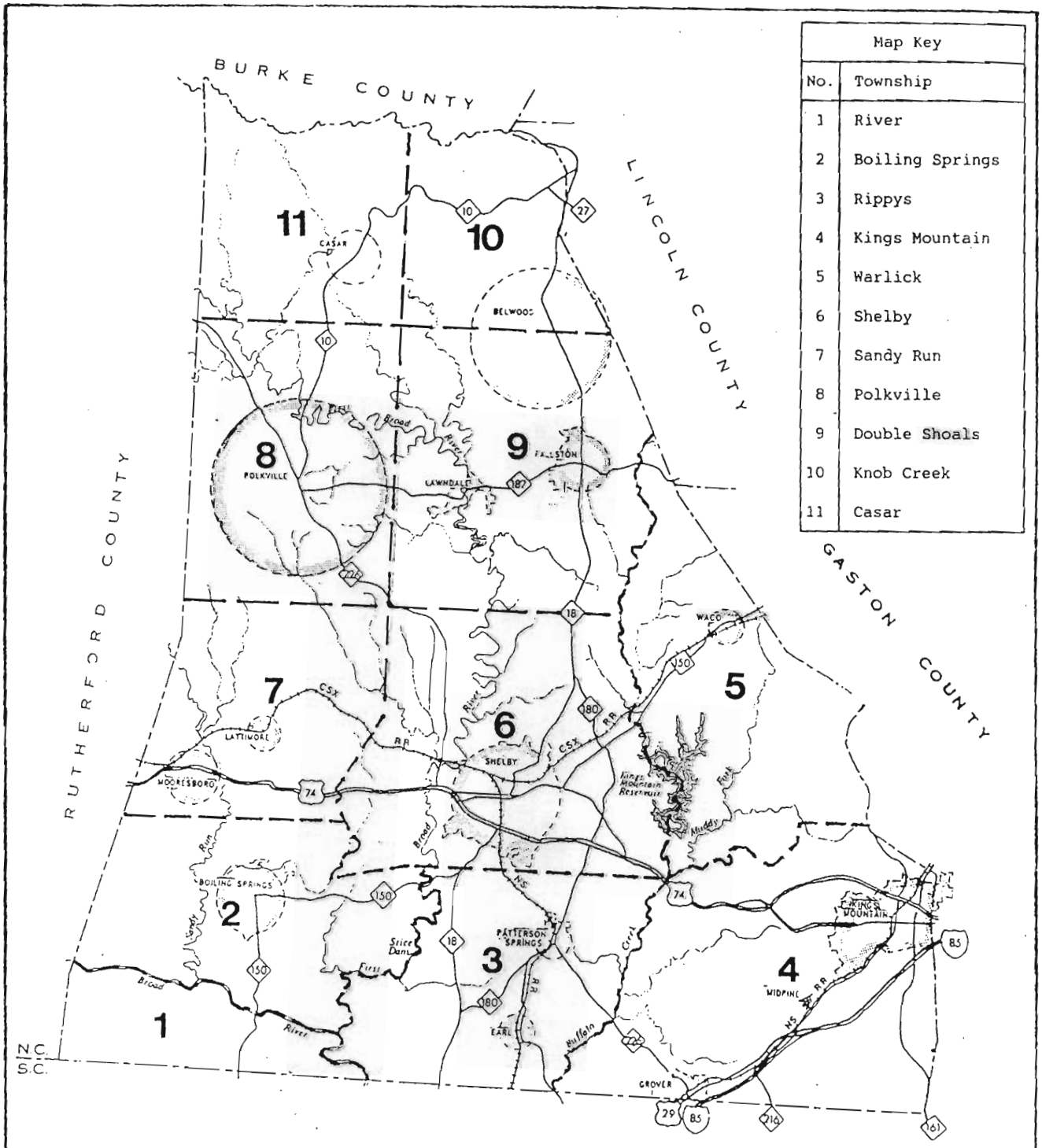


Figure II-1: Map of Cleveland County



See Table A-3 for township population summaries

Figure II-2: Cleveland County Townships and Municipalities

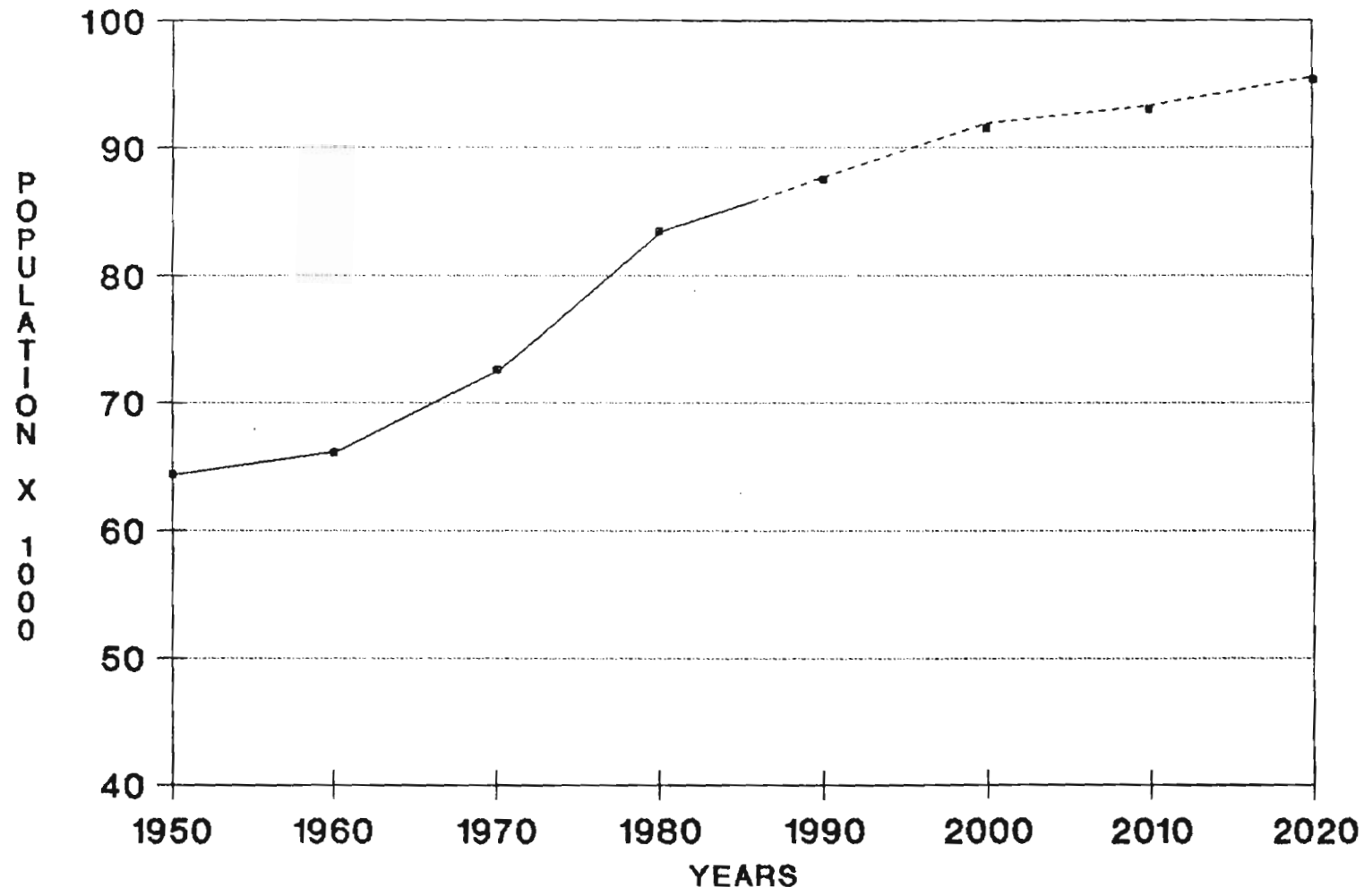


FIGURE II-3 CLEVELAND COUNTY POPULATION

—— Historical - - - Projected

Source: U.S. Census, DWR

SECTION III
WATER USES

Municipal Water Supplies

There were eight municipal water supply systems in the county in 1987. Their locations and proposed service areas are shown on Figure III-1. Five systems use ground water as the main source: Boiling Springs, Fallston, Grover, Lawndale, and Midpines Community Water System. Two systems, Shelby and the Upper Cleveland County Sanitary District, withdraw water from the First Broad River without impoundment. Kings Mountain withdraws water from the Kings Mountain Reservoir, an impoundment on Buffalo Creek. Field data collected by Division of Water Resources (DWR) personnel in 1987 for each of these systems is summarized in Table A-9. These data indicate that water use in 1987 for the public systems was 0.4 million gallons a day (MGD) from groundwater sources, about 6.4 MGD from the First Broad River, and 6 MGD from Buffalo Creek via the Kings Mountain Reservoir, for a total of about 12.8 MGD.

The Piedmont Metropolitan Water District (PMWD), formed in May, 1988, is expected to become operational in 1990. Patterson Springs and Earl are in the District as shown in Figure III-1. Although Grover and Midpines are within the geographic boundaries of PMWD, they are not participants in the District.

Appendix B describes each water supply system, its future water needs, and water supply alternative considerations.

Rural - Domestic

According to the North Carolina State Government Statistical Abstract (1984), there were 37,461 residents living in 16,279 year-round housing units in the county which were served by individual wells in 1980. DWR estimates that the number of rural year-round housing units grew by 3.7 percent to approximately 16,900 units in 1986.

The Upper Cleveland County Sanitary District (UCCSD), began providing potable water in August 1984 to approximately 2,500 of the 16,900 housing units located in the northern half of the county. The remaining 14,400 housing units located in the rural area were served by individual wells and this water use totaled about 1.7 MGD. Further reduction in rural domestic water use from wells can be expected as more homeowners are connected to community water systems.

Industrial/Large Commercial

The use of water by industry and large commercial companies is an important element in the projection of future use within the county. A list of 35 industrial and large commercial water users is shown on Table III-1. Eight of the industries are self-supplied (5.8 MGD) and the remaining 27 purchase water (6 MGD) from Shelby, Grover, or Kings Mountain Water Systems. Figure III-2 illustrates how they are generally clustered along main transportation routes.

The main industrial expansion area has been along the I-85 corridor in the area from Kings Mountain to the South Carolina State line, with some growth near Shelby. The northern part of the county has not experienced any recent significant industrial growth.

Agriculture

According to records of the North Carolina Office of Budget and Management, 60,100 acres of cropland were harvested within the county in 1985. Between 1970 and 1985, this figure varied between a low of 41,800 acres in 1970 and a high of 62,800 in 1979.

A survey of known agricultural water use in the county indicates that 775 acres were irrigated in 1980 (Sneed, 1981). A 1987 agricultural water use survey by DWR located and interviewed 13 farmers (each irrigated five acres or more) who irrigated a total of 354.5 acres of land in 1986. Table A-10 summarizes the data from these surveys.

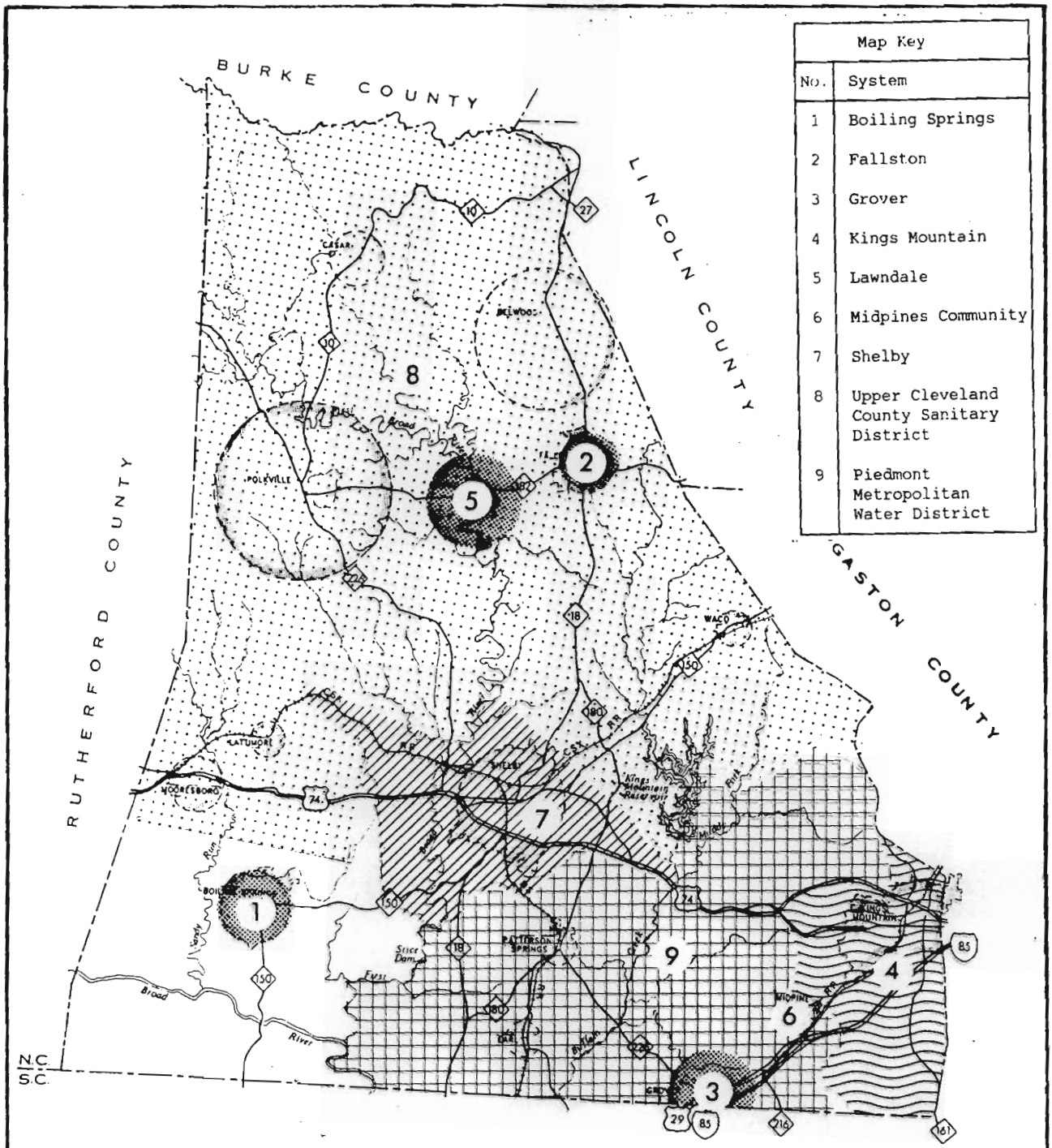
Data from the DWR irrigation survey indicates 194.6 million gallons (MG) of water was applied to irrigated crops during the 1986 growing season. Table A-11 summarizes irrigation data and concurrent records of rainfall for 1986. Approximately 77 percent of the total water was applied in the months of June, July, and August. The percentage increases to 90.7 when the month of May is included. The amount irrigated per acre for the year was estimated to be about 0.550 MG/acre.

