

REPORT FOR CONSULTATION ON THE
METROPOLITAN CHARLOTTE
INTERSTATE AIR QUALITY CONTROL REGION
(NORTH CAROLINA AND SOUTH CAROLINA)

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

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National Air Pollution Control Administration

May 1970

CONTENTS

Preface	i
Introduction	ii
Evaluation of Urban Factors	1
Geography of the Region	1
Present Distribution of Population and Urbanization Trends	7
Prospective Population and Economic Growth	22
Probable Directions of Urban Growth	27
Evaluation of Technical Factors	30
The Emission Inventory	30
Air Quality Analysis	38
Regional Governmental Organization	46
Proposed Air Quality Control Region	53

PREFACE

The Clean Air Act, as amended, directs the Secretary of Health, Education, and Welfare to designate "air quality control regions" to provide a basis for the adoption of regional air quality standards and the implementation of those standards. The Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities. This report is intended to provide the basic background information needed for the consultation. It proposes boundaries for the Metropolitan Charlotte Interstate Air Quality Control Region and discusses the factors which are the basis of the proposed boundaries.

The Region* boundaries proposed in this report remain subject to revisions suggested during consultation with State and local authorities. Formal designation of the Region will be made only after a careful review of all opinions and suggestions submitted during the consultation process.

The National Air Pollution Control Administration appreciates assistance received from the States of North Carolina and South Carolina, and the local governments and planning agencies in the area.

*For the purposes of this report, the word "region," when capitalized, will refer to the Metropolitan Charlotte Interstate Air Quality Control Region.

INTRODUCTION

THE REGIONAL APPROACH

Air pollution in the urban areas of the United States is a regional problem which frequently extends across governmental boundaries. Since air pollution problems are rarely confined to any single municipality or county, and are often not confined within a single State, successful control requires coordinated planning, standard setting, and enforcement by the several political jurisdictions which share a common problem. To date, State and local governments across the Nation have only begun to develop a regional approach to air pollution control.

The Clean Air Act, as amended, provides a regional approach which depends upon coordination and cooperation among all levels of government--municipal, county, State, and Federal. To set in motion the machinery for regional air pollution control, the Department of Health, Education, and Welfare designates air quality control regions (following consultation with State and local officials), issues air quality criteria, and publishes reports on control techniques. The designation of region boundaries indicates which State and local jurisdictions will be involved in a regional air pollution control effort. The air quality criteria indicate the extent to which various concentrations of air pollutants are harmful to health and damaging to

property. The reports on control techniques provide information on the costs and effectiveness of various techniques for controlling air pollutant emissions.

After the Department of Health, Education, and Welfare completes these initial steps, State governments develop air quality standards and plans for implementation of such standards within the boundaries of designated air quality control regions. An air quality standard for a region defines the desired limit of concentration of a pollutant in the ambient air. It represents the level of air quality which the regional control program will attempt to achieve. An implementation plan is a blueprint of the steps which will be taken to attain chosen regional air quality standards within a reasonable time. The Clean Air Act requires that within 90 days after the Secretary of Health, Education, and Welfare has designated the region, State Governors must submit letters indicating that they intend to set air quality standards for those pollutants for which criteria and control technology documents have been issued. They have an additional 180 days to set the standards. The procedure for setting standards includes a public hearing which allows residents of a region to express their views concerning the proposed standards. The Governors are required to submit to the Secretary, within an additional 180 days, plans for the implementation of the standards which have been adopted.

The Department of Health, Education, and Welfare reviews air quality standards and implementation plans in order to ascertain their consistency with the provisions of the Act.

When air quality standards and implementation plans are approved, States proceed to prevent and control air pollution in accordance with those standards and plans. This system for establishing a regional approach to air pollution control is outlined in Figure 1.

DESIGNATION OF AIR QUALITY CONTROL REGIONS

Designation of an air quality control region is one of the first steps in the regional approach to air pollution control. Section 107 (a) (2) of the Clean Air Act, as amended, directs the Secretary, Department of Health, Education, and Welfare to make such designations. The portions of the section relevant to this discussion state:

"...The Secretary, after consultation with appropriate State and local authorities shall...designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may...revise the designation of such regions...The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Procedure for Designation of Regions

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration (NAPCA) for designating air quality

FIGURE 1 - Flow Diagram for Action to Control Air Pollution
on a Regional Basis, Under the Clean Air Act

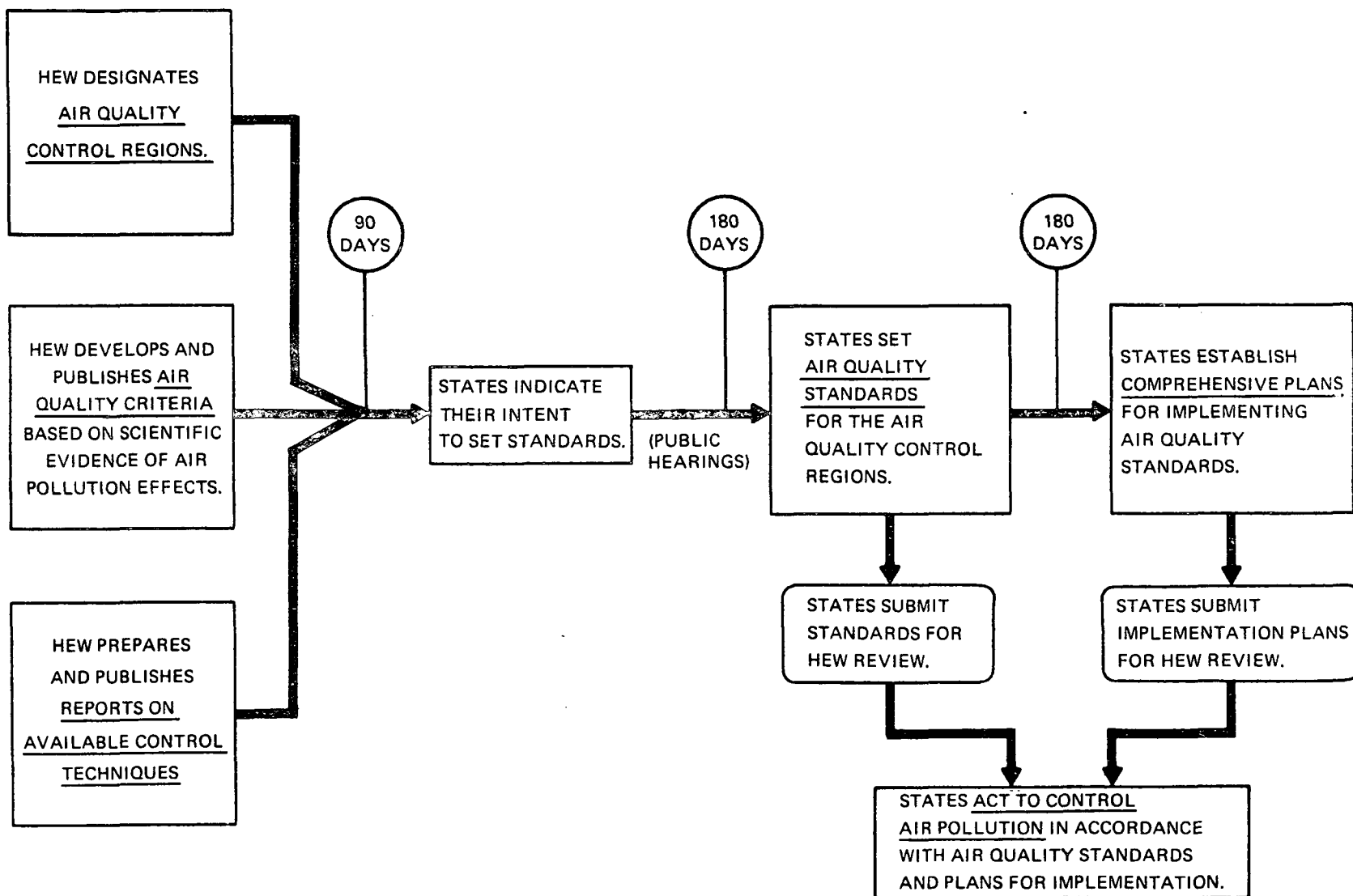
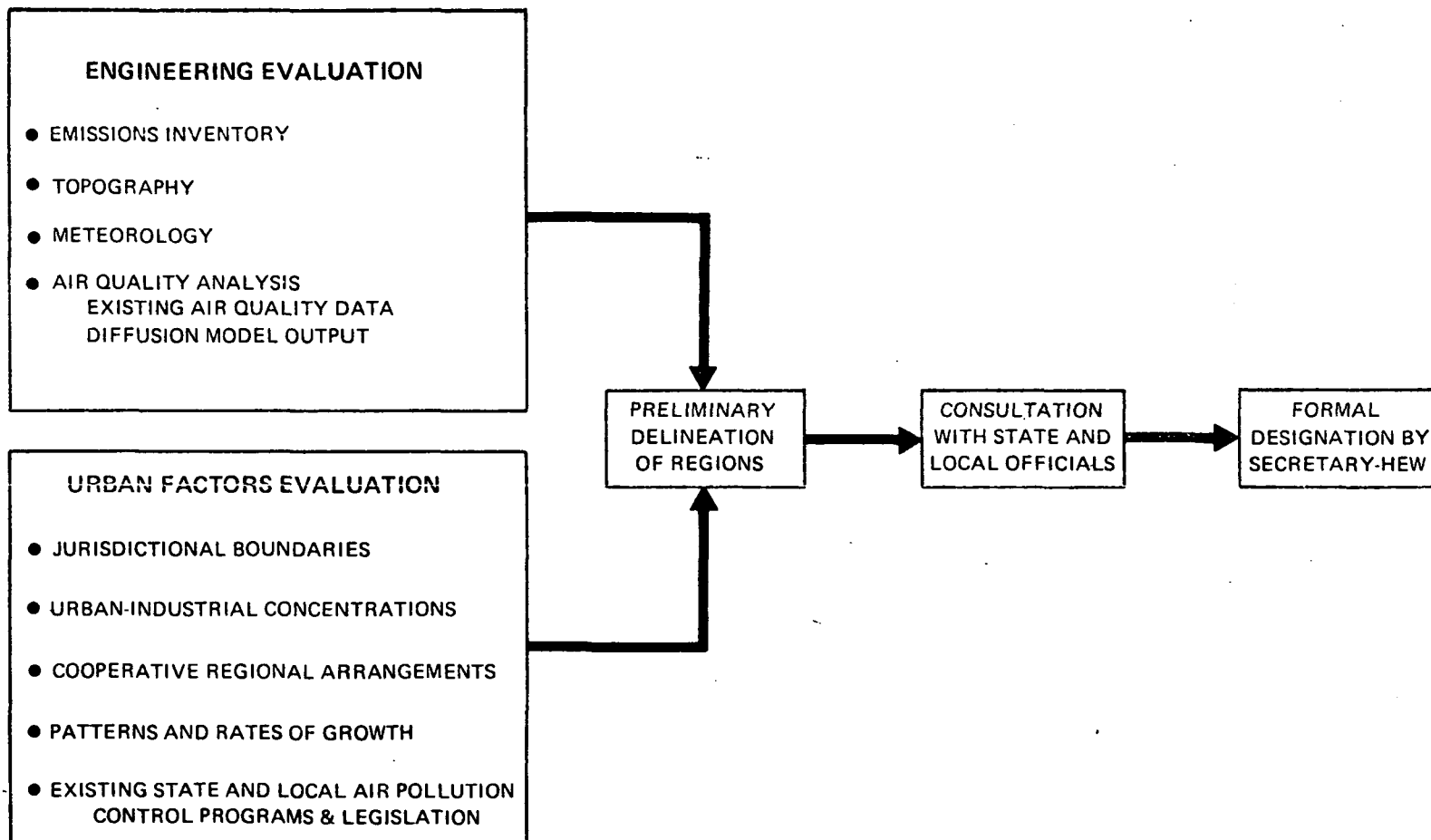