Livestock water use was reported to be about 1.2 MGD in 1980 (N.C. State Government Statistical Abstract, 1984). Reports from the Cleveland County Agricultural Extension Office confirm that total numbers of farms and livestock have not changed significantly in the past ten years and only slow growth is expected in the future. Therefore, livestock water use is expected to increase slowly from 1.2 MGD.

Golf course water use was reported to be about 0.2 MGD in 1980 (N.C. State Government Statistical Abstract, 1984) for five courses. There has been no significant change in the number of courses or their watering patterns. Therefore, water use is expected to remain at 0.2 MGD.

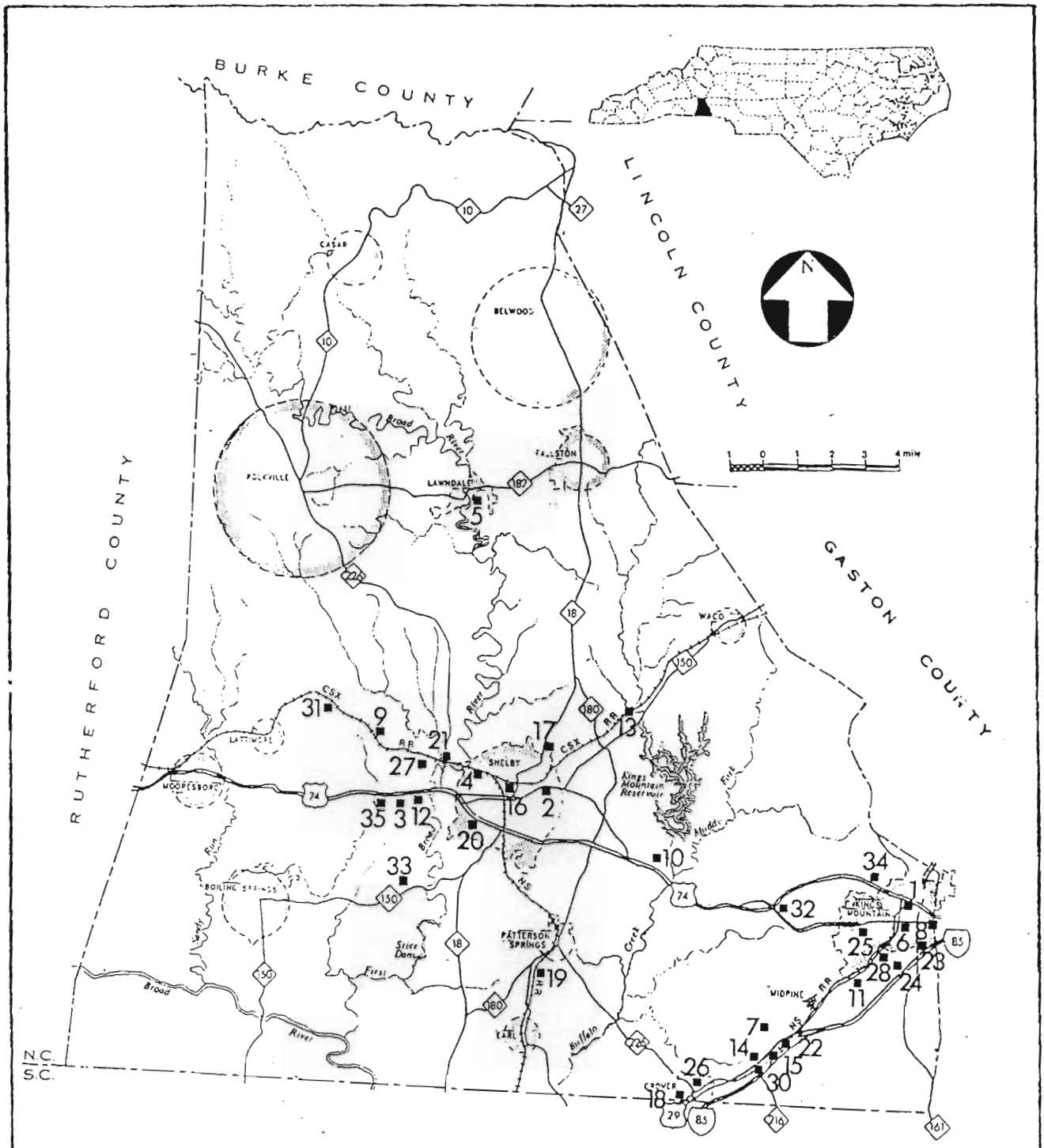
Hydroelectric Generation

The three known hydroelectric projects within the county are located on the First Broad River: Stice Shoals, sometimes called Shelby Dam, now operated by Duke Power; Lawndale, also known as Harrison Shoals, a deactivated facility owned by Cleveland Mills in Lawndale; and Shelby Dam Reservoir, a deactivated site located southwest of Shelby, upstream of N.C. Highway 150. The available data for hydroelectric projects is listed on Table III-2 with their locations shown on Figure III-3.



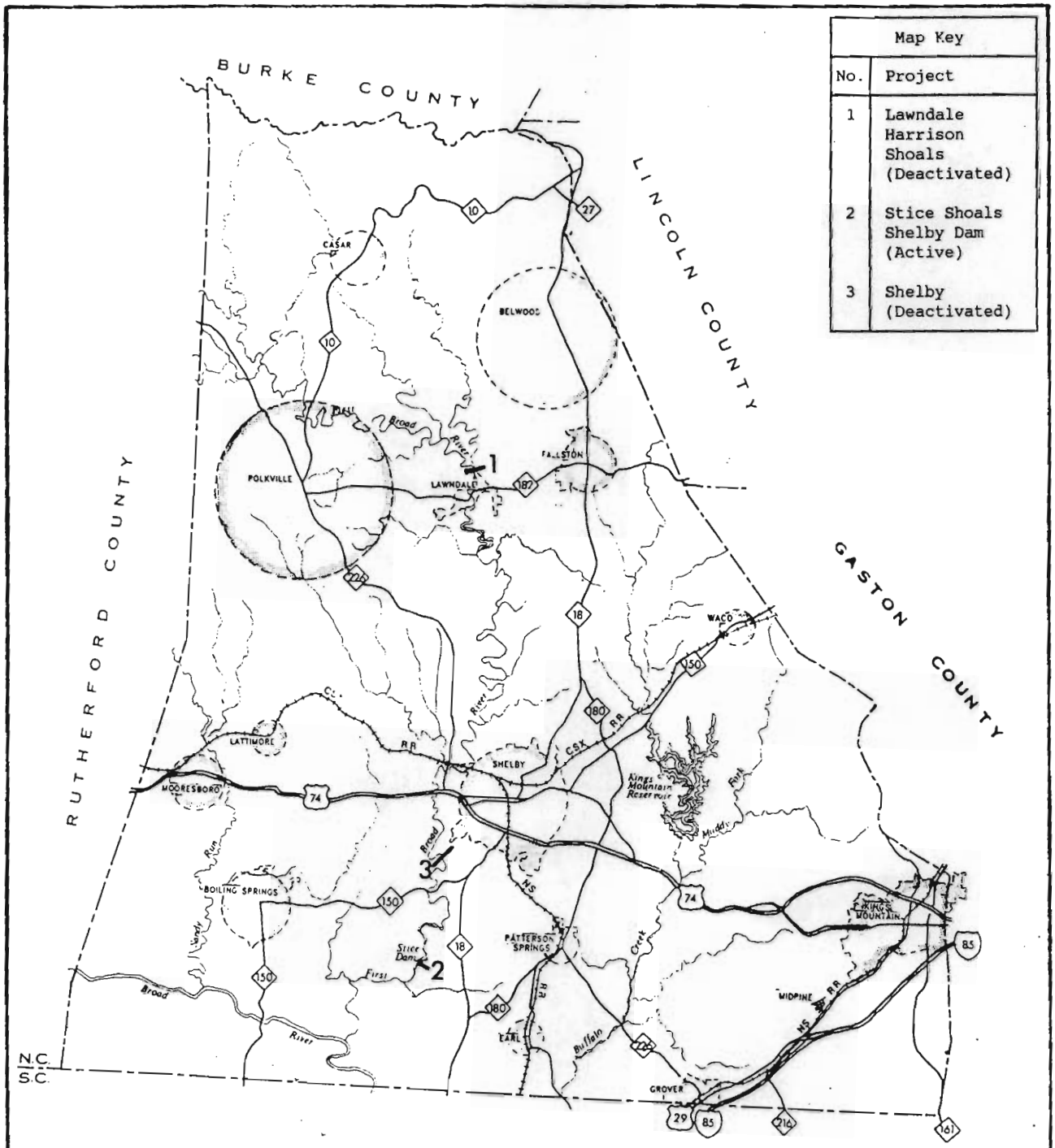
See Table A-9 for systems data

Figure III-1: Cleveland County Municipal Water Systems



See Table III-1 for map key

Figure III-2: Cleveland County Industrial/Large Commercial Water Users



See Table III-2 for data

Figure III-3: Cleveland County Hydroelectric Projects

Table III-1 Industrial and Large Commercial Water Uses in Cleveland County (See Figure III-2 for locations)

Map Key	Name	Source of Water: Self Supplied	Source of Water: Purchased From	Average Daily Use MGD	Peak Use MGD	Period Of Record	Future Needs MGD
1	Anvil Knitwear		Kings Mountain	0.773		Jan-Aug 87	
2	Bost Bakery		Shelby	0.017		Sep 86-Aug 87	
3	Chase Brass & Copper Inc.		Shelby	0.0437		Sep 86-Aug 87	
4	Cleveland Memorial Hospital		Shelby	0.073		Jan-Aug 87	
5	Cleveland Mills Co. Inc.-Lawndale	Bracketts Crk/First Broad R		0.360			
6	Clevemont Mills		Kings Mountain	0.477		Aug 1987	
7	Combustion Engineering		Kings Mountain	0.0325			
8	Commercial Shearing		Kings Mountain	0.030		Jan-Aug 87	
9	Container Corp. of America (CCA)		Shelby	0.013		Sep 86-Aug 87	
10	Copeland Corporation		Shelby	0.0481		Sep 86-Aug 87	
11	Cyprus Foote Mineral	N & S Br of Kings Crk/Wells		0.92	1.28	1987	
			Kings Mountain	0.07	0.11		
12	Dicey Mills, Inc.		Kings Mtn/Shelby	0.128	0.3	Sep 86-Aug 87	
13	Doran Textile		Shelby	0.087		Sep 86-Aug 87	
14	DuPont Huber		Kings Mountain	0.049		Jan-Aug 87	
15	Eaton Corporation		Kings Mountain	0.035		Jan-Aug 87	
16	Esther Mill Corp. (Doran)		Shelby	0.061		Jan-Aug 87	
17	Fasco Industries Inc.		Shelby	0.0663		Sep 86-Aug 87	
18	Grover Industries Inc.	Jakes Branch		0.284	0.384		0.5
			Grover	0.066			
19	Hoechst Celanese Corporation	Ranney Well/Buffalo Crk		0.881	1.27	Oct 86-Sep 87	
20	Holiday Inn		Shelby	0.015		Sep 86-Aug 87	
21	J & C Dyeing Company		Shelby	0.665	.09	Sep 86-Aug 87	
22	Kings Mill Inc.	GW		1.0			
			Kings Mountain	0.005		1977	
23	K Mill		Kings Mountain	0.103		Aug 1987	
24	Martin Marietta Aggregates	Head of Kings Creek/Pitwater		2.0		Sep 1986	
			Kings Mountain				
25	Mauney Hosiery		Kings Mountain	0.048		Jan-Aug 87	
26	New Minette Textiles Inc.	Jakes Branch		0.360	0.400	1988	
			Grover				
27	Ora Mill Co., Doran Textile Gp.	Well		0.013		1988	
28	Parkdale Mills Inc./Glen Raven		Kings Mountain	0.010		Jan-Aug 87	
29	Patterson Florist		Shelby	0.026		Sep 86-Aug 87	
30	Phillips and DuPont Optical		Kings Mountain	0.058		Aug 1987	
31	PPG Industries, Inc.		Shelby	1.069	3.0	Sep 86-Aug 87	
32	Reliance Electric Co.		Kings Mountain	0.057		Jan-Aug 87	
33	Shelby Knits/L & K		Shelby	0.214		Sep 86-Aug 87	
34	Spectrum Textured Fiber Inc.		Kings Mountain	1.628		Jan-Aug 87	
35	Union Carbide Corporation (Kemet)		Shelby	0.043		Sep 86-Aug 87	
		Total		11.8286*			
	*Note	Total self-supplied		5.8180			
		Total purchased from Kings Mountain		3.5035			
		Total purchased from Shelby		2.4411			
		Total purchased from Grover		0.0660			
				11.8286			

Table III-2 Hydroelectric Generation in Cleveland County
(See Figure III-3 for locations)

Map Key	Name of Dam Project	Owner	Location	Power Head (Feet)	Power Capacity (kilowatts)	Annual Generation (1000 kilowatt-hours)
1	Lawndale-Harrison Shoals (Deactivated)	Cleveland Mills	Near NC Highway 182	NR (a)	700-888	2600
2	Stice Shoals-Shelby Dam (Active)	Duke Power	6 miles SW of Shelby	25	600 (b)	1756
3	Shelby (Deactivated)	Unknown	Upstream of NC Highway 150	NR	NR	NR

Notes:
(a) Damaged by flood waters; not reapired; turbine removed.
(b) 2 units; 250 and 350 kilowatts
NR - No Record

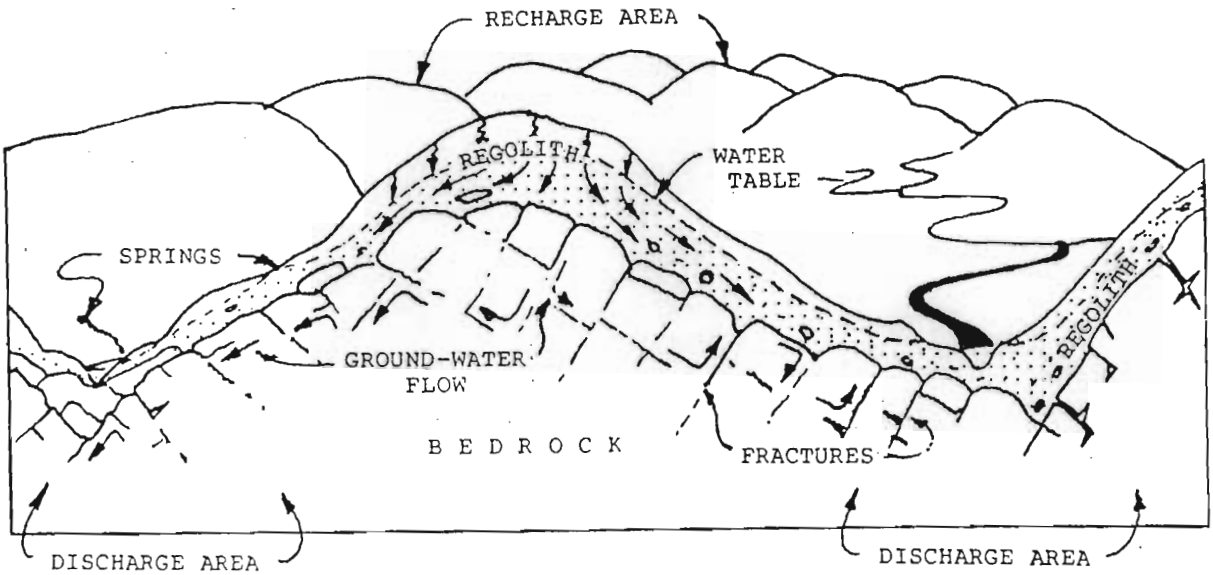
SECTION IV
WATER AVAILABILITY

Groundwater Supply

An appraisal of the Cleveland County groundwater resources, as found in Public Water Supplies of North Carolina, Part 3, by the U.S. Department of Interior Geologic Survey, July 1974, states the following:

> "As is typical of most areas in the Piedmont, topographic setting..." (in Cleveland County) "...is more significant to yield than rock type. On the average, wells in draws and valleys yield about twice as much water as wells on hills and slopes. Generally, the higher yielding wells are drilled in topographic low areas where the overlying mantle of weathered rock is thickest.
>
> The amount of groundwater available is estimated to average 0.45 million gallons per day (MGD) per square mile. Wells drilled in..." (draws and valleys) "...favorable locations, and spaced to prevent pump interference, would probably yield on the order of 0.04 to 0.05 MGD per well based on a 12 hours on and 12 hours off pumping day.