FIGURE 2 - Flow Diagram for the Designation of
Air Quality Control Regions



control regions.

After evaluating relevant technical and urban factors in a region, the National Air Pollution Control Administration publishes a proposed delineation of the boundaries. At the same time, NAPCA sets a time and place for a consultation meeting and distributes to State and local authorities a report of the evaluation study (such as this "Report for Consultation") which includes the boundary proposal. At the consultation meeting State and local authorities are encouraged to present fully their views and suggestions concerning the proposed boundaries of the region. Interested parties who do not have official status may submit comments in written form for the record. After careful review of all suggestions and opinions submitted for the record by interested parties, the Secretary of Health, Education, and Welfare makes a formal designation of the region boundaries and notifies the Governor(s) of the State(s) affected by the designation.

The Size of a Region

As stipulated in Section 107 (a) (2), the designation of air quality control regions should be based on "jurisdictional boundaries, urban-industrial concentrations and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards." This language suggests a number of objectives which are important in determining how

large an air quality control region should be. Basically, these objectives can be divided into three separate categories.

First, a region should be self-contained with respect to air pollution sources and receptors. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative

influence than short term data on episodic conditions. In summary, a region should include most of the important sources in the area as well as most of the people and property affected by those sources.

The second general objective requires that regional boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, regional boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that regional boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Because air pollution usually extends across governmental boundaries, the cooperation of several governmental bodies is required for the solution of a common set of air pollution problems. In this regard, the established patterns of governmental coopera-

tion on a range of urban problems is an important consideration, and the pattern of cooperation among existing air pollution control programs is a particularly relevant factor. In general, administrative considerations would argue against the division of governmental jurisdictions. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

As noted above, the evaluations of relevant technical, urban, and governmental factors form the basis of the boundary proposals published by NAPCA. The technical factors study takes account of the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are identified through an inventory of emissions from power generation, industrial operations, space heating, waste disposal, and other pollution-causing activities. The transport and distribution of pollutants in the ambient air are

analyzed on the basis of measured air quality data, the location of emissions, meteorological data, and topographic information. A mathematical diffusion model which predicts ambient pollution concentrations from information on emissions and meteorology can be used in areas where irregular topographical features would not invalidate the theoretical model. As a whole, the technical factors study indicates how large the air quality control region should be in order to encompass most pollution sources and most people and property affected by those sources.

The study of urban factors takes account of a different set of considerations. It discusses the location of urban and industrial concentrations and expected patterns of urban growth. As a whole, the urban factors study indicates how large a region should be in order to encompass expected regional growth.

The evaluation of the regional governmental organizations discusses the planning agencies, councils of government, and state and local air pollution control programs. This study attempts to define the combination of counties which, through cooperative regional arrangements, would best work together towards achieving clean air in the region.

The body of this report contains a proposal for the boundaries of the Metropolitan Charlotte Interstate Air Quality Control Region, based on the evaluation of technical, urban, and governmental factors. The report is intended to serve as the

background document for the Consultation between the National
Air Pollution Control Administration and the appropriate State
and local authorities.

EVALUATION OF URBAN FACTORS

Factors of major importance in considering boundaries for an air quality control region are those which have to do with the size, shape, nature, and dynamics of urbanization within the region. It is the concentration of population and work in urban centers that creates many sources of air pollution and exposes large numbers of people and valuable property to their effects.

This discussion will review the geography of the Metropolitan Charlotte area since physical characteristics can affect both the scale and direction of urban growth. The present pattern of population and economic activity will be considered, as well as the probable future pattern.

GEOGRAPHY OF THE REGION

This study of the Metropolitan Charlotte area encompasses fifteen counties in the States of North Carolina and South Carolina: Anson, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, and Union Counties in North Carolina; and Chester, Lancaster, Union, and York Counties in South Carolina (Figure3).

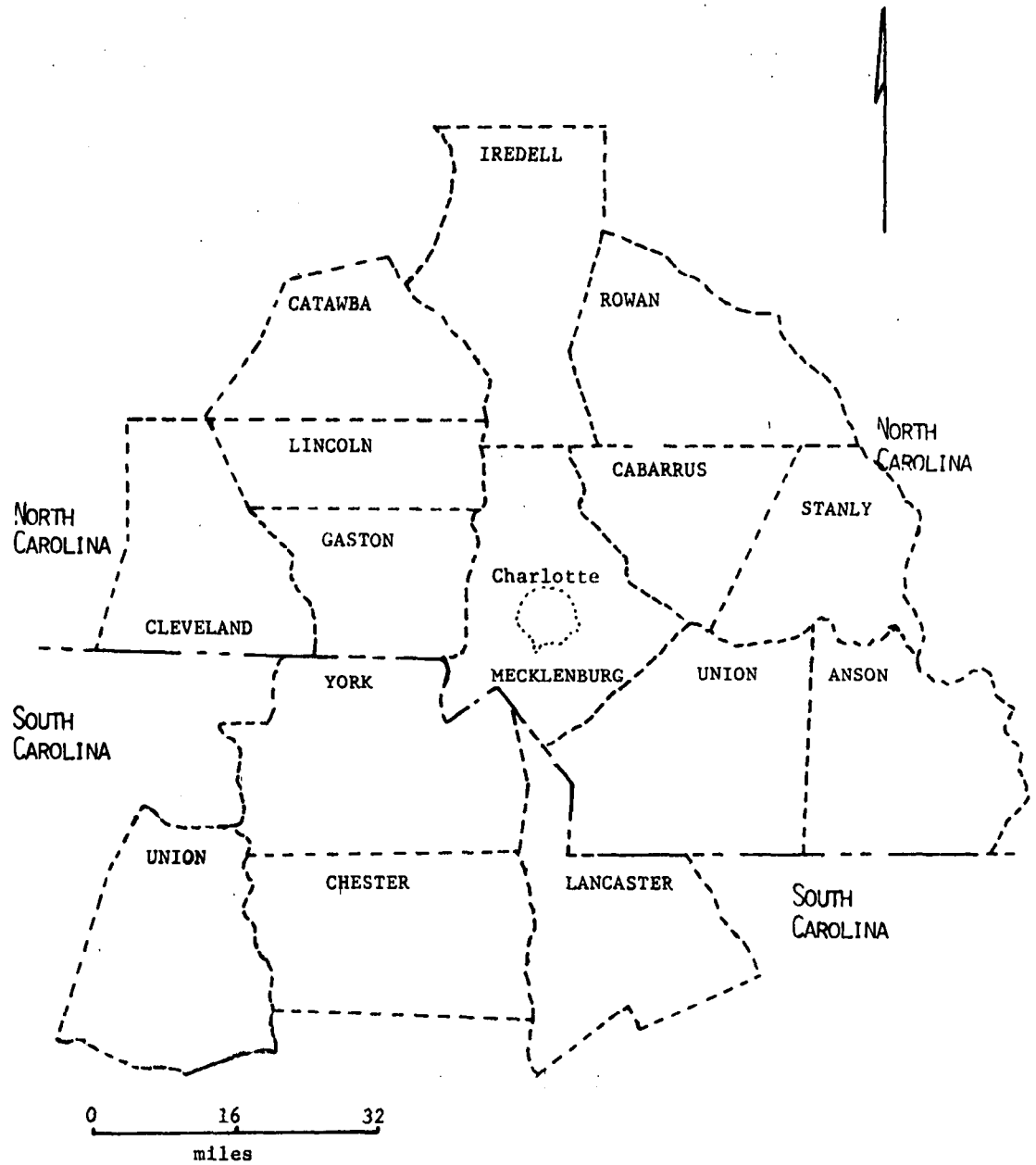


FIGURE 3 - Metropolitan Charlotte Interstate Study Area

The study area is located in the piedmont plateau of North and South Carolina, a distinct geographic region formed by the foothills of the Appalachian Mountains on the west and the "fall line" (line of rapids and falls in rivers) in the east. Average elevations descend from about 900 feet above sea level in the western foothills to about 600 feet in the area east of the City of Charlotte.

Charlotte is in the geographic center of the Piedmont Crescent, an industrial and commercial agglomeration, stretching some 300 miles from Raleigh, North Carolina, on the east, to Greenville, South Carolina, on the west (Figure 4). Charlotte's location in the heart of this region, enhanced by good transportation links along the spine of the Crescent, is responsible for its rank as the largest city in the Carolinas and its importance as a trucking, wholesaling, financial, and administrative center for the Crescent. For a smaller area of perhaps 23 counties within a radius of 40 - 50 miles of the City, Charlotte serves as the major retail and commercial center.

In the early 1800's, development of the Charlotte area was stimulated by the discovery of gold and the subsequent expansion of gold mining in North Carolina. The State was the leading producer of the metal until it was overtaken by California in the years following the Western gold rush of 1849.

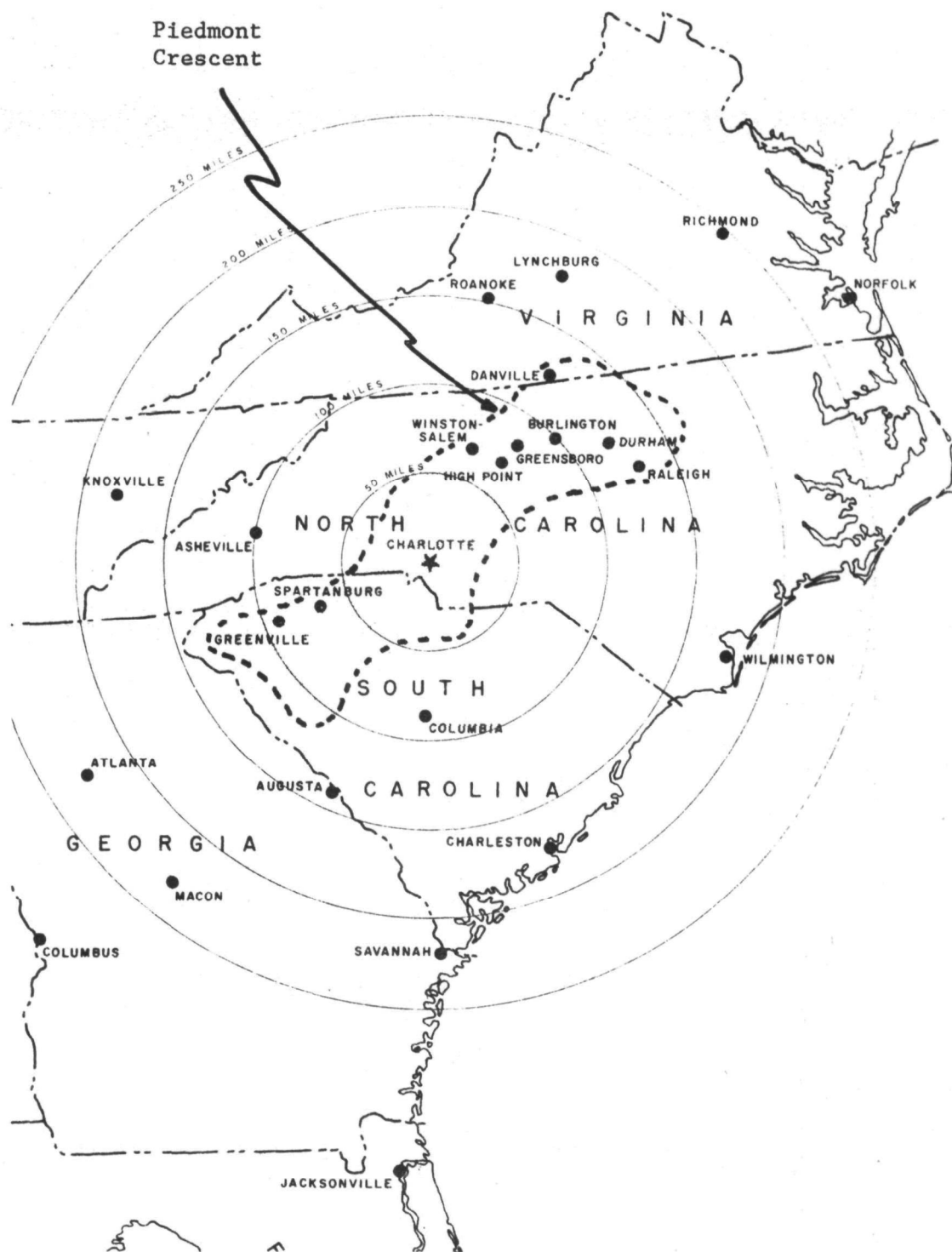


FIGURE 4 - The Piedmont Industrial Crescent

Cotton production was a primary activity of the area in the early nineteenth century, and the cotton textile industry was established by the middle of the century. In more recent times, associated activities such as the production of dyes, chemicals, and textile machinery, as well as textile finishing, wholesaling, sales, and research have been added to the textile manufacturing base of the area. Today, several major textile firms maintain national headquarters in Charlotte. Completion during the 1850's of the first railroad lines in the area, the availability of ample water resources in the Catawba Valley, and the exploitation of rivers for hydroelectric power laid the basis for industrial expansion.

Since World War II, the Charlotte study area has participated in and benefited from the rapid economic growth of the Southeastern United States. Its earlier advantages for industrial location have been substantially augmented by the construction of three major interstate highways through the area. I-85 and I-77 intersect at the City of Charlotte. When completed, these portions of the interstate system will provide direct connections between Charlotte and Greenville, South Carolina; Atlanta, Georgia; Columbia, South Carolina; Greensboro, North Carolina; as well as areas to the north across the Allegheny Mountains. A third east-west interstate highway, I-40, traverses the northern part of the study area (Figure 5).