Figure IV-1 illustrates the relationship between topography and the groundwater system in Cleveland County. The higher topographic features, such as hills, ridges, and other stream divides, are areas where surface water percolates downward into the groundwater system and are called "groundwater recharge areas." Conversely, draws and valleys tend to be areas where the groundwater returns to the surface through springs or seeps and are called "groundwater discharge areas" (Heath, 1980).



*Modified from Heath, R.C., 1980

Figure IV-1 Topography and Groundwater in Cleveland County*

In addition to location in low topography, a thick regolith (soil and weathered rock layer above bedrock) and commonly-fractured rock types at the well site are favorable for high well yields. The well depth does not need to be any greater than 400 feet, and depths between 100 and 200 feet are commonly sufficient to obtain yields of 100 gallons per minute (GPM). At depths greater than 400 feet, the rock fractures yielding water to a well are nearly absent (LeGrand, 1967).

Wells yielding less than 10 GPM may be found in settings that would appear ideal for higher-yield. These disappointing yields result when a well penetrates only a few or no water-bearing fractures. A few dry holes can therefore be encountered at a promising site before a higher-yielding well will be drilled.

In a recent Division of Water Resources (DWR) study of the yields from 69 wells across Cleveland County, the highest test yields were on the order of 200 GPM or 144,000 gallons based on a 12 hour pumping day. Although these test yields will probably decline over the lifetime of each well, groundwater yields of 100 GPM are generally available across the county if suitable sites are chosen and the wells are properly maintained. A tabulation of 66 wells for which there is sufficient data is shown on Table IV-1.

In the early 1960s Hoechst Celanese Corporation experimented with a collector well in the Buffalo Creek Valley, a groundwater discharge area. A collector well is a vertical well chamber from which horizontal vaults radiate into adjacent streamed alluvium. High yields typically can be achieved with collector wells--Hoechst Celanese's well had a test yield of 750 GPM. The well failed, however, after mud churned up by a sand-dredging operation upstream from the well clogged the alluvium and caused a decline of almost 50 percent in the well's yield. The well is no longer used.

In areas of the county where both recharge and discharge areas display high concentrations of iron and manganese in the groundwater, water treatment for these metals is necessary. Where iron or manganese is not a problem, the groundwater may require only chlorination to meet the public drinking water standards. The minima amount of treatment needed for groundwater makes it a more attractive source than surface water for many small towns. However, these communities would have to assume the risk and cost of drilling dry holes in their search for a suitable yielding well.

Surface Water Supply

All but one square mile of Cleveland County lies within the Broad River Basin. The head waters of the Broad River are located in North Carolina counties to the west of Cleveland County: the main stream originating in Henderson County and the three major tributaries (First Broad, Second Broad, and Green rivers) in Rutherford and McDowell Counties (Figure IV-2).

Streamflow characteristics in Cleveland County, summarized in Table A-12, were generated using information from selected active and discontinued USGS streamflow gaging stations. The locations of the gages are shown on Figure IV-3. Average rainfall runoff to the streams using data from all four gages is 0.98 MGD per square mile with a range of 0.9 to 1.1 MGD/square mile.

This variability of runoff is caused by differences in climate and physiographic factors such as rainfall, air temperature, soils, topography, etc. Generally, the long-term average runoff is higher in the mountains and less in the Piedmont area.

Non-Reservoir Surface Water Supply

Two streamflow characteristics or parameters, the estimated seven-day ten-year low flow (7Q10) and the lowest daily flow of record, were used to provide preliminary estimates of minimum flow that may be expected at an intake for a run-of-the-river water supply. The 7Q10 is the lowest seven consecutive days average low flow that can be expected to occur on an average of once in ten years. These data, based on the best available streamflow information for the area as recorded in USGS Water Data Reports, are shown on Table IV-2.

The Shelby and the Upper Cleveland County Sanitary District (UCCSD) systems both use surface water resources without reservoir storage, although there are small diversion structures at each of the two Shelby intakes. Table IV-2 shows estimated low flow conditions at each intake and a potential intake site on the Broad River identified by the county.

Reservoir Surface Water Supply

Reservoir Analysis

Most large water supply systems in North Carolina depend on reservoirs for their water supply. As towns grow and water needs exceed the minimum streamflow, storage must be provided. A detailed hydrologic analysis is required at a proposed reservoir site to determine the reservoir size having sufficient storage capacity to furnish a specified yield.

In determining the reservoir site feasibility and storage requirements, many aspects of the site must be considered: patterns of water supply withdrawal, inflow characteristics, foundation suitability, flood control, net evaporation, seepage, minimum downstream release, siltation, land use and availability, and economics. Only estimated characteristic inflows were considered in this analysis. The remaining factors must be considered at later stages of determining the site feasibility.

In Cleveland County, only the Kings Mountain water supply system withdraws water from a reservoir. The county and local governments, however, have identified two reservoir sites to meet anticipated future water needs. Data and the results of yield analysis for the Kings Mountain Reservoir and the two potential reservoirs, Muddy Fork and Dock Turner, are shown on Table IV-3. The analyses were based on monthly streamflow data from the First Broad River near Casar streamflow gage and the Indian Creek near Laboratory streamflow gage. The gaged streamflow values were multiplied by a drainage area ratio factor to determine inflow to each of these reservoirs. Using the inflow values, a mass balance analysis was performed to determine the safe yield that could be sustained at various pool levels. Safe yield is the maximum rate at which water can be withdrawn continuously without exhausting the supply. The safe yield 20, that draft rate which, on the average, could be sustained 19 out of 20 years, was used. This implies a 5 percent chance of deficiency for any given year.

Table IV-3 lists the "required" reservoir storage for the associated draft rates based on streamflow records for the First Broad River near Casar gage and the Indian Creek near Laboratory gage. Streamflow data for these nearby gaging stations were used as index stations to determine the required storage.

Methodology

The reservoir yields were determined using the STALLS Model which performs a mass balance type analysis of a partial duration series of low-flow events based on monthly streamflow data. It was assumed that for each reservoir all the storage is allocated to water supply (no sediment storage or flood storage). Also, the minimum release requirement plus losses due to evaporation and seepage will have to be determined and subtracted from the reservoir safe yield as shown in this report. The amount of storage needed just for water supply (safe yield) at each reservoir site has some degree of reliability, i.e., 95 percent in the case of safe yield 20.

In many cases, the safe yields for a water supply should be adjusted to reflect other uses of the water. Other uses might include the following:

1) Increased releases for water quality protection, particularly for downstream reaches receiving wastewater discharges.

2) Irrigation.

3) Preservation of fish and wildlife.

4) Recreation.

5) Flood Control.

6) Hydropower.

Minimum release requirements for sustaining downstream needs, such as preservation of fish and wildlife, directly reduce the water supply potential of reservoirs. These minimum flow requirements result in continuous drafts during drought conditions. Other uses, such as recreation, indirectly reduce reservoir yields. Where recreational benefits are a concern, lake drawdowns may need to be limited, requiring a portion of the reservoir volume to be dedicated to recreation. Safe yields may also be reduced when a flood control volume is subtracted from the useful storage. Therefore, the safe yields shown in Table IV-3 do not reflect the potential loss of storage due to a reassignment of available storage because of increases in recreation use, flood control, and downstream flow requirements. All of these or other additional uses are possible and must be considered in a final analysis.

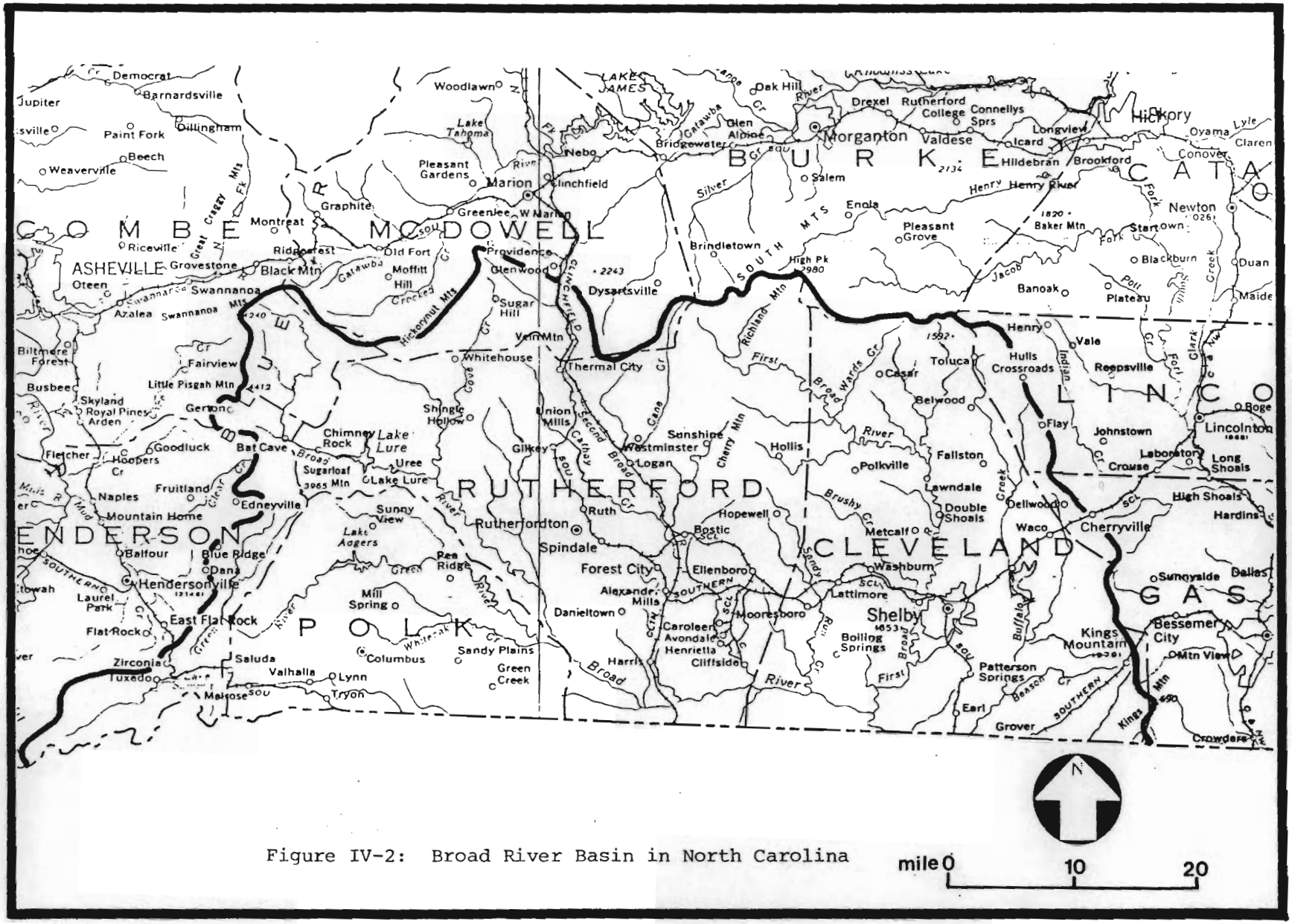
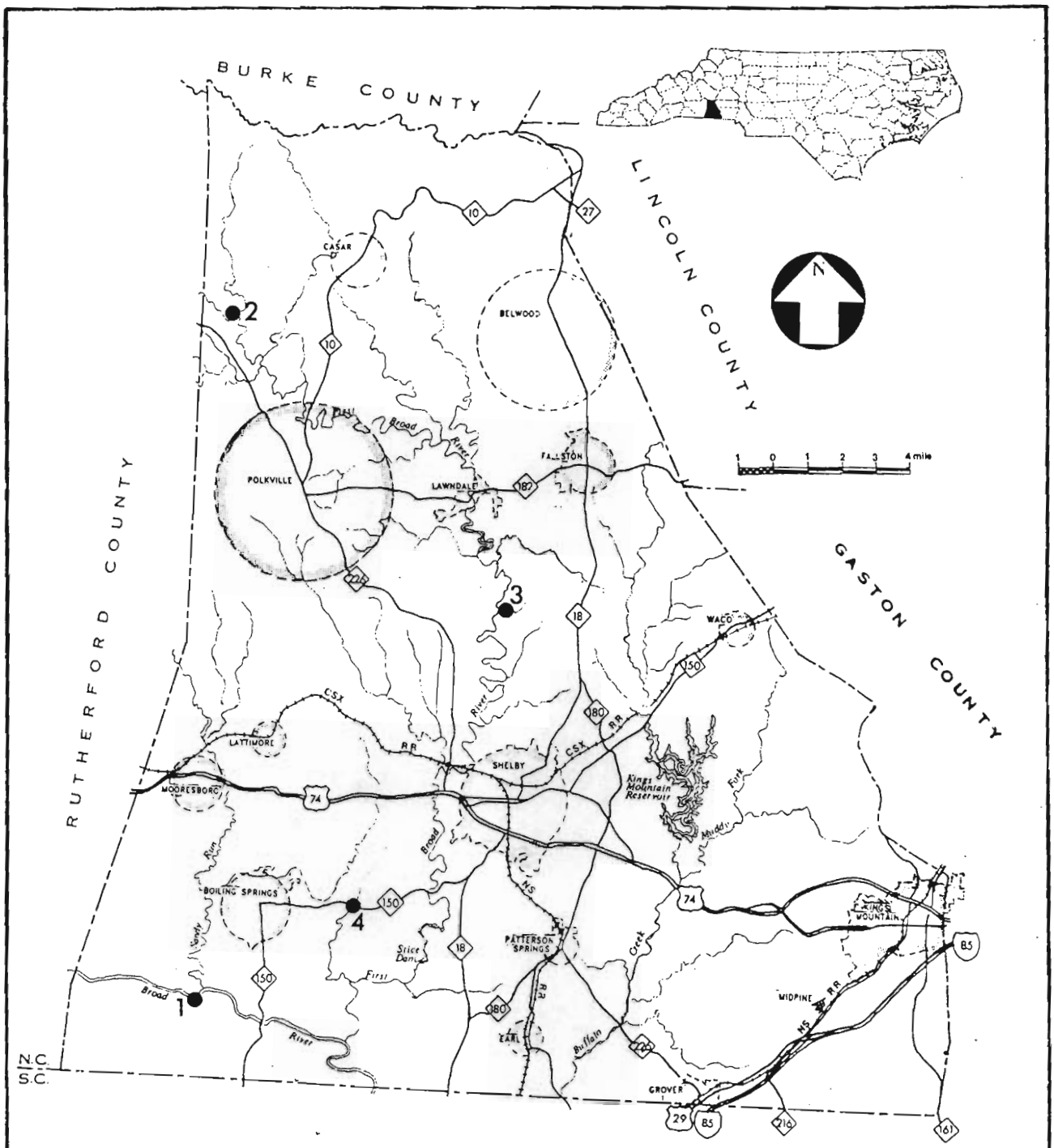
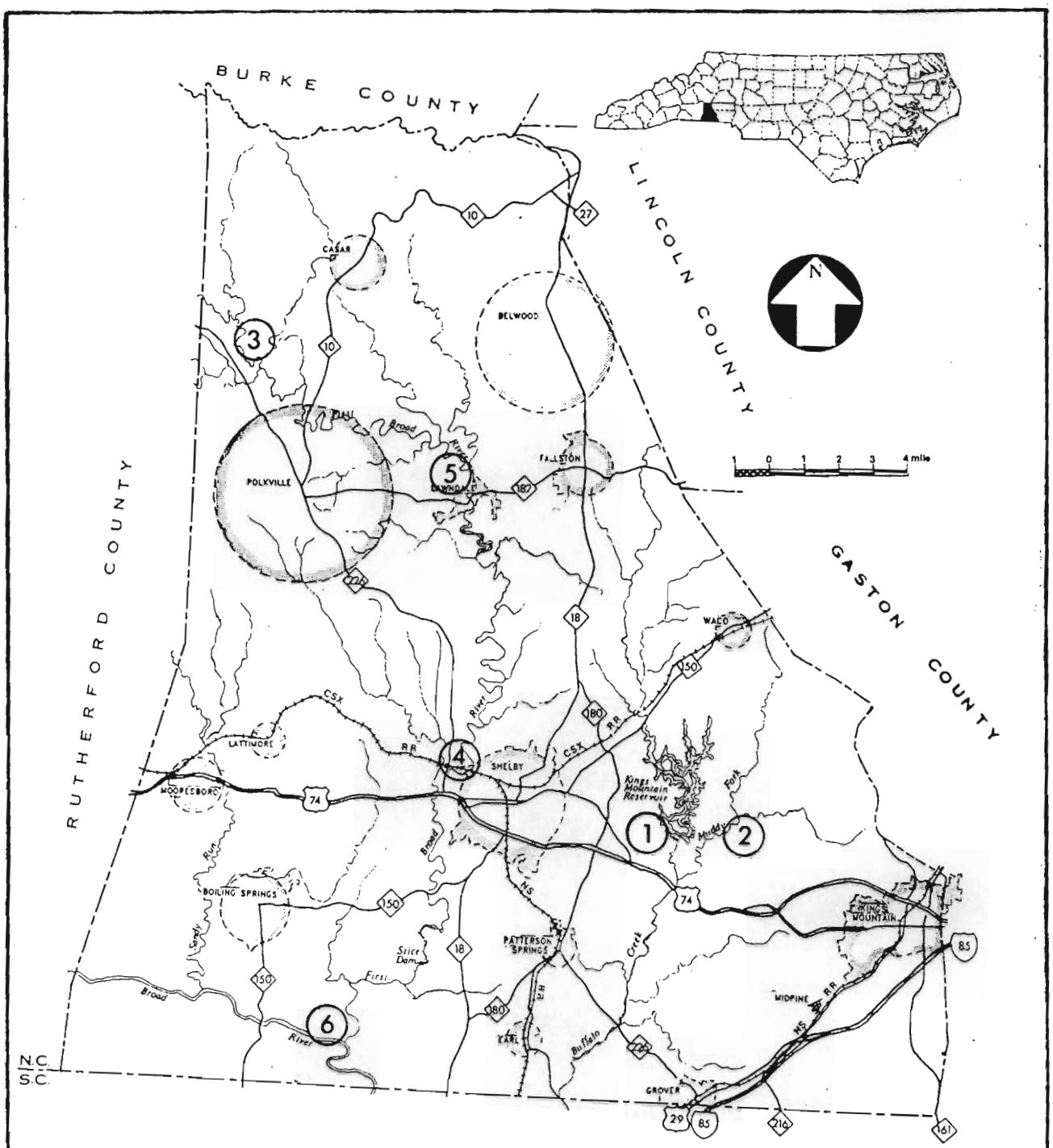