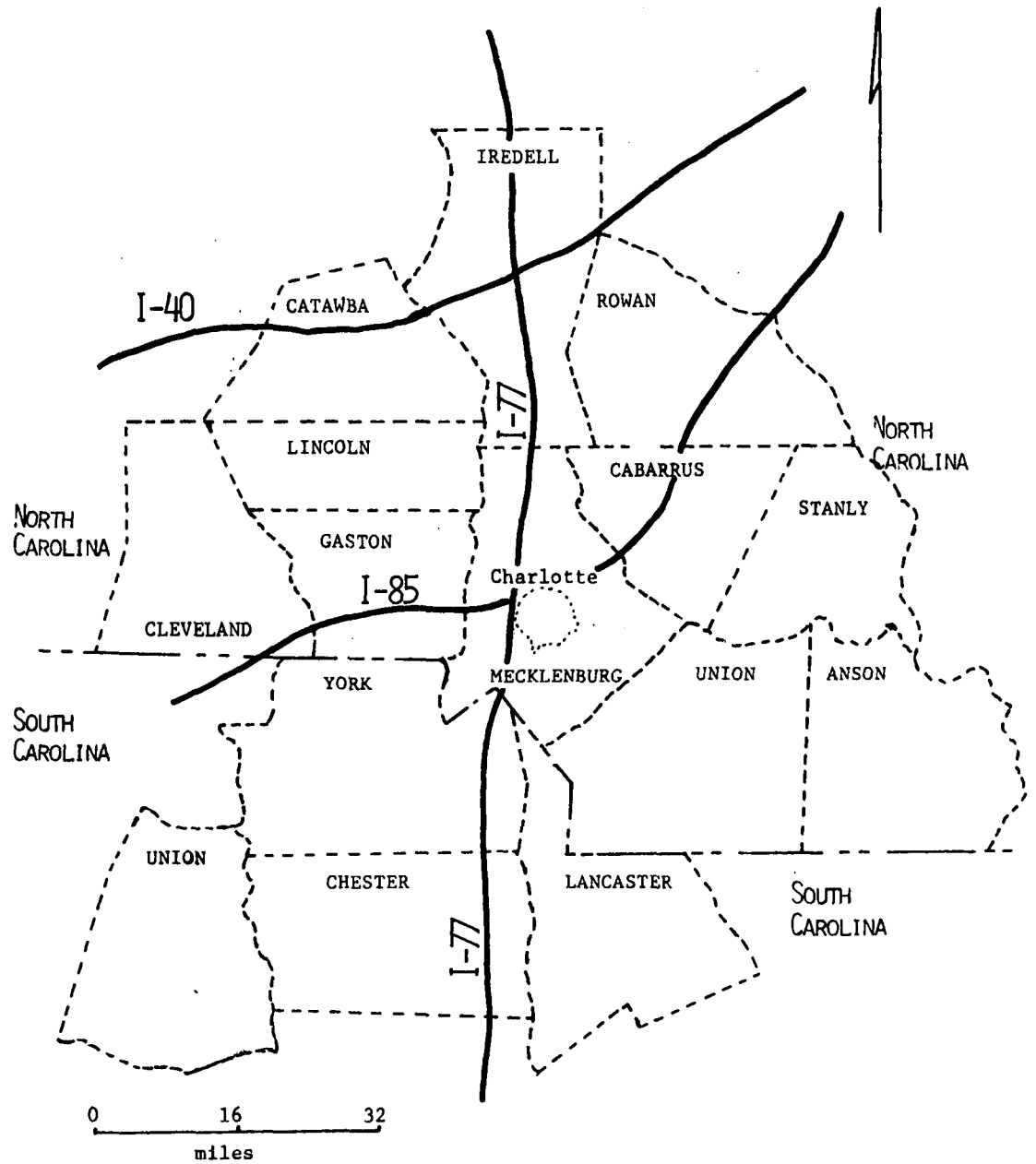


FIGURE 5 - Metropolitan Charlotte Interstate Study Area,
Interstate Highway System

PRESENT DISTRIBUTION OF POPULATION AND URBANIZATION TRENDS

Estimates of 1970 population for each county in the study area are shown in Table I. Mecklenburg County with a population of about 368,000 is by far the largest. Gaston County with about 160,000 people is second. Six counties--Cabarrus, Catawba, Cleveland, Iredell, Rowan, and York--have populations between 75,000 and 95,000. The remaining seven counties range in population between 24,000 and 54,000.

The extent to which the counties in the study area have become or are becoming urbanized can be measured in a number of ways: (1) population growth in the last decade, (2) population density, (3) the proportion of total land in farmland and the reduction in farmland acreage, (4) travel interchange between counties, (5) growth of total employment, and (6) growth of manufacturing employment.

Population change during the last two decades for counties in the study area is shown in Table II. The study area population has increased from about 946,000 in 1950 to 1,071,000 in 1960 and about 1,291,000 in 1970. This change represents an average annual increase of 1.3 percent during the 1950's and 1.9 percent in the 1960's. Some counties have added substantial numbers of people in the last decade while others have not. Large increases occurred in Mecklenburg (an increase of about 96,000) and in Gaston (up

Table IEstimated Population of Metropolitan
Charlotte Study Area Counties, 1970

<u>Counties</u>	<u>Total</u> (thousands)
North Carolina Portion	(1,095)
Anson	24
Cabarrus	77
Catawba	90
Cleveland	75
Gaston	159
Iredell	80
Lincoln	32
Mecklenburg	368
Rowan	93
Stanly	44
Union	53
South Carolina Portion	(196)
Chester	32
Lancaster	45
Union	31
York	88
Study Area Total	(1,291)

Source: Metropolitan Charlotte, a report commissioned by the City of Charlotte, 1964. Union (N.C.), Chester, Lancaster, and Union (S.C.) estimates made by Linton, Miels and Coston, Inc.

Table II

Population Change in the Metropolitan Charlotte
Study Area by County: 1950, 1960, and 1970

	<u>1950^{a/}</u>	<u>1960^{a/}</u>	<u>1970^{b/}</u>	<u>Change 1950-60</u>	<u>Change 1960-70</u>
North Carolina Portion	(772,939)	(891,823)	(1,094,800)	(118,884)	(202,977)
Anson	26,781	24,962	24,000	- 1,819	- 962
Cabarrus	63,783	68,137	76,600	4,354	8,463
Catawba	61,794	73,191	88,900	11,397	15,709
Cleveland	64,357	66,648	75,300	2,291	8,652
Gaston	110,836	127,074	159,400	16,238	32,326
Iredell	56,303	62,526	79,500	6,223	16,974
Lincoln	37,459	28,814	32,200	- 8,645	3,386
Mecklenburg	197,052	272,111	368,000	75,059	95,889
Rowan	75,410	82,817	93,200	7,407	10,383
Stanly	37,130	40,873	44,200	3,743	3,327
Union	42,034	44,670	53,500	2,636	8,830
South Carolina Portion	(172,598)	(179,015)	(196,500)	(6,417)	(17,485)
Chester	32,597	30,888	32,000	- 1,709	1,112
Lancaster	37,071	39,352	44,800	2,281	5,448
Union	31,334	30,015	31,500	- 1,319	1,485
York	71,596	78,760	88,200	7,164	9,440
Study Area Total	(945,537)	(1,070,838)	(1,291,300)	(125,301)	(220,462)

Sources: a/ U. S. Census of Population.

b/ Estimates taken from Metropolitan Charlotte, Hammer and Associates, 1964. Union (N.C.), Chester, Lancaster, and Union (S.C.) estimates made by Linton, Miels and Coston, Inc.

32,300). Substantial growth has taken place in seven others: Iredell up 17,000; Catawba, 16,000; Rowan, 10,000; York, 9,400; Union (N.C.) 8,800; Cleveland, 8,600; and Cabarrus, 8,500.

Anson County has experienced a slight decline in the last two decades and three others--Lincoln, Chester, and Union, South Carolina--reversed small losses in the fifties with small gains in the sixties.

Population density is a good measure of urbanization in the Metropolitan Charlotte study area because the counties are relatively small and of similar size. Estimated population densities for 1970 range from a high in Mecklenburg County of 679 persons per square mile to a low of 45 in Anson County (Figure 6). Counties with densities of over 150 persons per square mile are Mecklenburg, Gaston, Catawba, Cabarrus, Rowan, and Cleveland.

Reductions in farm acreage provide some indication of urbanization. All counties in the study area experienced a decline in land used for farming in the last decade as shown on Table III-A and Table III-B. Between 1960 and 1966, the greatest declines occurred in Gaston, Lancaster, York, Union (S.C.), and Anson Counties. According to the 1964 Census of Agriculture, the proportion of all land in agriculture ranged from a low of 29.6 percent in Union County (S.C.) to a high of 60.5 percent in Union County (N.C.). Counties with a relatively low proportion of agricultural land, in addition to Union (S.C.) were Mecklenburg, Lancaster, Gaston, Catawba, and York.