Figure IV-2: Broad River Basin in North Carolina



See Table A-12 for data

Figure IV-3: Locations of USGS Stream Gaging Stations in Cleveland County



See Tables IV-2 and IV-3 for data

Figure IV-4: Surface Water and Potential Reservoir Water Supply Sites in Cleveland County

Table IV-1 Characteristics of 66 Municipal, Community, Industrial, Institutional, and Commercial Wells Drilled in Igneous or Metamorphic Rock Formations in Cleveland County

Type Drilled	Number	Test Yield Range GPM	Average Yield GPM	Median Yield GPM
By Topography				
Draws and Valleys	21	0-263	113.5	100.0
Intermediate Areas:				
Slopes or flat areas	33	0-200	42.8	30.0
Hills	5	6-30	18.2	20.0
Undetermined	7	15.5-80	43.1	40.0
Total	66	0-263	62.0	34.0 (30-37.5)
By Function				
Municipal	24	2-250	84.5	53.5
Industrial (not including Hoechst Celanese Ranney Well)	21	0-263	71.9	30.0
Other	21	0-100	31.0	20.0
Mobile Home Parks 12				
Subdivisions 6				
Schools 2				
Commercial 1				
Total	66	0-263	62.0	34.0 (30-37.5)

Sources: NC NRCD, DWR Field Investigations, October 1987; DEM Permits; and NC DHR, DHS files

Table IV-2 Non-Reservoir Surface Water Supply, Cleveland County
(See Figure IV-4 for locations)

Map Key	Water Supply Intakes	Source	Drainage Area (Sq. Mi.)	Mean Annual Flow (MGD)	Lowest Daily Flow on Record (MGD)	7 Day, 10 Year Low Flow at Intake (MGD)
4	Shelby	First Broad River	226	204	12.4	38.5
5	Upper Cleveland County Sanitary District	First Broad River	146	132	8	24.9
6	(Potential)(a)	Broad River	875	973	68	219

(a) As identified by local governments

Notes: Suggested range and reliabilty for streamflow estimates is ±35%

Average flows at intakes, lowest daily flows on record and 7-day 10-year low flows at intakes are based on ratios by drainage area from the USGS gaging station, First Broad River near Lawndale.

Source: US Geological Survey Water Resources Data - North Carolina

Table IV-3 Allowable Draft and Required Storage for Reservoir Sites
(See Figure IV-4 for locations)

Map Key	Reservoir	Drainage Area (Sq. Mi.)	Normal Pool(a) (Acre-Feet)	Estimated Range Allowable Draft(b) (MGD)	Range of Required Storage(b & c) (Acre-Feet)
1	Kings Mountain (Existing)	68	39,000	53 46	22,900 28,300
2	Muddy Fork (Potential)(d)	30	64,400	23 20	10,100 12,500
3	Dock Turner (Potential)(d)	100	35,000	78 64	33,600 35,100

Notes:
(a) As reported to N.C. Division of Water Resources for existing and potential reservoir sites.
(b) Upper values: Casar gage analyses; lower values: Laboratory gage analyses.
(c) Suggested deviation of the storage required for corresponding allowable draft is about 15 to 25 percent.
(d) As identified by local governments.

Source: U.S. Geological Survey Water Resources Data - North Carolina

Based on STALLS Analyses Using First Broad River Near Casar and Indian Creek Near Laboratory Gages

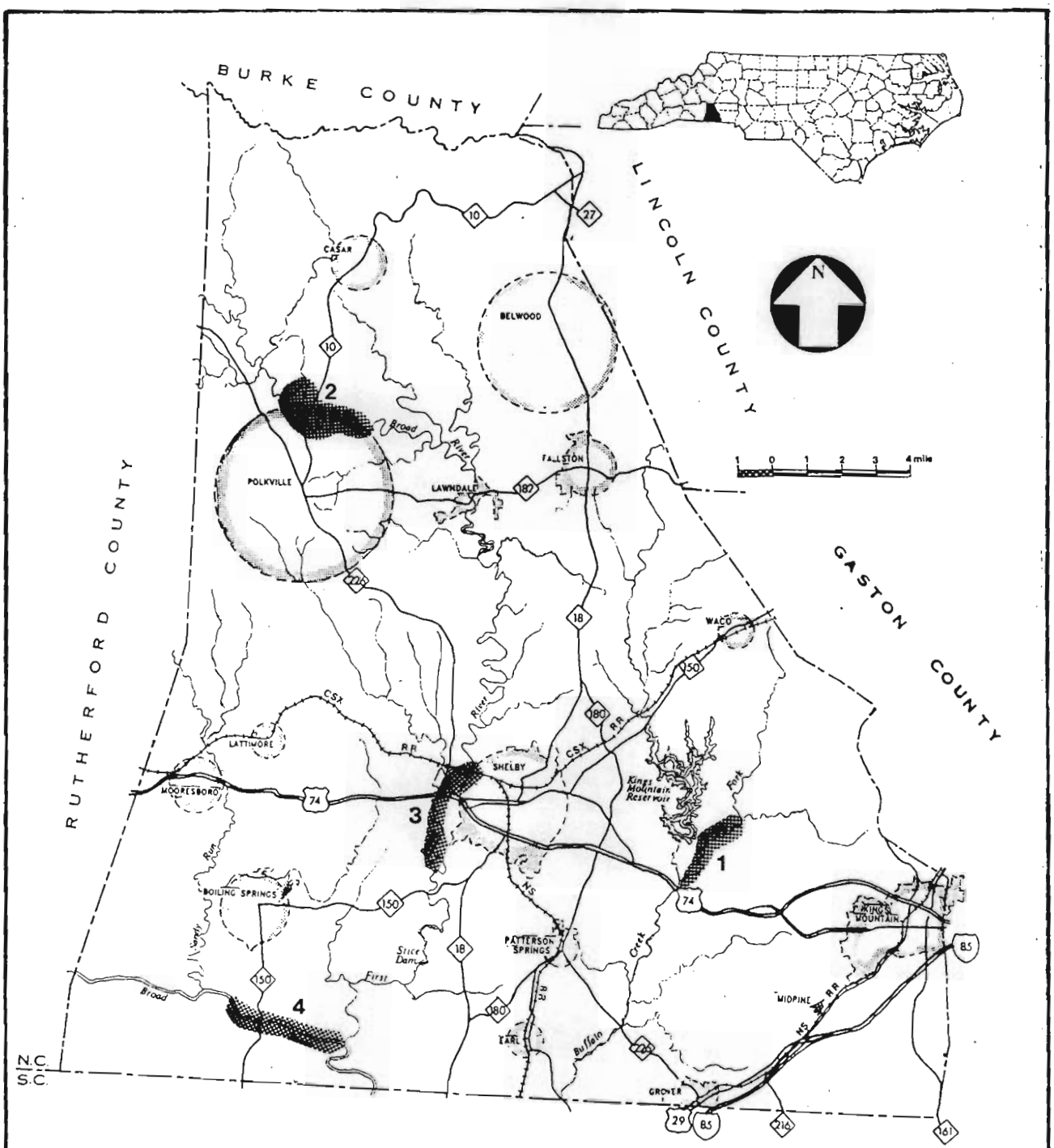
SECTION V
INSTREAM FLOW NEEDS

At any given location in a stream, all uses of water can be categorized as either instream or offstream. Instream uses are activities or functions which rely on water being in the stream channel. Such uses include: aquatic habitat, water quality maintenance, recreation, aesthetics, hydroelectric power generation, navigation, conveyance to downstream users, maintaining wetlands, and preventing sediment build-up. Offstream uses require the diversion of water from the stream channel. These uses include water withdrawals for municipal, industrial, and agricultural purposes. Hydroelectric power generation is also considered an offstream use when the project diverts water from the natural channel. Diversions for offstream uses can range from temporary and brief in duration to permanent, constant withdrawals.

Instream Flow Needs refer to the amount of water needed to maintain instream uses at an acceptable level at a particular location on a stream at a particular time. This amount of water also includes that water to be conveyed past a point for offstream uses at points farther downstream. Only certain instream uses may be applicable at any given location in the stream system. Instream target flows are based on maintaining one dominant instream use or a combination of uses. Meeting target flows should be a goal of any water resource project. During those times when natural flows are below the target flow, projects capable of flow augmentation should maintain the target flow, while others without flow augmentation should use the naturally occurring flow as the temporary target. Instream flow needs and target flows may vary with the time of year. For example, a certain flow may only be needed for fish spawning or recreational use during a particular season.

Instream and offstream uses of water have the potential to create conflicts and shortages of water. Different flow needs must be quantified so that management decisions can be made which will minimize conflicts and maximize both instream and offstream benefits. Existing offstream needs can be quantified by surveying municipal, industrial, and agricultural users. Future needs can then be projected.

An evaluation has been conducted of instream flow needs of Buffalo Creek downstream of the Kings Mountain Reservoir as a result of a proposed hydroelectric installation at the existing dam; the results of which are not available at this time. Other river reaches would need to be evaluated if an impoundment or diversion of water were planned for the sites shown on Figure V-1 and described on Table V-1.



See Table V-1 for data

Figure V-1: Potential Instream Flow Need Study Reaches in Cleveland County

Table V-1 Potential Instream Flow Study Reaches in Cleveland County
(See Figure V-1 for locations)

Map Key	Site	Description of River Segment Location	Drainage Area (a) (Sq. Mi.)	Mean Annual Flow (a) (MGD)
1	Muddy Fork	Downstream of Muddy Fork Reservoir site to confluence with Buffalo Creek.	30	27
2	First Broad River Polkville	Downstream of Dock Turner Reservoir site to SR 1512 near Polkville.	100	90
3	First Broad River Shelby	Downstream of existing City of Shelby WTP intake to SR 1121.	226	204
4	Broad River	Downstream from confluence with Jolly Branch to confluence with First Broad River.	948 Above rapids	1053

Notes:
(a) USGS Data

SECTION VI
WATER QUALITY

Groundwater

The chemical quality of groundwater in Cleveland County is generally good. The water is usually soft to moderately hard and local iron concentrations may exceed 0.3 milligrams per liter (MG/L). The average dissolved solids concentration in water from 13 wells surveyed in 1974 was 115 MG/L.