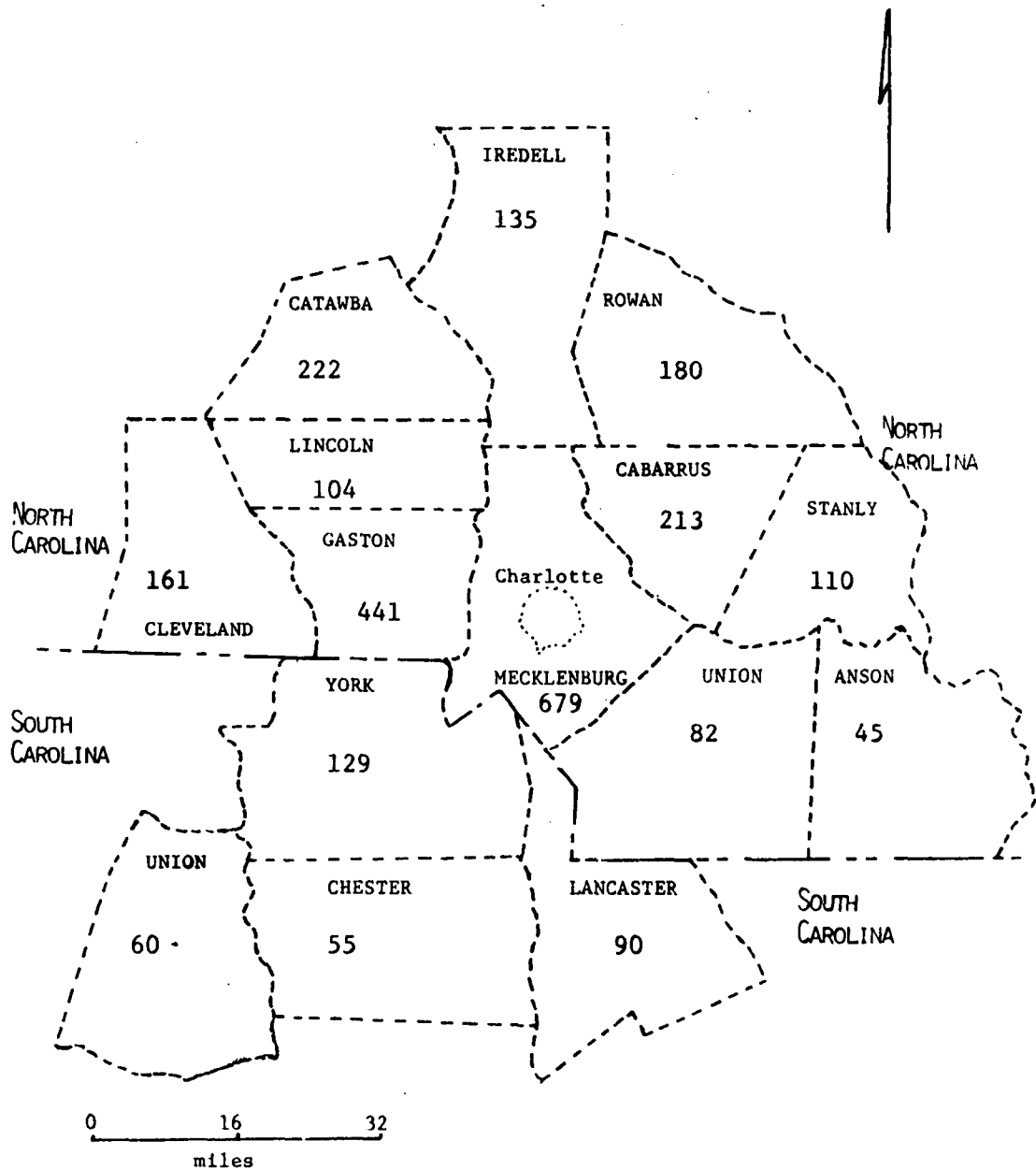


FIGURE 6 - Estimated Population Per Square Mile of Metropolitan Charlotte Study Area Counties, 1970

Table III-A

Farmland in the North Carolina Portion
of the Metropolitan Charlotte Study Area

12

<u>Counties</u>	<u>Farmland</u> <u>1960 a/</u> (sq. miles)	<u>Farmland</u> <u>1966 a/</u> (sq. miles)	<u>Decrease</u> <u>1960-66</u> (sq. miles)	<u>Farmland</u> <u>1964 b/</u> (000 acres)	<u>Percentage of</u> <u>Total Land in</u> <u>Farms, 1964</u>
Total Farmland	(3,773)	(3,521)	(-252)	(1,639)	
Anson	396	354	-42	166	48.6
Cabarrus	308	283	-25	134	58.1
Catawba	333	301	-32	110	42.2
Cleveland	414	397	-17	158	53.0
Gaston	251	191	-60	83	36.4
Iredell	497	472	-25	221	58.5
Lincoln	267	245	-22	100	50.8
Mecklenburg	*	*	*	107	30.7
Rowan	399	395	-4	177	53.6
Stanly	324	314	-10	134	52.5
Union	584	569	-15	249	60.5

Sources: a/ Profile of North Carolina Counties, Statistical Services Center Budget Division, Department of Administration, December 1968.

b/ County Data Book, 1967, U. S. Bureau of the Census.

Note: *Information is not available.

Table III-B

Farmland in the South Carolina Portion
of the Metropolitan Charlotte Study Area

<u>Counties</u>	<u>Farmland</u> <u>1959 a/</u> (sq. miles)	<u>Farmland</u> <u>1964 a/</u> (sq. miles)	<u>Decrease</u> <u>1959-1964</u> (sq. miles)	<u>Farmland</u> <u>1964 b/</u> (000 acres)	<u>Percentage of</u> <u>Total Land in</u> <u>Farms, 1964</u>
Total Farmland	(1,093)	(914)	(-179)	(584)	
Chester	325	294	-31	188	50.2
Lancaster	223	166	-57	106	33.0
Union	197	152	-45	97	29.6
York	348	302	-46	193	44.1

Sources: a/ Conservation Needs Inventory, Soil Conservation Service, U. S. Department of Agriculture, to be published in 1970.

b/ County Data Book, 1967, U. S. Bureau of the Census.

Highway traffic flows provide an excellent index of the linkages between urban activities (e.g., the trip from home to work, or home to shopping place). Figure 7 shows average traffic flows per day on the North Carolina primary highway system for 1968. The strongest linkage, about 40,000 vehicles per day, took place between Mecklenburg and Gaston Counties. Nearly as important were Mecklenburg's links to Cabarrus County (about 26,000 vehicles per day) and to Union County (about 14,000 vehicles per day). The flow of about 25,000 vehicles between Cabarrus and Rowan was also significant. Of lesser importance was the flow of about 8,000 vehicles between Catawba and Iredell and 10,000 between Mecklenburg and York. Traffic links between other counties were in the range of 2,000 to 6,000 vehicles per day.

Trends in the distribution of total employment in the 15-county study area are shown in Table IV. In 1968, Mecklenburg County contained 30.8 percent of the study area's total employment; Gaston, 11.7 percent, Catawba, 9.9 percent; and Cabarrus, 7.4 percent. Between 1962 and 1968, Mecklenburg and Catawba Counties increased somewhat their share of the area's employment, while Cabarrus County's share declined slightly. Substantial gains in absolute numbers occurred in Mecklenburg (40,620), Gaston (13,530), and Catawba (15,145). The three Counties accounted for about 63 percent of the employment gain for the area.

Table IV

Total Employment in the Metropolitan Charlotte Study Area

	<u>1/</u>	<u>1/</u>	<u>Change</u>	<u>Proportion of</u> <u>Study Area Total</u>	
	<u>1962</u>	<u>1968</u>		<u>1962</u>	<u>1968</u>
North Carolina Portion	<u>383,285</u>	<u>483,020</u>	<u>99,735</u>	<u>85.6</u>	<u>86.5</u>
Anson	<u>7,305</u>	<u>7,890</u>	<u>585</u>	<u>1.6</u>	<u>1.4</u>
Cabarrus	<u>35,645</u>	<u>41,450</u>	<u>5,805</u>	<u>8.0</u>	<u>7.4</u>
Catawba	<u>40,095</u>	<u>55,240</u>	<u>15,145</u>	<u>9.0</u>	<u>9.9</u>
Cleveland	<u>25,130</u>	<u>29,760</u>	<u>4,630</u>	<u>5.6</u>	<u>5.3</u>
Gaston	<u>51,510</u>	<u>65,040</u>	<u>13,530</u>	<u>11.5</u>	<u>11.7</u>
Iredell	<u>28,720</u>	<u>32,180</u>	<u>3,460</u>	<u>6.4</u>	<u>5.8</u>
Lincoln	<u>8,360</u>	<u>11,350</u>	<u>2,990</u>	<u>1.9</u>	<u>2.0</u>
Mecklenburg	<u>130,830</u>	<u>171,450</u>	<u>40,620</u>	<u>29.2</u>	<u>30.8</u>
Rowan	<u>27,040</u>	<u>32,450</u>	<u>5,410</u>	<u>6.0</u>	<u>5.8</u>
Stanly	<u>15,920</u>	<u>19,190</u>	<u>3,270</u>	<u>3.6</u>	<u>3.4</u>
Union	<u>12,730</u>	<u>17,020</u>	<u>4,290</u>	<u>2.8</u>	<u>3.0</u>
	<u>2/</u>	<u>2/</u>	<u>Change</u>		
	<u>1961</u>	<u>1968</u>		<u>1961</u>	<u>1968</u>
South Carolina Portion	<u>64,710</u>	<u>75,350</u>	<u>10,640</u>	<u>14.4</u>	<u>13.5</u>
Chester	<u>10,140</u>	<u>12,500</u>	<u>2,360</u>	<u>2.3</u>	<u>2.2</u>
Lancaster	<u>14,960</u>	<u>18,700</u>	<u>3,740</u>	<u>3.3</u>	<u>3.4</u>
Union	<u>10,830</u>	<u>11,850</u>	<u>1,020</u>	<u>2.4</u>	<u>2.1</u>
York	<u>28,780</u>	<u>32,300</u>	<u>3,520</u>	<u>6.4</u>	<u>5.8</u>
Study Area Total	<u>447,995</u>	<u>558,370</u>	<u>110,375</u>	<u>100.0</u>	<u>100.0</u>

Source: 1/ Profile, North Carolina Counties, Statistic Center, Budget Division, Department of Administration, December 1968.