In areas of the county where both recharge and discharge areas display high concentrations of iron and manganese in the groundwater, water treatment is necessary. Where iron or manganese is not a problem, the groundwater may require only chlorination to meet the public drinking water standards. The minimal amount of treatment needed for groundwater makes it a more attractive supply source than surface water for many small towns.

High concentrations of iron and manganese may be avoided by locating wells on slopes or hills. Although well yields are typically lower than in the valleys and draws, less iron or manganese will generally be found in the groundwater supply in these areas.

Surface Water

Ambient Water Quality Conditions

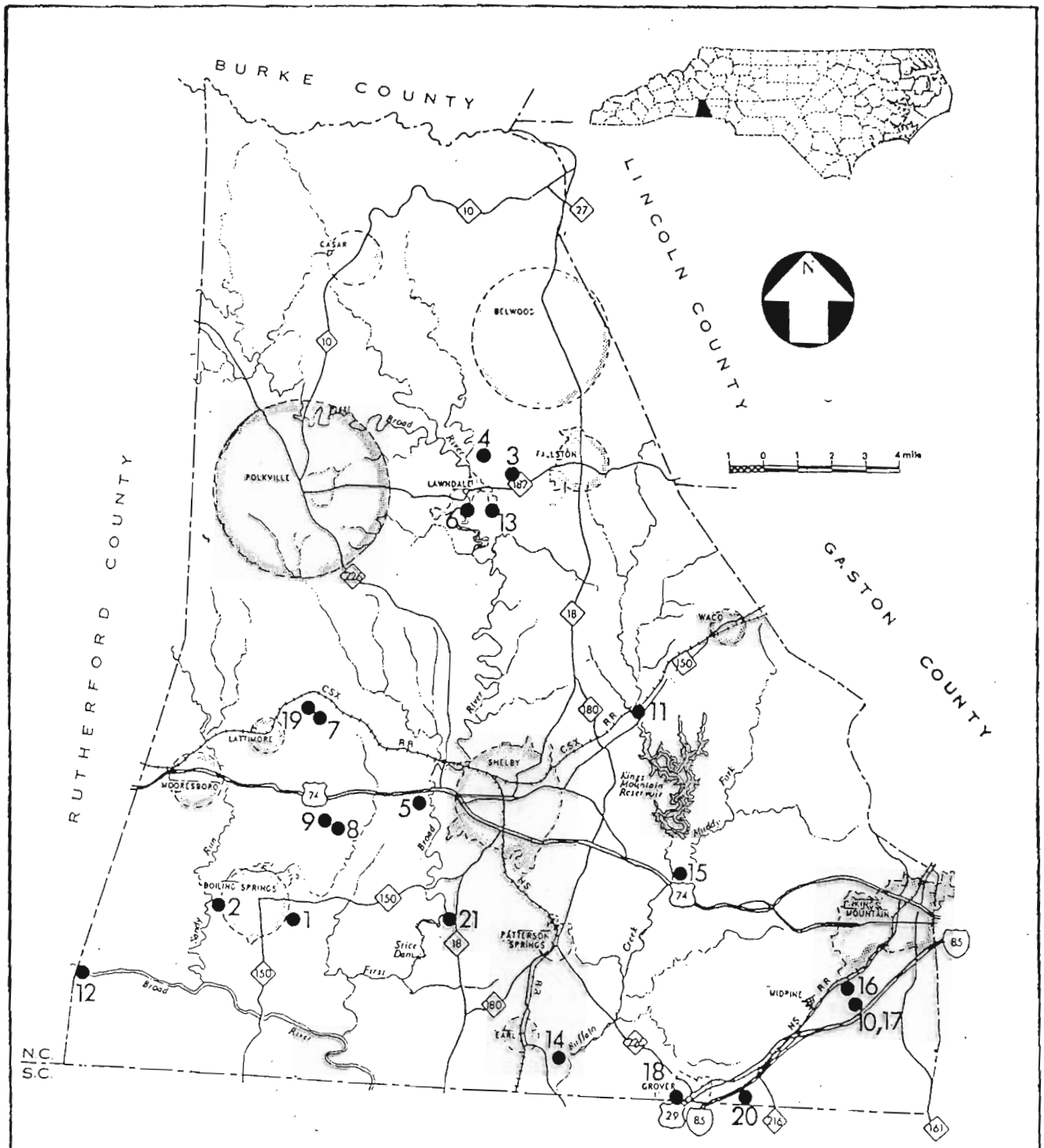
The Division of Environmental Management (DEM) of the North Carolina Department of Natural Resources and Community Development (NRCD) has assigned "best use" classifications to all surface waters of the State large enough to have been given names on USGS topographic maps. Surface water use classifications are: WS-I: streams without discharges and with a non point source management strategy; WS-II: streams with domestic wastewater discharges only; WS-III: streams suitable for water supply and all class C usages and with a non point source management strategy; B: streams designated primarily for recreation; and C: streams designated for aquatic life protection. These classifications are used to guide regulatory programs regarding the level of protection required for a given water use. For example, wastewater treatment facilities which discharge into receiving water bodies which support primary recreation uses (B) are required to have standby equipment to ensure that failure will not cause the discharge of inadequately disinfected wastewater (15 NCAC 2H.0124). A listing of the quality of waters of Cleveland County as evaluated by the Water Quality Section of DEM along with a key of abbreviations is contained in Table A-13 in the Appendix.

DEM also maintains a network of water quality monitoring stations. Water samples are collected regularly at each station and analyzed for a wide range of chemical and biological parameters. These parameters include heavy metals, bacteria, nutrients, dissolved oxygen, and materials which consume oxygen. At some of these stations collections are also made of bottom-dwelling aquatic animals such as insects, bugs, worms, and crustaceans (Benthic macroinvertebrates). The number and types of organisms present provide an assessment of the quality of the water body, since some species are known to be

more tolerant of pollutants than others. Also, if the pollutants enter the water body on an intermittent basis, as with stormwater runoff, it is possible that chemical sampling of the water will miss these pollutants. There are two ambient stations on the First Broad River in Cleveland County from which benthic macroinvertebrate data has been collected (NRCD 1982). This data indicates good to excellent water quality in the headwater areas near Casar and fair to good/fair conditions near Earl. Data from one tributary, Brushy Creek, also indicated fair water quality. A large set of biological data has been collected from Buffalo Creek and its tributaries near the Minette Mills and Kings Mountain wastewater treatment plant discharges. This data indicates good/fair water quality above these point sources and poor below. However, data collected further downstream indicates that some water quality recovery occurs before Buffalo Creek flows into South Carolina. A complete listing of water quality monitoring stations can be obtained from the Water Quality Section of DEM.

Wastewater Discharges

All discharges of wastewater to surface waters of the State are regulated by the State of North Carolina under the National Pollutant Discharge Elimination System (NPDES). Approximately 48 NPDES permits are presently in effect in Cleveland County. However, the majority of these are considered "minor" discharges, including small volume municipal and industrial treatment plants, schools, and individual residences. Twenty-one discharge permits issued for discharges of 0.01 million gallons per day or more are listed in Table VI-1 and their locations shown on Figure VI-1. One permit is for the cooling water discharges from the Duke Power Cliffside electric generating plant.



See Table VI-1 for data.

Figure VI-1: Wastewater Facilities Discharging Flows of ≥ 0.01 MGD to Surface Waters in Cleveland County

Table VI-1 Wastewater Facilities Discharging Flows ≥ 0.01 MGD to Surface Waters in Cleveland County
(See Figure VI-1 for locations)

Map Key	NPDES Permit Number	Facility	Stream	Permitted Flows (MGD)	Average 5/87-4/88 (MGD)
1	NC0020141	Boiling Springs - East Side WWTP	Poplar Branch	0.07	0.05
2	NC0020141	Boiling Springs - West Side WWTP	UT Sandy Run Creek	0.15	0.11
3	NC0066486	Burns High School	UT Maple Creek	0.0175	0.0067
4	NC0066389	Burns Jr. High School	UT Maple Creek	0.02	0.0062
5	NC0061743	Chase Brass & Copper	UT Brushy Creek	0.036	0.0029
6	NC0004120	Cleveland Mills Company	First Broad River	0.6	0.3036
7	NC0005061	Container Corporation of America	EF Beaverdam Creek	0.01	0.0095
8	NC0066401	Crest High School	UT Beaverdam Creek	0.0175	0.0101
9	NC0066460	Crest Jr. High School	Big Beaverdam Creek	0.02	0.0094
10	NC0033570	Cyprus Foote Mineral Company	Kings Creek	0.123	0.000
11	NC0004103	Doran Yarn Mill	Buffalo Creek	0.02	0.00419
12	NC0005088	Duke Power Cliffside	Broad River	270.0 13.0	* 8.96
13	NC0031062	F. Beam Rest Home (Cleveland Care Center)	UT Magness Creek	0.004	0.0032
14	NC0004952	Hoest Celanese Fibers Cooling	Buffalo Creek	0.85	0.522
15	NC0020737	Kings Mountain WWTP	Pilot Creek, Buffalo Cr.	3.853	3.40
16	NC0005444	Martin Marietta Corporation	Kings Creek	1.26	No Data
17	NC0024821	NC DOT I-85 Welcome Center	Kings Creek Dixon Branch	0.024 0.030	0.00183
18	NC0004235	New Minette Mills Incorporated	Lick Branch	0.625	0.254
19	NC0004685	PPG Industries	Brushy Creek	0.875	0.894
20	NC0032867	Roadside Truck Plaza	UT Dixon Branch	0.0145	0.0044
21	NC0024538	Shelby WWTP	Hickory Creek	6.0	3.48

*Once through cooling

Source: NC Division of Environmental Management Permit Files and NCDWR field data

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APPENDIX A

Figures

A-1. Rivers and Streams in Cleveland County

Tables

A-1. Monthly Average Temperatures and Precipitation for Shelby

A-2. Municipal and Rural/Suburban Population Distribution in Cleveland County, 1950-1987

A-3. Township and County Population for Cleveland County 1950-1980

A-4. Population for Municipalities and Rural/Suburan Areas in Cleveland County, 1950-1987

A-5. Forecast of Population in Cleveland County to Year 2020

A-6. Cleveland County Work Force and Employment

A-7. Commuting Patterns for Cleveland County

A-8. Summary of Employment by Industrial Category: Non-Agricultural Wage - Salary Employment, by Place of Work in Cleveland County

A-9. Systems Data For Public Water Supplies in Cleveland County, 1987

A-10. Areas Irrigated in 1980 and 1986, Cleveland County

A-11. Cleveland County Irrigation/Precipitation - 1986

A-12. Streamflow Characteristics of Continuous Record USGS Stations

A-13. Water Quality for Cleveland County Streams

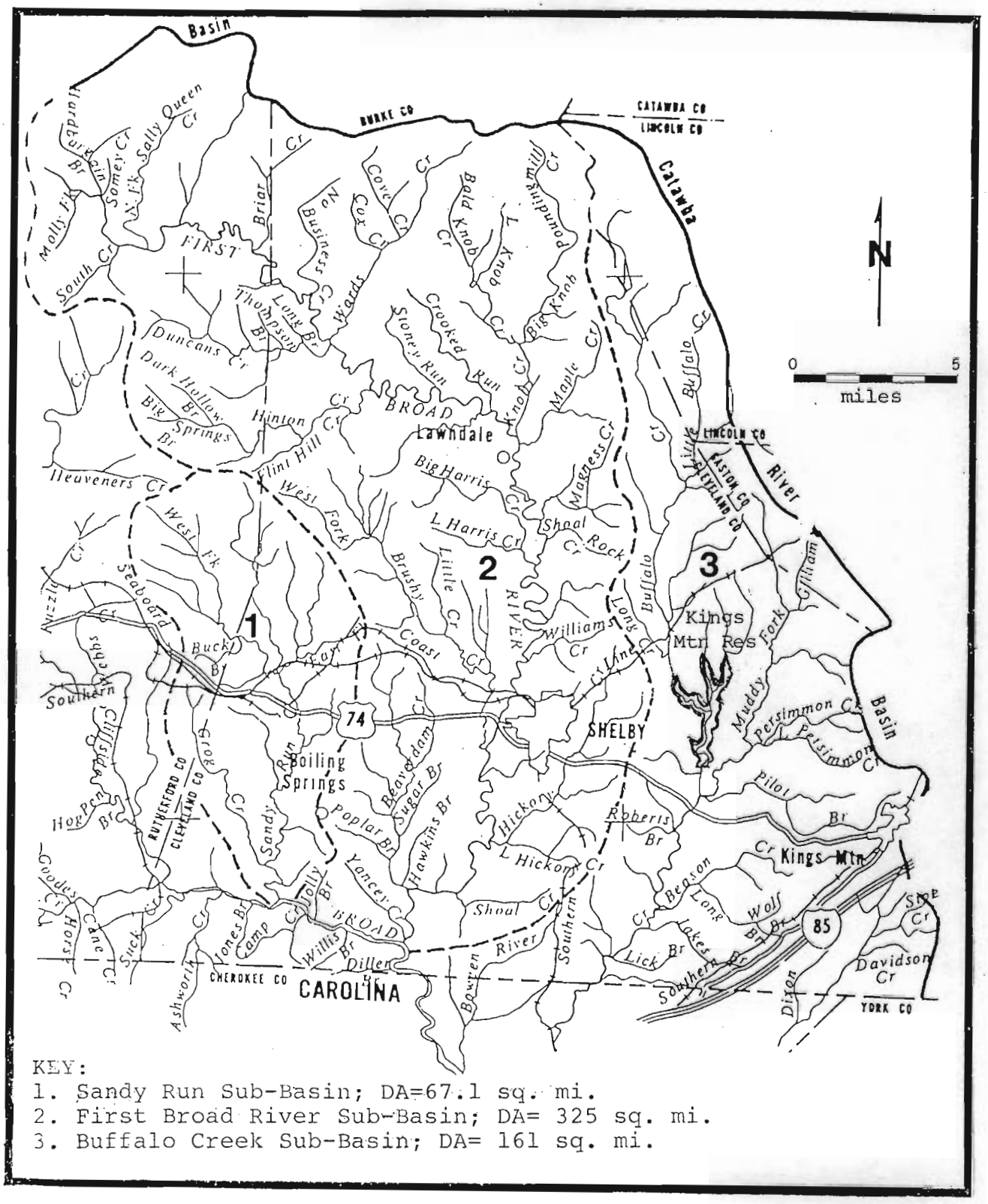

Figure A-1: Rivers and Streams in Cleveland County

Table A-1 Monthly Average Temperatures and Precipitation for Shelby

Month	Temperature degrees F	Precipitation (in)	Precipitation Percent of Annual
January	40.3	3.8	7.9
February	42.4	4.2	8.8
March	49.5	4.8	10.0
April	59.9	4.0	8.3
May	68.2	3.4	7.1
June	75.4	4.3	9.0
July	77.9	5.1	10.6
August	76.9	4.8	10.0
September	70.9	3.8	7.9
October	60.3	2.9	6.0
November	49.5	3.0	6.2
December	40.8	3.9	8.1
Annual	59.3	48.0	100.0
Source: NOAA Climatological Data MC Volume 92			

Table A-2 Municipal and Rural/Suburban Population Distribution in Cleveland County, 1950-1987

Year	Percent of Total County Population	
	Municipal	Rural/Suburban Areas
1950	40	60
1960	44	56
1970	43	57
1980	37	63
1987	38	62

Table A-3 Township and County Population for Cleveland County, 1950-1980

Township		Year				1970-80 % Increase
Name	No.	1950	1960	1970	1980	
River	1	1,022	755	617	678	10
Boiling Springs	2	3,876	3,822	5,193	5,733	11
Rippys	3	3,427	3,415	4,172	7,227	73
Kings Mountain	4	13,467	14,724	14,897	16,368	10
Warlick	5	3,209	3,004	3,547	5,494	54
Shelby	6	23,431	26,024	29,384	31,324	7
Sandy Run	7	3,455	3,090	3,995	5,208	30
Polkville	8	3,594	2,533	2,731	2,677	- 2
Double Shoals	9	5,331	6,071	4,747	5,315	12
Knob Creek	10	1,834	1,428	1,836	1,826	0
Casar	11	1,711	1,162	1,437	1,545	8
Total County		64,357	66,048	72,556	83,435	15

Source: U.S. Census

Table A-4 Populations for Municipalities and Rural/Suburban Areas in Cleveland County, 1950-1987.

Municipality	Year				
	1950	1960	1970	1980	1987[1]
Belwood[2]	--	--	736	613	597
Boiling Springs	1,145	1,311	2,284	2,381	2,382
Casar[3]	--	--	339	346	341
Earl[3]	--	--	195	206	233
Fallston[3]	--	--	301	614	700
Grover	535	538	555	597	642
Kings Mountain	7,206	8,008	8,323	8,430	8,549
Lattimore	286	257	257	237	240
Lawndale	964	723	544	469	659
Mooresboro[2]	--	--	443	405	404
Patterson Springs[2]	--	--	478	731	771
Polkville[2]	--	--	494	528	1,755
Shelby	15,508	17,698	16,328	15,310	15,415
Waco	310	256	245	322	357
Total Municipal	25,954	28,791	31,522	31,189	33,046
Rural/Suburban	38,403	37,257	41,034	52,246	53,244
Total County	64,357	66,048	72,556	83,435	86,290

[1] 1987 population estimated by NC Office of State Budget and Management, October 1988

[2] Incorporated or reactivated between the 1970 and 1980 Census. The 1970 Census estimates were derived by the Bureau of Census.

[3] Incorporated or reactivated between the 1960 and 1970 Census.

(--) No Record

Table A-5 Forecasts of Population in Cleveland County To Year 2020

Year	Population
1987	86,290
1990	87,500
2000	91,500
2010	93,000
2020	95,300

Source: NC Office of State Budget and Management
Division of Water Resources, NCNRCD

Table A-6 Cleveland County Work Force and Employment

	December 1972	December 1986	December 1987
Labor Force	36,730	41,770	41,330
Employment	36,190	39,790	39,780
Unemployment	540	1,980	1,550

Source: NC Employment Security Commission Labor Market Reports

Table A-7 Commuting Patterns for Cleveland County

County/City	1960 Out Commuters	1970 Out Commuters	1980 Out-commuters journey from Cleveland to:	1980 In-commuters journey to Cleveland from:
Burke	NR	NR	334	14
Catawba	NR	NR	815	63
Gaston	NR	NR	3417	1408
Lincoln	NR	NR	228	142
Mecklenburg	NR	NR	448	44
Rutherford	NR	NR	734	1191
Cherokee, SC	NR	NR	461	1297
Spartanburg, SC	NR	NR	230	25
York, SC	NR	NR	137	78
Other	NR	NR	453	367
Total	NR	NR	7257	4629
Net commuting	1175	1211	2628	

NR: No Record

Source: Research and Planning Services, Office of State Budget and Management NC State Data Center Technical Report No. 5, NC Commuting Patterns, Feb., 1985

Table A-8 Summary of Employment by Industrial Category: Non-Agricultural Wage - Salary Employment, by Place of Work in Cleveland County

	1970	Dec. 1972	1975	1980	1985	Dec. 1986	Dec. 1987	June 1988
Manufacturing	14,960	17,280	14,920	15,550	13,800	14,510	14,850	15,400
Non Manufacturing	12,060	13,580	13,780	16,600	18,040	19,770	18,640	19,060
Construction	NR	1,170	NR	NR	NR	1,240	1,540	1,590
T.C.P.U. (a)	NR	700	NR	NR	NR	750	810	800
Trade	NR	4,650	NR	NR	NR	7,280	7,150	6,710
F.I.R.E. (b)	NR	660	NR	NR	NR	750	710	710
Services (c)	NR	2,880	NR	NR	NR	4,930	3,850	5,100
Government	NR	2,730	NR	NR	NR	3,950	3,740	3,300
Other	NR	790	NR	NR	NR	870	840	850
Total	27,020	30,860	28,700	32,150	31,840	34,280	33,490	34,460

Notes:
(a) Transportation, communication, and public utilities
(b) Finance, insurance, and real estate
(c) Also includes entertainment and recreation

NR: No Record

Sources: Office of State Budget and Management, Research and Planning Services:
"Profile, NC Counties" 1981, 1985, 1987
NC State Employment Security Commission Bulletins

Table A-9 Systems Data For Public Water Supplies in Cleveland County 1987
(See Figure III-1 for locations)

	Boiling Springs	Fallston Water Association	Grover	Kings Mountain	Lawndale	Midpines Community Water System	Shelby	Upper Cleveland County Sanitary District
Map Key	1	2	3	4	5	6	7	8
Population Served	2442	608	660	9700	600	450	20000	6867
Service Connections	790	185	--	--	--	126	--	--
Metered Connections	766	185	280	3397	250	126	8647	--
Water Use MGD								
Treated/Pumped	0.217	0.035	0.106	6.00	0.037	0.025	5.93	0.445
Bought	--	--	--	--	--	--	--	--
Total	--	--	--	--	--	--	--	--
Maximum/Peak	0.309	--	0.231	8.35	--	--	9.81	0.851
Industrial	--	--	--	3.91	--	--	2.44	--
Water Source								
Stream	--	--	--	Buffalo Creek (J.H. Moss Lake)	--	--	First Broad River	First Broad River
Wells (Number)	4	2	4	--	2	3	--	--
Other	--	--	Kings Mtn	--	UCCSD(a)	--	--	--
Allowable Draft (MGD)				20		--	30	19.4
Raw Water Pumping Capacity (MGD)				8			12(b)	2.02
Treatment Capacity (MGD)	--	--	--	8	--	--	10	2.25
Percent of Water Distributed To:								
Residential	100	100	66	40.5(c)	--	100	59	97.2
Commercial	--	--	8	--	--	--	--	2.8
Industrial	--	--	13	48.9	--	--	41	--
Institutional	--	--	13	--	--	--	--	--
Other Systems	--	--	--	10.6	--	--	--	--
Per Capita Demand (GPCD)	89	58	161	619	62	56	297	65

Notes:

(a) UCCSD - Upper Cleveland County Sanitary District.

(b) Reference: Letter from Shelby 10-7-88

(c) Estimated combined residential, commercial, institutional.

Table A-10 Acres Irrigated in 1980 and 1986, Cleveland County

Year	Crop							
	Corn	Pasture	Small Fruits	Soybeans	Sweet Potatoes	Tree Fruits	Vegetables	TOTAL
1980	200	--	26	100	4	260	185	775
1986	17	10	81.5	--	2	166	78	354.5

Sources: 1980 North Carolina irrigation survey, R. Sneed, NCSU
1986 North Carolina Division of Water Resources agricultural water use survey

Table A-11 Cleveland County Irrigation/Precipitation - 1986

Month	Water Applied MG	Percent Of Total	*Precipitation (In) Shelby NNE	
			In	Departure From Normal
Jan	0	0	M. 3.93	NR
Feb	0	0	7.07	3.04
Mar	0.5	0.3	4.06	-1.30
Apr	16.4	8.4	1.99	-1.87
May	26.8	13.8	0.73	-3.39
Jun	56.2	28.9	3.54	-0.97
Jul	54.5	28.0	0.40	-3.95
Aug	38.9	20.0	1.95	-2.62
Sep	1.2	0.6	NR	NR
Oct	0.1	Trace	M. 0.10	NR
Nov	0	0	4.12	0.97
Dec	0	0	M. 2.75	NR
Totals	194.6	100.0	30.64	-10.09**

M Insufficient or partial data.

NR No record.

** Four months of rainfall record are missing. Individual months for which there are records shows trends.

Source: NOAA Climatological Data MC Volume 92.

Table A-12 Streamflow Characteristics Of Continuous Record USGS Gage Stations
(See Figure IV-3 for locations)

Map Key	Station Number	Station Name	Drainage Area	Average Flow		Yield/Square Mile		7 Day, 10 Year Low Flow		Period Of Record
				CFS	MGD	CFS	MGD	CFS	MGD	
1	02151500	Broad River	875.0	1505	973	1.72	1.11	--	--	10-25 to 9-87
			--	--	--	--	--	339.81	219.62	10-25 to 9-78
2	02152100	First Broad River Near Casar	60.5	93.2	60.2	1.54	1.00	--	--	10-59 to 9-87
			--	--	--	--	--	23.73	15.34	10-59 to 9-78
3	02152500	First Broad River Near Lawndale	200.0	279	180.3	1.40	0.90	52.78	34.11	2-40 to 9-68
4	02152610	Sugar Branch Near Boiling Springs	1.42	2.07	1.34	1.46	0.94	--	--	10-68 to 9-87
			--	--	--	--	--	0.31	0.20	10-68 to 9-78
	02143500	Indian Creek Near Laboratory(a)	69.2	89	57.5	1.29	0.83	--	--	8-51 to 9-86

Notes:
(a) In Lincoln County, not shown on Figure IV-3

CFS: Cubic Feet per Second
MGD: Million Galllons per Day

Table A-13 Water Quality for Cleveland County Streams

CLEVELAND COUNTY STREAMS — December 1, 1988

Name of Stream	Description	Class	Index No.	Miles	Major Causes	Rating	Basis	Major Sources	Sub-category
Suck Creek	From source to Buffalo Creek	WS-III	9-53-2.7	5.5	Sed	PS	M	NP	10
Long Creek	From source to Buffalo Creek	WS-III	9-53-3	3.1		ST	E	NP	11,13,14
Whiteoak Creek	From source to John Henry Moss Reservoir, Buffalo Creek	WS-III	9-53-4	0 0		ST	M	NP	11,13,14
Buffalo Creek	From Cleveland County SR 2033 to Lick Branch/NC-74, Cleve. Co.	C	9-53-(5)	8.5 0		PS	E	P,NP	2,11,14,32,63,65
Muddy Fork	From source to Buffalo Cr/nr Oak Grove	C	9-53-6	13.8		PS	E	NP	11,14,32,63,65
Gilliam Creek	From source to Muddy Fork	C	9-53-6-1	1.9		PS	E	NP	11,14,32,63,65
Persimmon Creek	From source to Muddy Fork	C	9-53-6-2	5.1		NE		NP	11,14,32,63,65
Little Persimmon Creek	From source to Persimmon Creek	C	9-53-6-2-1	4.7		NE		NP	11,14,32,63,65
Potts Creek (Pilot Branch)	From source to Muddy Fork	C	9-53-6-3	8.9 0		NE		NP	11,14,32,42
Roberts Branch (Joes Lake)	From source to Dam at Joes Lake	B	9-53-7-(1)	0.7		NE		NP	11,14,32,63,65
Roberts Branch	From Dam at Joes Lake to Buffalo Creek	C	9-53-7-(2)	1.9		NE		NP	11,14,32,63,65
Beason Creek	From source to Buffalo Cr/SR 2252	C	9-53-8	10.2		ST	M	NP	11,14,32
Long Branch	From source to Beason Cr/Battlewood Rd	C	9-53-8-1	5.6		S	M	NP	11,14,32
Wolf Branch	From source to Long Branch	C	9-53-8-1-1	1.3		S	M	NP	11,14,32
Jakes Branch	From source to Buffalo Creek	C	9-53-9	5.3		NE		NP	11,14,32
Buffalo Creek (North Carolina Portion)	From Lick Branch to the last crossing at North Carolina-South Carolina State Line	WS-III	9-53-(10)	0 0 0		PS	M	NP	11
Buffalo Creek	Near Grover/NC-198	WS-III	9-53-(10)a	0.5	Cu Pb	PS	M	P	01,03
Buffalo Creek	NC-198/Cleveland County	WS-III	9-53-(10)b	0.4	Cu Pb Sed Fecal	PS	M	NP	11,14,32,63,65
Lick Branch	From source to Buffalo Creek	C	9-53-11	0					
Lick Branch	SR-2229/Cleveland County	C	9-53-11a	0.9	Sed	NS	M	P	1
Lick Branch	SR-2227/Cleveland County	C	9-53-11b	2.3		PS	M	NP	11
UT Lick Branch	Below Minette Mills, Cleveland County	C	9-53-11c	0.5		NS	M	NP	11
Kings Creek	From source to North Carolina-South Carolina State Line	C	9-54	5.3 0	Sed	NS	M	NP	
Sipe Creek (City Lake)	From source to Dam at Kings Mountain's City Lake	WS-III	9-54-1-(1)	2.3 0		NE NE			
Sipe Creek	From Dam at Kings Mountain's City Lake to Kings Creek	C	9-54-1-(2)	0.6 0		NE			
Unnamed Tributary at Lake Montonia (Lake Montonia)	From source to Dam at Lake Montonia	B	9-54-1-3-(1)	0.9 0 0		NE			
Unnamed Tributary at Lake Montonia	From Dam at Lake Montonia to City Lake, Sipe Creek	C	9-54-1-3-(2)	1.2 3		NE			
Davidson Creek (Davidson Lake)	From source to Dam at Davidson Lake	WS-III	9-54-2-(1)	1.6 0		NE		NP	14,51,32
Davidson Creek	From Dam at Davidson Lake to Kings Creek	C	9-54-2-(2)	0.7 0		NE		NP	14,51,32
Dixon Branch	From source to North Carolina-South Carolina State Line	C	9-54-3	4 0		ST	M		
Clark Fork	From source to North Carolina-South Carolina State Line	WS-III	9-54-4	1.3 0		NE			