2/ Per Interview with Research and Statistics Section, South Carolina Employment Security Commission, April 1970.

An analysis of 1968 employment by major categories of employment indicates that the study area is heavily dominated by manufacturing (Table V). Of the area's total employment of 558,370, over 238,000 persons--about 42 percent of the total--are engaged in manufacturing. Only in Mecklenburg County is nonmanufacturing employment--construction, transportation, public utilities, trade, finance, services, and government--of major significance. Outside of Mecklenburg County, the proportion of manufacturing employment to total employment in 1968 was over 52 percent. Agriculture is not a major source of employment in any county of the study area.

Trends in the distribution and growth of manufacturing employment are shown in Table VI. Gaston County led in 1968 manufacturing employment, closely followed by Mecklenburg, Catawba, and Cabarrus Counties. These four counties accounted for about 55 percent of the study area's 1968 manufacturing employment. Between 1962 and 1968, the largest absolute gain occurred in Catawba County (up about 9,000). Both Rowan and Union (N.C.) made impressive additions to moderate-sized 1962 bases. York, Mecklenburg, and Cabarrus Counties lost a small portion of their share of the study area's manufacturing employment.

In 1968, by far the most important manufacturing industry was textiles. Of 477 manufacturing establishments employing more than 100 persons, the textile industry accounted for 264--more than one-half of the total (Table VII). The associated apparel and

Table V

Profile of Employment by County in the Metropolitan Charlotte Study Area, 1968

	<u>Total Employment</u>	<u>Manufac- turing</u>	<u>Construc- tion</u>	<u>Transportation, Communications, and Utilities</u>	<u>Trade</u>	<u>Finance, Insurance, and Real Estate</u>	<u>Service</u>	<u>Government</u>	<u>Agriculture</u>	<u>Other</u>
North Carolina										
Portion 1/	(483,020)	(199,720)	(20,420)	(27,750)	(75,130)	(15,420)	(39,120)	(39,300)	(13,050)	(53,110)
Anson	7,890	2,470	180	150	810	100	380	1,000	1,260	1,540
Cabarrus	41,450	26,650	920	580	3,880	520	1,780	2,560	960	3,600
Catawba	55,240	30,780	2,140	2,660	7,140	790	3,060	2,540	900	5,230
Cleveland	29,760	13,940	790	500	3,470	560	1,670	2,890	1,930	4,010
Gaston	65,040	38,420	1,440	3,120	6,570	910	3,620	4,340	720	5,900
Iredell	32,180	16,000	1,260	610	3,810	400	2,050	2,580	1,770	3,700
Lincoln	11,350	5,690	330	210	1,150	140	700	860	890	1,380
Mecklenburg	171,450	34,930	10,060	18,000	40,300	10,640	20,710	15,490	870	20,450
Rowan	32,450	13,470	1,340	1,290	4,110	720	2,960	3,700	1,110	3,750
Stanly	19,190	10,510	780	340	2,000	230	1,190	1,530	940	1,670
Union	17,020	6,860	1,180	290	1,890	410	1,000	1,810	1,700	1,880
South Carolina										
Portion 2/	(75,350)	(38,450)	(2,400)	(1,450)	(7,650)	(1,400)	(4,350)	(7,100)	(4,150)	(8,400)
Chester	12,500	6,150	400	200	1,250	150	500	1,150	1,050	1,650
Lancaster	18,700	11,050	550	500	1,450	300	1,000	1,200	800	1,850
Union	11,850	6,550	150	200	1,000	150	600	1,100	700	1,400
York	32,300	14,700	1,300	550	3,950	800	2,250	3,650	1,600	3,500
Study Area Total	(558,370)	(238,170)	(22,820)	(29,200)	(82,780)	(16,820)	(43,470)	(46,400)	(17,200)	(61,510)

Sources: 1/ North Carolina Work Force Estimates by County, Area, and State, Bureau of Employment Security Research, Employment Security Commission of North Carolina, August 1969.

2/ South Carolina's Manpower in Industry, Research and Statistics Section, South Carolina Employment Security Commission, April 1969.

Table VI

Manufacturing Employment in the Metropolitan Charlotte Study Area

<u>County</u>	<u>1/</u>	<u>1/</u>	<u>Change</u>	<u>Proportion of</u> <u>Study Area Total</u>	
	<u>1962</u>	<u>1968</u>		<u>1962</u>	<u>1968</u>
North Carolina Portion	<u>152,560</u>	<u>199,720</u>	<u>41,760</u>	<u>82.4</u>	<u>83.8</u>
Anson	<u>1,800</u>	<u>2,470</u>	<u>670</u>	<u>1.0</u>	<u>1.0</u>
Cabarrus	<u>22,280</u>	<u>26,650</u>	<u>4,370</u>	<u>12.0</u>	<u>11.1</u>
Catawba	<u>21,730</u>	<u>30,780</u>	<u>9,050</u>	<u>11.7</u>	<u>12.9</u>
Cleveland	<u>10,400</u>	<u>13,940</u>	<u>3,540</u>	<u>5.6</u>	<u>5.9</u>
Gaston	<u>30,000</u>	<u>38,420</u>	<u>8,420</u>	<u>16.2</u>	<u>16.1</u>
Iredell	<u>13,420</u>	<u>16,000</u>	<u>2,580</u>	<u>7.2</u>	<u>6.7</u>
Lincoln	<u>3,750</u>	<u>5,690</u>	<u>1,940</u>	<u>2.0</u>	<u>2.4</u>
Mecklenburg	<u>28,730</u>	<u>34,930</u>	<u>6,200</u>	<u>15.6</u>	<u>14.7</u>
Rowan	<u>8,910</u>	<u>13,470</u>	<u>4,560</u>	<u>4.8</u>	<u>5.7</u>
Stanly	<u>7,710</u>	<u>10,510</u>	<u>2,800</u>	<u>4.2</u>	<u>4.4</u>
Union	<u>3,830</u>	<u>6,860</u>	<u>3,030</u>	<u>2.1</u>	<u>2.9</u>
	<u>2/</u>	<u>2/</u>	<u>Change</u>	<u>1961</u>	<u>1968</u>
	<u>1961</u>	<u>1968</u>			
South Carolina Portion	<u>32,620</u>	<u>38,450</u>	<u>5,830</u>	<u>17.6</u>	<u>16.2</u>
Chester	<u>4,390</u>	<u>6,150</u>	<u>1,760</u>	<u>2.4</u>	<u>2.6</u>
Lancaster	<u>8,900</u>	<u>11,050</u>	<u>2,150</u>	<u>4.8</u>	<u>4.6</u>
Union	<u>5,830</u>	<u>6,550</u>	<u>720</u>	<u>3.1</u>	<u>2.8</u>
York	<u>13,500</u>	<u>14,700</u>	<u>1,200</u>	<u>7.3</u>	<u>6.2</u>
Study Area Total	<u>185,180</u>	<u>238,170</u>	<u>47,590</u>	<u>100.0</u>	<u>100.0</u>

Source: 1/ Profile, North Carolina Counties, Statistic Center, Budget Division, Department of Administration, December 1968.

2/ Per Interview with Research and Statistics Section, South Carolina Employment Security Commission, April 1970.