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Table A-13 Water Quality for Cleveland County Streams (continued)

CLEVELAND COUNTY STREAMS — December 1, 1988

Name of Stream	Description	Class	Index No.	Miles	Major Causes	Rating	Basis	Major Sources: Major	Major Sources: Sub-category
BROAD RIVER *	From Green River to North Carolina-South Carolina State Line	WS-III	9-(28)			PS	M	NP	11
BROAD RIVER	Near Cliffside, N.C./Hwy 221A	WS-III	9-(28)a	0 26.7		PS ST	M M	NP	11
Suck Creek	From North Carolina-South Carolina State Line to Broad River	WS-III	9-42	4.2 0		S	E		
Lake Houser	Entire lake and connecting stream to Broad River	C	9-43	1.4 0		NE			
Ashworth Creek	From North Carolina-South Carolina State Line to Broad River	WS-III	9-44	3.9	Sed	S	E	NP	11
Jones Branch	From source to Broad River	WS-III	9-45	1.8		PS	E	NP	11
East Fork Sandy Run Creek	From source to Sandy Run Creek	C	9-46-3	3.8		PS	E	NP	11,13,14,32
Church Branch	From source to Sandy Run Creek	C	9-46-4	2		PS	E	NP	11,13,14,32
UT Sandy Run Creek	From source to Sandy Run Creek	C	9-46-4.5	1.5		PS	M	P,NP	3,11,13,14,32
Grog Creek	From source to Sandy Run Creek	C	9-46-5	8.1	Sed	S	E	NP	11,13,14,32
Camp Creek	From source to Broad River	WS-III	9-47	2.7		PS	E	NP	11
Jolly Branch	From source to Broad River	WS-III	9-48	2		PS	E	NP	11
Willis Branch	From source to Broad River	WS-III	9-49	1.5		PS	E	NP	11
Mountain Creek	From source to First Broad River	C	9-50-9	1.6		ST	E		
Parker Branch	From source to First Broad River	C	9-50-10	0.7		ST	E		
First Broad River	From Cleveland County SR 1530 to Knob Creek/nr Casar, SR-1530	WS-III	9-50-(11)	17.5 0		S	M	NP	21,23
Wards Creek	From source to First Broad River	C	9-50-12	9.7	Sed	S	E	NP	11
Tims Creek	From source to Wards Creek	C	9-50-12-1	2.4		PS	E	NP	11
Cove Creek	From source to Wards Creek	C Tr	9-50-12-2	3.7		PS	E	NP	11
Cox Creek	From source to Wards Creek	C	9-50-12-3	3.2		PS	E	NP	11
No Business Creek	From source to Wards Creek	C	9-50-12-4	3.7		S	E		
Thompson Branch	From source to Duncans Creek	C	9-50-13-3	1.5		ST	E		
Long Branch	From source to Duncans Creek	C	9-50-13-4	1.4		ST	E		
Big Branch	From source to First Broad River	C	9-50-14	1		ST	E		
Hinton Creek	From source to First Broad River	C	9-50-15	13.3	Sed	S	E	NP	11
Green Branch	From source to Hinton Creek	C	9-50-15-1	3		PS	E	NP	11
Taylor Branch	From source to Hinton Creek	C	9-50-15-2	2.1		PS	E	NP	11
Big Springs Branch	From source to Hinton Creek	C	9-50-15-3	1.5		PS	E	NP	11
Dark Hollow Branch	From source to Hinton Creek	C	9-50-15-4	1.8		PS	E	NP	11
Flint Hill Creek	From source to Hinton Creek	C	9-50-15-5	1.6		PS	E	NP	11
Stoney Run Creek	From source to First Broad River	C	9-50-16	3.8		S	E	NP	11,14
Grassy Branch	From source to First Broad River	C	9-50-17	5.6		S	E		
Crooked Run Creek	From source to First Broad River	C	9-50-18	6.5	Sed	S	E	NP	11,14
First Broad River	From Knob Creek to Cleveland Mills Company Hydroelectric Dam	C	9-50-(18.5)	0 0		S	M		
Knob Creek (Big Knob Creek)	From source to First Broad River	C	9-50-19	13.5 0	Sed	S	E	NP	11,14,18
Poundingmill Creek	From source to Knob Creek	C	9-50-19-1	3.5		S	E		
Adams Branch	From source to Knob Creek	C	9-50-19-2	2.4		PS	E	NP	11
Little Knob Creek	From source to Knob Creek	C	9-50-19-3	6.8	Sed	S	E	NP	11
Bald Knob Creek	From source to Little Knob Creek	C	9-50-19-3-1	3.5		S	E	NP	11,14,21
Maple Creek	From source to First Broad River	C	9-50-20	4	Sed	S	E	NP	11,13,18

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Table A-13 Water Quality for Cleveland County Streams (continued)

CLEVELAND COUNTY STREAMS — December 1, 1988

Name of Stream	Description	Class	Index No.	Miles	Major Causes	Rating	Basis	Major Sources	Sub-category
Bracketts Creek	From source to First Broad River	C	9-50-21	0.4		S	E		
First Broad River	From Cleveland Mills Company Hydro-electric Dam to Shelby Downstream Raw Water Intake	WS-III	9-50-(22)	0					
First Broad River	From Clev. Mls Dam to Williams Cr	WS-III	9-50-(22)a	0 2		S	M		
First Broad River	From Williams Cr to Shelby Int.	WS-III	9-50-(22)b	9.9		PS	M	NP	11
Magness Creek	From source to First Broad River	WS-III	9-50-23	5.1		S	E		
Shoal Rock Creek	From source to First Broad River	WS-III	9-50-24	2.2		S	E		
Big Harris Creek	From source to First Broad River	WS-III	9-50-25	6.6		S	E	NP	11,14,32
Little Harris Creek	From source to Big Harris Creek	WS-III	9-50-25-1	3.5	Sed	S	E		
Williams Creek	From source to First Broad River	WS-III	9-50-26	3.2		S	E	NP	11,14,32
Unnamed Tributary between Shelby Raw Water Intakes (North Club Lake)	From source to First Broad River	C	9-50-27	1.8 0		S	E		
First Broad River	From Shelby Downstream Raw Water Intake to Broad River/nr Earl	C	9-50-(28)	0 13.6 0	Fecal	ST	M	P,NP	03,11
Brushy Creek	From source to First Broad R/US-74	C	9-50-29	15		PS	M	NP	11
East Fork Brushy Creek	From source to Brushy Creek	C	9-50-29-1	1.6		S	E	NP	11,14,42
West Fork Brushy Creek	From source to Brushy Creek	C	9-50-29-2	4.4		S	E	NP	11,14,42
Flag Branch	From source to Brushy Creek	C	9-50-29-3	1.6		S	E	NP	11,14,42
Little Creek	From source to Brushy Creek	C	9-50-29-4	3.5		S	E	NP	11,14,42
Hickory Creek	From source to First Broad River	C	9-50-30	9.8	Tox	PS	M	P,NP	3,40,11,14,32
Beams Lake	Entire lake and connecting stream to Hickory Creek	C	9-50-30-1	0.7 0		ST	E	NP	11,14,32
Little Hickory Creek	From source to Hickory Creek	C	9-50-30-2	2.3		ST	E	NP	11,14,32
Sulphur Springs Branch (Little Hickory Creek)	From source to Hickory Creek	C	9-50-30-3	3.7		ST	E	NP	11,14,32
Logan Branch	From source to Sulphur Springs Branch	C	9-50-30-3-1	0 2.2		ST	E	NP	11,14,32
Shoal Creek	From source to First Broad River	C	9-50-31	3.5		ST	E		
Bear Creek	From source to Shoal Creek	C	9-50-31-1	1		ST	E		
Beaverdam Creek	From source to First Broad River	C	9-50-32	10.9		S	E	NP	11,14,18,32
Overflow Branch	From source to Beaverdam Creek	C	9-50-32-1	1		NE		NP	11,14,18,32
Swainsville Creek	From source to Beaverdam Creek	C	9-50-32-2	2.8		S	E	NP	11,14,18,32
Sugar Branch	From source to Beavrdm Cr/nr Boiling Spg	C	9-50-32-3	2.7	Fecal	NS	M	NP	11,14,18,32
Poplar Branch	From source to Beaverdam Creek	C	9-50-32-4	2.9		S	E	NP	11,14,18,32
Hawkins Branch	From source to Beaverdam Creek	C	9-50-32-5	2.3		S	E	NP	11,14,18,32
Yancey Branch	From source to Broad River	C	9-50-33	3.7		S	E		
Diller Branch	From source to Broad River	WS-III	9-51	1.1		S	E	NP	11
Bowen River	From source to North Carolina-South Carolina State Line	C	9-52	7.6		ST	M		
Wylies Creek	From source to North Carolina-South Carolina State Line	WS-III	9-52-1	1.3 0		NE			
Buffalo Creek (Kings Mountain Reservoir)	From source to Cleveland County SR 2033	WS-III	9-53-(1)	27.4 0		NE		NP	11,13,14
Little Creek	From source to Buffalo Creek	WS-III	9-53-1.3	4.4		ST	E	NP	11,13,14
Glenn Creek	From source to Little Creek	WS-III	9-53-1.3-1	4.3		ST	E	NP	11,13,14
Little Buffalo Creek	From source to Buffalo Creek	WS-III	9-53-2	6.3		S	E	NP	11,13,14
Long Branch	From source to Buffalo Creek	WS-III	9-53-2.3	3		S	E	NP	11,13,14

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KEY FOR TABLE A-13

Stream Classifications

WS III	Water is suitable for water supply and all Class C usages, close scrutiny and contorl of toxicants.
B	Water is suitable for outdoor bathing, boating, and wading, and all Class C uses.
C	Water is suitable secondary recreation such as fish and wildlife propagation; also suitable for boating, and wading.
C Tr	Water is classified as a C trout stream. Sutiable for natural trout propagation and maintenance of stocked trout.

Causes

Sed	Sediment
Fecal	Fecal coliform bacteria
Tox	Effluent toxicity
Cu	Copper
Pb	Lead

Rating: How well a stream or water body supports its designated use, drinking supply, swimming, secondary recreation, etc.

S	Stream is able to support its designated uses.
ST	Support Threatened; some tendency for degradation to occur that is threatening the water body's ability to maintain a use.
PS	Partial support; waterbody supports only a part of its designated uses such as fishing but not drinking water supply.
NS	Nonsupport; water body is unable to support most or any of its designated uses.
NE	Not evaluated.

Basis: How a rating was obtained.

M	Monitored; biological or chemical data available for water body in last five years.
E	Evaluated; no available monitoring data; based on DEM (NC Division of Environmental Management) best professional judgement, usually and use or downstream water quality.

KEY FOR TABLE A-13 (continued)

Source: Source of pollution.

P — Point source: facilities which discharge wastewater into streams through a pipe; generally includes municipal wastewater treatment plants and industries.

NP — Nonpoint source; general land-disturbing activities such as urban development and construction, agriculture, silviculture (forestry), septic tanks and mining.

Source sub-categories

01 Industrial wastewater treatment plant (WWTP)

02 Municipal (minor) WWTP

03 Municipal (major) WWTP

10 Agriculture (general)

11 Non-irrigated crop production

13 Specially crop production (e.g. truck farming, orchards)

14 Pasture land

18 Animal holding/management areas.

20 Silviculture

21 Harvesting, reforestation, residue management

23 Road construction/maintenance

30 Construction

32 Land development

Source sub-categories continued

40 Urban runoff (general)

42 Combined sewers (source control)

50 Resource extraction/exploration/development

51 Surface mining

60 Land disposal (runoff/leachate from permitted areas)

63 Landfills

65 On site wastewater systems (septic tanks, etc.)

APPENDIX B

WATER SUPPLY SYSTEMS, NEEDS, AND ALTERNATIVES

Water systems within the county (Figure II-1) are briefly described for present and future water use and water availability. Information on modifying current operational procedures that could save a community from economic distress during droughts is also outlined for consideration. Alternative water supply sources are listed for areas without a water system and for water systems where future needs may exceed existing supply.

The identification and listing of the water supply considerations are for general information and not an endorsement or recommendation by the State. Present and future water use is defined as the average daily amount of water used over a twelve month period.

The following alternative considerations may be applicable to most of the water systems:

Modify operational practices.

- Curtail peaking problems by promoting year round water conservation for all customers.
- Discussions could take place with large water users regarding changing water use patterns. For example, conservation practices could be used where applicable, i.e. recycling of cooling, process water, or wastewater.
- Reduce and maintain unaccounted-for water use to less than 10 percent.
- Develop a Water Shortage Response Plan.

Participate in a regional water system through interconnecting water mains. An economic analysis of the projected benefits and costs of the regional system, based on future demands, would assist in evaluating this alternative.

TOWN OF BOILING SPRINGS

Present Source

The Town of Boiling Springs obtains its water supply from four wells, with a reported system production of 0.22 million gallons per day (MGD). The water is chlorinated before it enters the distribution system.

Present Use

In 1987, the town served a population of 2,442, including 766 metered customers. Water use in 1987 was about 0.22 MGD.

Projected Needs

Boiling Springs well system produced enough water to supply 1987 needs. Future water needs will exceed current supply prior to 1990.

Year	Population Served	Water Use Average Daily (MGD)
1990	2570	0.278
2000	2660	0.299
2010	2730	0.322
2020	2780	0.339

Alternative Considerations

1. Modify operational practices.

2. Investigate area for suitable location of additional well or wells.

3. Interconnect with and purchase water from the Upper Cleveland County Sanitary District (UCCSD). UCCSD distribution lines are within 1.5 miles of the northern edge of the town limit.

4. Interconnect with and purchase water from Shelby or Piedmont Metropolitan Water District (PMWD). The eastern edge of the town limit would be approximately three miles from Shelby, or the water district when proposed water lines are installed.

5. Participate in a regional water system.

TOWN OF FALLSTON

Present Source

Fallston obtains its water supply from two wells. Treatment consists of on-site chlorination and water softening. The reported system production is about 0.101 MGD.

Present Uses

The Fallston water system began business in 1963 and has about ten miles of water lines within the Town of Fallston and the surrounding area. In 1987, it served a population of approximately 608 that includes 185 metered customers. Water use in 1987 was about 0.040 MGD.

Projected Needs

Fallston's current water supply is about equal to their projected 2020 water need.

Year	System Population	Water Use Average Daily (MGD)
1990	730	0.048
2000	825	0.058
2010	900	0.068
2020	950	0.076

Alternative Consideration

Modify operational practices.

TOWN OF GROVER

Present Sources

The Town of Grover obtains its water supply from four wells and has been interconnected to the Kings Mountain system since 1983. The original system was built in the 1930s and upgraded in 1963, 1977, and 1981. The reported well system production is 0.08 MGD. Water purchased in 1987 from Kings Mountain varied and averaged about 20,000 gallons per day (GPD).

Present Uses

In 1987, the town reported that it served a population of 660 including 280 metered customers. Average use was 0.106 MGD in 1987.

Projected Needs

The Town of Grover has an agreement annually renewed with the Kings Mountain Water System to purchase up to 6 million gallons per month. Grover Industries will expand their plant in the spring of 1989 and will require an additional water supply of about 67,000 GPD from the Grover system. Considering the well system supply (0.08 MGD) and purchased water from Kings Mountain (0.20 MGD) for a total of 0.28 MGD, the current supply is greater than the 2020 projected need.

Year	Town Population	Water Use Average Daily (MGD)
1990	760	0.198
2000	810	0.212
2010	850	0.225
2020	900	0.235

Alternative Considerations

1. Modify operational practices.

2. Participate in a regional water system.

KINGS MOUNTAIN WATER SYSTEM

Present Source

Since 1972, the City of Kings Mountain has obtained its raw water supply from the Kings Mountain Reservoir, an impoundment on Buffalo Creek. The drainage area at the dam is approximately 68 square miles. The average inflow to the reservoir is between 40 to 80 MGD and the seven-day minimum flow expected to occur at least once in ten years (7Q10) is estimated to be 5 to 11 MGD. Reservoir analyses indicate the unadjusted safe yield exceeds 20 MGD and may be as high as 46 to 53 MGD.

Present Use

In 1987, the city reported that it served a population of approximately 9,700 including 3,397 metered customers, 110 of which were located in suburban areas. The water treatment plant treated an average of 6 MGD, reaching a maximum daily peak of 8.354 MGD in July. Approximately 59.7 percent of the water produced from January to August, 1987, was sold to large industrial and commercial customers and the Towns of Bessemer City and Grover as shown in Table B-1.

Projected Needs

The available water supply from the Kings Mountain Reservoir exceeds the projected 2020 water need for the Kings Mountain system.

Year	Population Served (a)	Water Use Average Daily (MGD)
		(a) + (b) = (c)
1990	9970	2.47 + 3.67 = 6.14
2000	10800	2.69 + 4.11 = 6.80
2010	11700	2.91 + 4.68 = 7.59
2020	12600	3.14 + 5.76 = 8.90

(a) Kings Mountain only

(b) Water needs for Grover, Bessemer City and industries.

Alternative Considerations

1. Modify operational practices.

2. Investigate to determine the adjusted maximum allowable withdrawal for water supply from Kings Mountain Reservoir.

3. Participation in a regional water system.

MIDPINES COMMUNITY WATER SYSTEM

Present Source

The system has been in operation since 1965 and obtains its water supply from three wells, one of which is held in reserve. The well system production is about 0.049 MGD.

Present Use

In 1987, the system served a population of approximately 450 including 126 metered residential customers delivering an average of between 0.025 and 0.030 MGD.

Projected Needs

The current water supply is about equal to the 2020 projected water need.

Year	Population Served	Water Use Average Daily (MGD)
1990	470	0.031
2000	510	0.036
2010	540	0.041
2020	565	0.045

Alternative Considerations

1. Modify operation procedures.

2. Participate in a regional water system.

CITY OF SHELBY

Present Source

The City of Shelby withdraws raw water supply an intake on the First Broad River. The city's water supply intake is located approximately one mile upstream of the US 74 bridge crossing. The drainage area at the intake is approximately 225 square miles and average flow is about 204 MGD. The 7Q10 minimum flow is estimated to be 38.5 MGD. Three small off stream raw water storage reservoirs with a total capacity of about 19 million gallons provide the flexibility of operating for two days without withdrawing water from the river. United States Geological Survey streamflow data indicates an unadjusted draft rate of about 30 MGD for water supply from the First Broad River at Shelby's intake.

The City of Shelby operates a Class A water treatment plant, which was originally built in 1949 and upgraded in 1960. In 1974, high rate filters were installed to increase plant capacity. The treatment facility has a finished water and pumping capacity of 10.5 MGD.

Present Use

In 1987, the city reported that it served an estimated population of approximately 20,000 including 8,647 metered customers, 1,935 of which were located in suburban areas. The plant treated an average of 5.93 MGD, reaching a maximum daily peak of 9.809 MGD in July. Approximately 45 percent of the water produced was sold to large industrial and commercial customers as listed in Table B-2.

Projected Needs

The available water supply from the First Broad River for Shelby appears to exceed their projected 2020 water need.

Year	Population Served	Water Use Average Daily (MGD)
1990	21000	7.26
2000	22575	7.93
2010	24300	9.58
2020	26150	11.38

Alternative Considerations

1. Modify operational practices.

2. Investigate to determine the adjusted draft and feasibility for expanding the run-of-the-river water supply from the First Broad River.

3. Participate in a regional water system.

PIEDMONT METROPOLITAN WATER DISTRICT

Present Source

The creation of the Piedmont Metropolitan Water District (PMWD) was approved in May 1988 by the North Carolina Department of Human Resources in order to provide potable water to an area in the southern part of the county. A water supply for the district has not been selected.

Present Use

Water use in the District was not known for 1987.

Projected Needs

Projected population and industrial water needs for the district, including Earl and Patterson Springs, are:

Year	Population Served	Domestic Use (MGD)	Industrial Use (MGD)	Water Use Average Daily (MGD)
1990	6300	0.403	0.100	0.503
2000	9900	0.693	0.300	0.993
2010	11700	0.878	0.500	1.378
2020	15900	1.272	0.600	1.872

Alternative Considerations

1. Interconnect with and purchase water from the Kings Mountain system. A Kings Mountain water main extends to the Town of Grover within the District.

2. Interconnect with and purchase water from Shelby. The northern edge of the district's proposed distribution system is in close proximity to Shelby's distribution system.

3. Participate in a regional water system.

TOWN OF EARL

Present Source

The Town of Earl residents obtain their water from individual wells.

Present Use

The population of the town in 1986 was about 230; water use was unknown.

Projected Needs

The town plans to be served in the future by the Piedmont Metropolitan Water District.

Year	Town Population	Water Use Average Daily (MGD)
1990	245	0.015
2000	280	0.018
2010	310	0.022
2020	325	0.024

Alternative Consideration

Participate in a regional water system.

TOWN OF PATTERSON SPRINGS

Present Source

The town is served by individual wells and Norfolk Southern Railroad wells.

Present Use

The population of Patterson Springs in 1986 was about 769. Water use was unknown.

Projected Need

The town will be served in the future by the Piedmont Metropolitan Water District. Ability of current supply to meet future water needs is unknown.

Year	Town Population	Water Use Average Daily (MGD)
1990	785	0.048
2000	830	0.055
2010	870	0.063
2020	900	0.071

Alternative Consideration

Participate in a regional water system.

UPPER CLEVELAND COUNTY SANITARY DISTRICT

Present Source

The Upper Cleveland County Sanitary District (UCCSD) obtains its raw water supply from the First Broad River about 20 miles upstream from the Shelby intake. The drainage area at the intake, two miles upstream of Lawndale, is approximately 146 square miles. Based on nearby streamflow records, the average flow at the intake is about 132 MGD and the 7Q10 minimum flow is estimated to be 24.9 MGD. United States Geological Survey streamflow data indicates an unadjusted draft rate of about 19 MGD for water supply from the First Broad River at the intake for UCCSD.

Present Use

A water treatment plant built in 1982 and has a finished water and pumping capacity of 2.55 MGD and operated five hours per day, seven days per week in 1987. Finished water production averaged about 0.445 MGD with some daily peaks of 0.85 MGD for more than 2,490 metered customers. Approximately 97 percent of the water produced was sold to residential customers.

Projected Needs

The available water supply from the First Broad River appears to exceed the projected 2020 water need for the District including Belwood, Casar, Lattimore, Mooresboro, Polkville, and Waco.

Year	Population Served	Water Use* Average Daily (MGD)
1988	8600	0.59
1989	13750	0.89
1990	16800	1.09
2000	17300	1.13
2010	17800	1.67
2020	18300	2.20

* Excludes Lawndale

Alternative Considerations

1. Modify operational practices.

2. Investigate to determine the adjusted draft and feasibility for expanding the run-of-the-river water supply from the First Broad River.

3. Participate in a regional water system.

TOWN OF BELWOOD

Present Source

The Town of Belwood residents either purchased their potable water from the Upper Cleveland County Sanitary District or have individual wells.

Present Use

In 1986, the town population was approximately 601. The town has one industry, Standard Crankshaft, located on NC 18. Water use in 1987 is unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Belwood's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	595	0.036
2000	590	0.038
2010	610	0.043
2020	640	0.049

Alternative Consideration

Continue to participate in a regional system.

TOWN OF CASAR

Present Source

The Town of Casar residents either purchased their potable water from the Upper Cleveland County Sanitary District or have individual wells.

Present Use

The North Carolina Office of State Budget and Management estimated the town's population to be approximately 344 in 1986. Water use in 1987 is unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Casar's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	340	0.020
2000	335	0.022
2010	345	0.024
2020	370	0.028

Alternative Consideration

Continue to participate in a regional system.

TOWN OF LATTIMORE

Present Source

The Town of Lattimore residents either purchased their potable water from the Upper Cleveland County Sanitary District or have individual wells.

Present Use

In 1986, the Town population was approximately 405. Water use in 1987 is unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Lattimore's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	242	0.016
2000	252	0.018
2010	272	0.020
2020	312	0.025

Alternative Consideration

Continue to participate in a regional system.

TOWN OF LAWNDALE

Present Source

The Town of Lawndale obtains its water supply from two wells with a reported production of 0.0864 MGD. The town can also purchase finished water from the Upper Cleveland County Sanitary District through four interconnections, only one of which is metered.

Present Use

In 1987, the town reported that it served a population of approximately 600, including 250 metered customers. Average water use was about 0.037 MGD in 1986.

Projected Needs

Lawndale's water supply available from their well systems and by purchase from the Upper Cleveland Sanitary District will be adequate for their long range needs.

Year	Population Served	Water Use Average Daily (MGD)
1990	720	0.047
2000	800	0.056
2010	870	0.065
2020	925	0.074

Alternative Considerations

1. Modify operational practices.

2. Expand the capacity of the existing well system through site specific studies for the location of strategically placed wells.

3. Participate in a regional water system.

TOWN OF MOORESBORO

Present Source

The Town of Mooresboro residents either purchase their potable water from the Upper Cleveland County Sanitary District or have individual wells.

Present Use

The population of Mooresboro in 1986 was about 405 with water use unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Mooresboro's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	406	0.026
2000	408	0.029
2010	412	0.031
2020	420	0.034

Alternative Consideration

Continue to participate in a regional system.

TOWN OF POLKVILLE

Present Source

The Town of Polkville residents either purchase their potable water from the Upper Cleveland County Sanitary District or have individual wells.

Present Use

The town population was about 631 in 1986, however, due to an extension of town limits in 1988, the population increased to 2,016. Water use date in 1987 is unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Polkville's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	2090	0.136
2000	2260	0.158
2010	2430	0.182
2020	2600	0.208

Alternative Consideration

Continue to participate in a regional system.

TOWN OF WACO

Present Source

The Town of Waco residents either purchase potable water from the CSX Railroad wells system or have individual wells.

Present Use

The town population was about 353 in 1986 and water use is unknown.

Projected Needs

Available water supply from the Upper Cleveland County Sanitary District appears to be adequate for Waco's long range needs.

Year	Town Population	Water Use Average Daily (MGD)
1990	374	0.024
2000	425	0.030
2010	477	0.036
2020	529	0.042

Alternative Considerations

1. The Upper Cleveland County Sanitary District plans to extend water mains to the town in the very near future.

2. Participate in a regional water system.

Table B-1 Monthly Water use of Bessemer City, Grover, and Large Industry Customers on the Kings Mountain System for the Period of January to August 1987

Customer	Values in MGD and Percentages of Total Water Provided by Kings Mountain EWTP Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	YTD Avg
Spectrum	1.518	1.884	1.563	1.902	1.771	1.364	1.440	1.581	1.628
Anvil Knitwear	0.821	0.861	0.846	0.787	0.755	0.740	0.642	0.737	0.774
Commercial Shearing	0.019	0.021	0.026	0.028	0.032	0.036	0.040	0.038	0.03
Cleveland Mills	0.260	0.396	0.390	0.388	0.453	0.431	0.407	0.479	0.401
Mauney Hosiery	0.032	0.036	0.071	0.052	0.050	0.046	0.045	0.050	0.048
Parkdale Mills	0.008	0.008	0.012	0.005	0.013	0.013	0.010	0.014	0.01
DuPont	0.019	0.049 (a)	0.065	0.047	0.056	0.064	0.035	0.060	0.049
Eaton Corp	0.076	0.035 (a)	0.043	0.022	0.023	0.024	0.030	0.026	0.035
Reliance Electric	0.031	0.054	0.045	0.044	0.054	0.062	0.082	0.084	0.057
Total Large Industry (MGD)	2.784	3.344	3.061	3.275	3.207	2.780	2.731	3.069	3.032
Percent of Total Use	47.9	54.3	49.9	55.4	51.4	45.4	44.1	44.1	49.1
Bessemer City	0.549	0.793	0.524	0.654	0.654	0.573	0.448	0.703	0.612
Grover	0.024	0.022	0.008	0.006	0.013	0.080	0.048	0.116	0.04
Total Town Use	0.573	0.815	0.532	0.660	0.667	0.653	0.496	0.819	0.652
Percent of Total Use (MGD)	9.9	13.2	8.7	11.2	10.9	10.7	8.0	11.8	10.6
Total of Large Industry and Towns (MGD)(b)	3.357	4.159	3.593	3.935	3.874	3.433	3.227	3.888	3.684
Percent of Total Use	57.8	67.5	58.6	66.5	63.3	56.1	52.1	55.9	59.7
Total Water Produced (MGD)(c)	5.811	6.164	6.133	5.914	6.119	6.119	6.194	6.954	6.176(d)

Notes:
(a) Estimated Water Use
(b) Excludes Residental Use in Kings Mountain
(c) Total Finished Water Produced at Ellison Water Treatment Plant (EWTP)
(d) 1987 12 Month Average is 6.00 MGD

Table B-2 Average Daily Use For The Largest Non-Residential Customers On The Shelby System, September 1986 - August 1987

	MGD
Pittsburgh Plate Glass (PPG)	1.069
J and C Dyeing	0.665
Shelby Knits (L and K)	0.214
Dicey Mills	0.128
Doran Textiles	0.087
Cleveland Memorial Hospital	0.073
Chase Brass	0.044
Copeland Corporation	0.048
City Park Swimming Pool	0.020
FASCO	0.066
City of Shelby Pump Station and Filter Plant	0.070
Kemet (Union Carbide)	0.043
Esther Mill	0.061
Bost Bakery	0.017
Patterson Florist	0.026
City of Shelby Waste Water Treatment Plant	0.022
Wilson Produce	0.004
Allen White - Holiday Inn	0.015
Container Corporation of America (CCA)	0.013
Shelby Public Schools	0.012
Total	2.697