Table VII

Distribution of Selected Categories of Industry,
Metropolitan Charlotte Study Area, 1968

(number of establishments employing 100 persons or more)

<u>Counties</u>	<u>Apparel</u>	<u>Textile Mills</u>	<u>Furniture and Fixtures</u>	<u>Paper</u>	<u>Machinery and Electrical</u>	<u>Other</u>	<u>Total</u>
North Carolina Portion <u>a/</u>	(44)	(234)	(41)	(9)	(22)	(85)	(435)
Anson	2	4	-	-	-	2	8
Cabarrus	1	16	-	-	-	1	18
Catawba	8	31	25	1	1	7	73
Cleveland	1	23	1	1	-	2	28
Gaston	3	88	-	1	7	9	108
Iredell	10	15	5	1	1	5	37
Lincoln	-	13	3	-	1	-	17
Mecklenburg	9	13	3	4	10	39	78
Rowan	6	12	2	1	1	9	31
Stanly	2	11	1	-	-	2	16
Union	2	8	1	-	1	9	21
South Carolina Portion <u>b/</u>	(5)	(30)	-	(2)	-	(5)	(42)
Chester	2	5	-	-	-	1	8
Lancaster	1	3	-	-	-	3	7
Union	-	8	-	-	-	1	9
York	2	14	-	2	-	-	18
Study Area Total	(49)	(264)	(41)	(11)	(22)	(90)	(477)

Sources: a/ North Carolina Directory of Manufacturing Firms, 1968,
The North Carolina Department of Labor.

b/ Thirty-Fourth Annual Report of the Department of Labor
of the State of South Carolina, July 1, 1968 - June 30, 1969.

machinery industries (the latter mainly textile machinery) together accounted for an additional 71 establishments; furniture for 41; and paper for 11.

Some of the largest plants in the area, each employing more than 1,000 persons, are a textile plant and a tire cord factory in Gaston County; two apparel plants in Cabarrus County; two hosiery mills in Catawba County; a fiber glass plant and a chemicals factory in Cleveland County; two cotton mills in Iredell County; and a chemicals plant in Rowan County. A pulp and paper mill in York County, S. C., employs 700 persons.

PROSPECTIVE POPULATION AND ECONOMIC GROWTH

According to one set of estimates, based largely on a 1964 research study undertaken for the city of Charlotte, the population of the Metropolitan Charlotte study area is projected to increase about 23 percent between 1970 and 1980, from a total of 1,291,000 to 1,590,000. The annual growth rate implicit in these

1/ "Metropolitan Charlotte", a report prepared by Hammer and Associates for the city of Charlotte, 1964

estimates is 2.1 percent, a rate higher than the 1.9 percent rate of growth estimated to have been achieved in the previous decade (Table VIII).

U. S. Census Bureau projections for the period 1965-75 suggest a lower annual future growth rate for the study area population. ^{2/} Census projections for the Charlotte Standard Metropolitan Statistical Area (Mecklenburg and Union, N. C., Counties) range from 1.8 to 2.2 percent per year, on the basis of two different fertility assumptions. However, for the non-metropolitan areas of both North Carolina and South Carolina, the Census Bureau estimates annual growth rates of only 0.6 to 1.0 percent. Weighted by the 1970 distribution of population between the Charlotte SMSA and the remainder of the study area, the average annual growth rates for the area would range between 1.0 to 1.4 percent. At these rates, the study area population would increase from 10.5 to 15 percent between 1970 and 1980 to totals at the end of the decade of 1,426,000 to 1,484,000.

Whether the population growth rates will decline to these levels or be sustained at higher levels will depend in large part on the area's economic growth. The latter in turn will depend, in the relatively short-term future, on the expansion of the dominant manufacturing industries of the area, particularly

^{2/} U. S. Department of Commerce, Bureau of the Census, Projections of the Population of Metropolitan Areas: 1975, Current Population Reports, Series P-25, No. 415, January 31, 1969.

Table VIII

Population Forecasts by County for 1970 and 1980,
Metropolitan Charlotte Study Area

(number of persons)

<u>Counties</u>	<u>1960^{a/}</u>	<u>1970^{b/}</u>	<u>1980^{b/}</u>
North Carolina Portion	(891,823)	(1,094,800)	(1,382,100)
Anson	24,962	24,000	23,600
Cabarrus	68,137	76,600	91,000
Catawba	73,191	88,900	110,700
Cleveland	66,648	75,300	90,700
Gaston	127,074	159,400	206,400
Iredell	62,526	79,500	96,400
Lincoln	28,814	32,200	36,200
Mecklenburg	272,111	368,000	514,000
Rowan	82,817	93,200	108,100
Stanly	40,873	44,200	48,700
Union	44,670	53,500	56,300
South Carolina Portion	(179,015)	(196,500)	(206,700)
Chester	30,888	32,000	33,000
Lancaster	39,352	44,800	45,400
Union	30,015	31,500	33,000
York	78,760	88,200	95,300
Study Area Total	(1,070,838)	(1,291,300)	(1,588,800)

Sources: a/ U. S. Census of Population.

b/ Metropolitan Charlotte: An Economic Study of its Commercial Development Potential, Hammer and Company Associates, 1964. This forecast was made for a 24-county area encompassing all but Union County, S. C. Forecasts for Union (S.C.), Union (N.C.), Lancaster, and Chester were adjusted slightly to reflect recent population changes not anticipated by the study.

textiles.

North and South Carolina, together with Georgia, are the leading textile States in the Nation. Most of the modern, highly efficient plants, notably those producing or utilizing synthetic fibers, are located in these States. During the 1960's, leading firms in the industry invested heavily in product development, technological innovation, and equipment modernization. As a result, an industry formerly labor-intensive is shifting toward a more capital-intensive structure. According to the U. S. Department of Commerce, some new textile plants represent a capital investment of \$40,000 - \$50,000 per worker compared to an average gross investment of about \$9,000 per worker for all textile plants in 1968.^{3/}

There is little doubt that the outlook for the innovative sectors of the textile industry of the study area will continue favorable, even in the face of intense domestic and international competition. On the other hand, increased efficiency in manufacture will mean fewer employees for additional units of output. The National Planning Commission estimates that in the period 1968-80, textile output will grow at an average annual rate of 1.6 percent but that employment will decline at an average rate of 2.3 percent per year.^{4/}

^{3/} U. S. Industrial Outlook, 1970

^{4/} Economic Projections to 1980: Growth Patterns for the Coming Decade, Report No. 70-N-1, March, 1970.

In the more labor-intensive portions of the textile industry, as well as in the apparel and furniture industries of the area, industrial expansion should be accompanied by employment growth although productivity increases can be expected to reduce the rate of employment growth.

Over the longer term, economic growth capable of supporting high rates of population increase in the study area may require a more diversified economic base. The textile and apparel industries now dominant in the area, are ones for which demand tends to be relatively inelastic. Thus, as incomes and purchasing power in the Nation rise, the market for textile and apparel products does not rise as quickly. In the last decade, the output of textile mill products, for example, rose only 54 percent while automobile production rose 92 percent.

Toward the objective of diversification, Metropolitan Charlotte has the advantage of being a regional center for the Piedmont Crescent which could grow to serve a wider area in the rapidly growing Southeast Region of the United States.

PROBABLE DIRECTIONS OF URBAN GROWTH

An increase in urbanized land in the study area will occur not only because population and commercial and industrial activity expand but also because space standards will rise. For example, new residential construction may require larger lots, and new plants and shopping facilities, including those relocating inside the study area, will tend to be designed as one-story facilities with large parking areas rather than multi-story buildings with little auxiliary space. This reduction in density will multiply urban land requirements beyond that associated with increases in population and economic activity in the past.

As shown on Figure 8, the Central Piedmont Regional Council of Local Governments expects most of the prospective urban growth to occur in corridors radiating from Charlotte and extending into Gaston, Cleveland, Iredell, Cabarrus, Union (N.C.), and York Counties. Completion of Interstate Highways 77 and 85 should reinforce the radial pattern suggested by the Piedmont Council. In addition, it appears possible that growth in Catawba County will proceed eastward on I-40 to link up with the Mecklenburg County-Iredell County northward expansion along I-77. The present substantial link between Cabarrus and Rowan Counties could be further strengthened. Urban growth of the remaining counties in the study area is likely to center around existing county seats and other small towns.

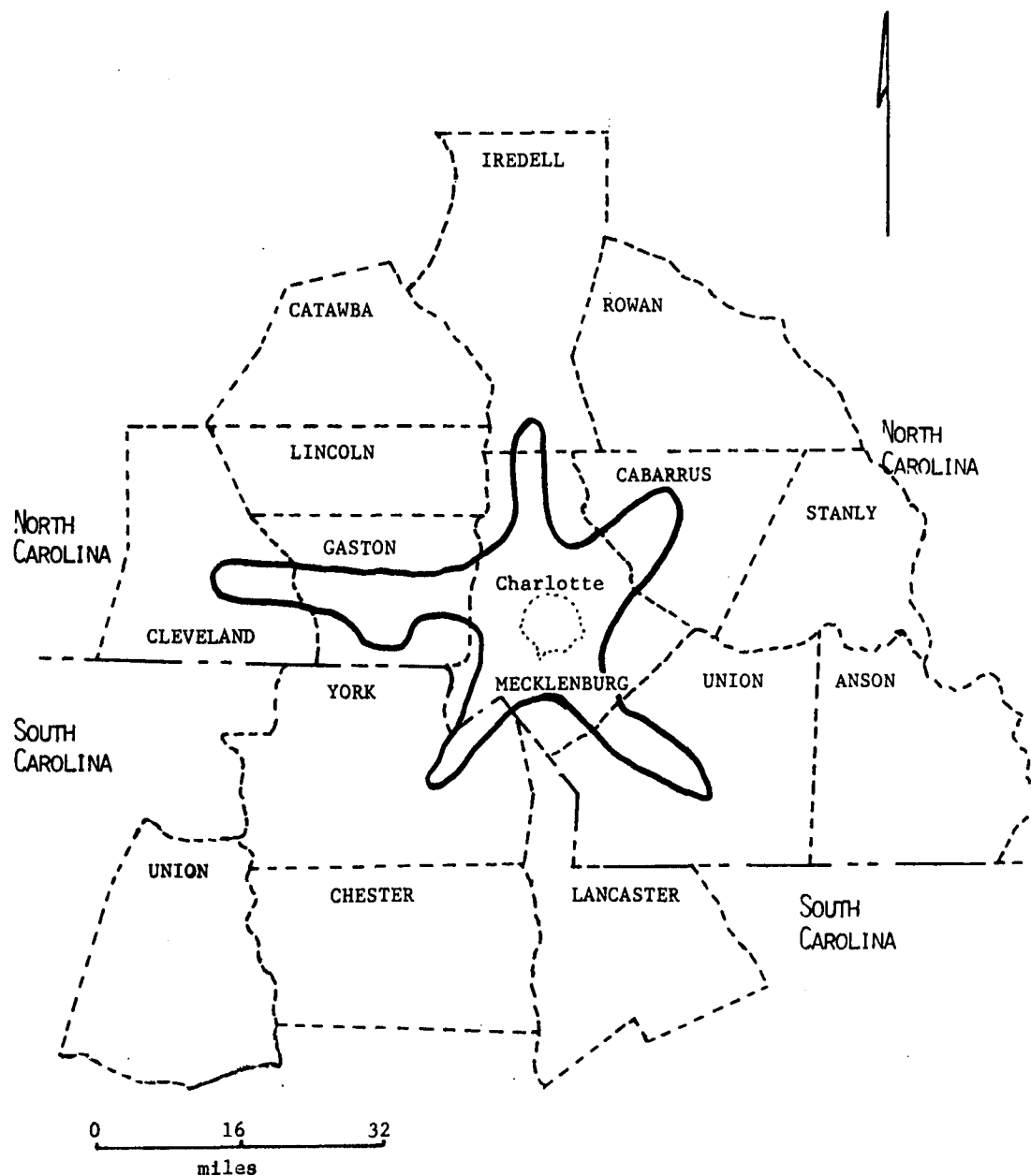


FIGURE 8 - Growth Directions Forecast by the Central Piedmont Regional Council of Local Governments, Metropolitan Charlotte Study Area

To provide electric power for future growth, major utility companies in a four-State area (the Carolinas, Virginia, and a portion of West Virginia) are cooperating to provide for a doubling of power requirements by 1980. The Duke Power Company, which is the primary supplier of the Metropolitan Charlotte area as well as a participant in the regional pool, plans the installation of 1,225 megawatts of additional generating capacity in the study area within the next five years. One unit is to be located in the border area between Catawba and Iredell Counties and the other in Cleveland County. While the fuel type for these plants is not specified, the Company has hitherto relied almost exclusively on coal. To date, this coal has been of low sulfur content. However, rising demands for and the limited supply of such coal may make it difficult to assure use of low-sulfur coal in future plants.

EVALUATION OF TECHNICAL FACTORS

The technical factors of importance in considering the boundaries of a proposed air quality region are: the total quantity of pollutants emitted, the geographic pattern of emission sources, and patterns of pollutant dispersion.

In the Charlotte area, information with respect to these factors was obtained from an emission inventory conducted by the National Air Pollution Control Administration (NAPCA), air quality monitoring data obtained locally, and a theoretical diffusion model based on the inventory data and meteorological information.

THE EMISSION INVENTORY

The emission inventory covered a study area consisting of 12 counties, shown in Figure 11.

Five major pollutants were examined in the inventory: sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides. The complete report of the emissions inventory will be published by NAPCA in a separate document. Data from the inventory will be summarized in this report.

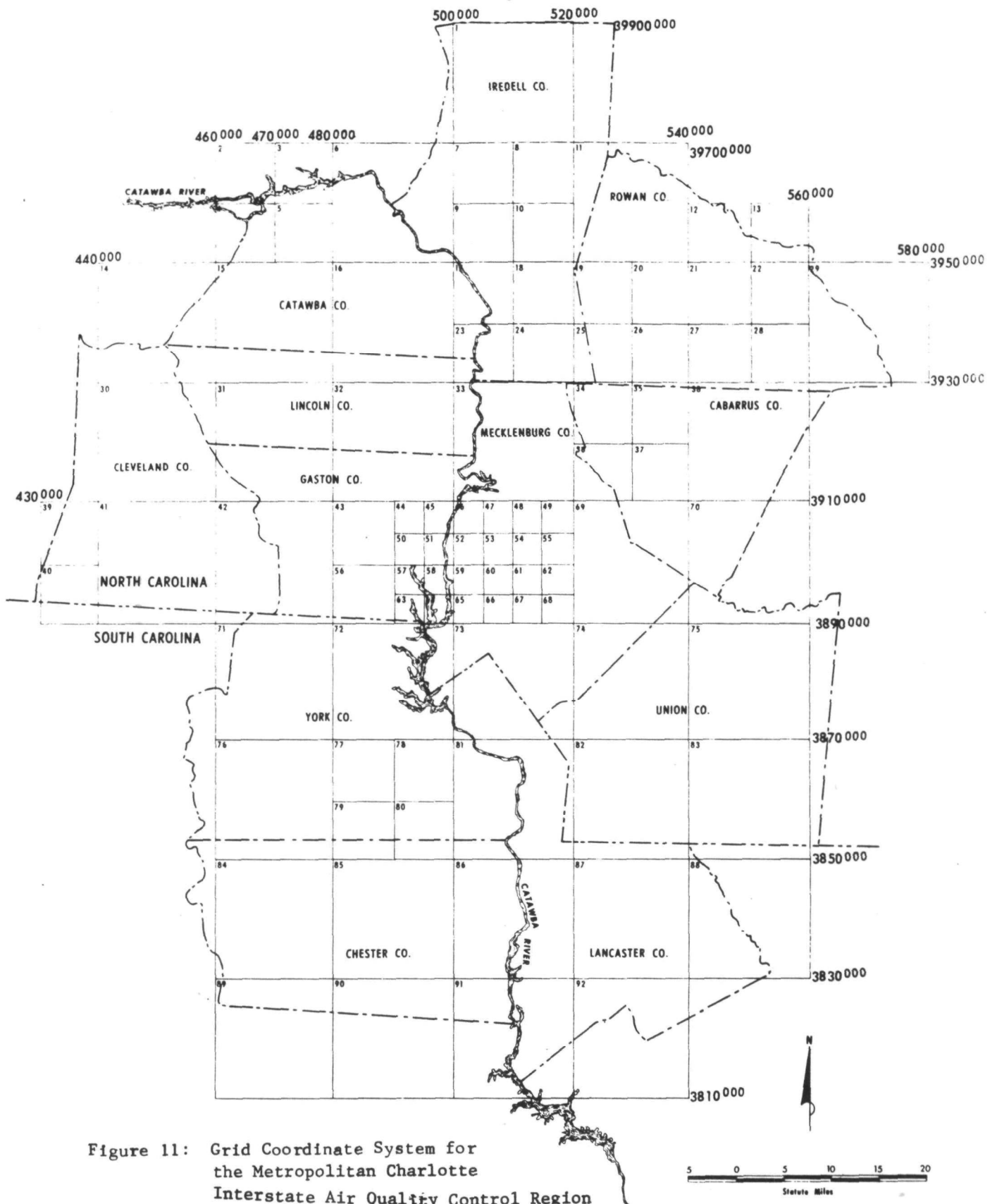


Figure 11: Grid Coordinate System for
the Metropolitan Charlotte
Interstate Air Quality Control Region

Sources of emissions have been classified into five categories: fuel combustion, industrial process losses, transportation, refuse disposal, and evaporation losses. A summary table of five pollutants--sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides--emitted from these five source categories is shown in Table IX.

Emissions were also attributed to the study area counties where they originated. A percentage summary of emissions by county is shown in Table X. A more detailed summary of three pollutants by county is shown in Table XI.

And finally, the study area was divided into grid zones (Figure 11) and point and area sources of sulfur oxides, particulates, and carbon monoxide attributed to the grids of their origin. This distribution over the 92 grid zones of the study area is shown in Table XII.

Significant emissions of sulfur oxides were noted in the grid zones containing electric power generating plants (13, 23, 33, 39, 64) and in grid zone 81, which contains chemical, kraft paper, and plywood plants. These zones also generated high levels of particulate matter. Particulate levels are high in grid zones containing open dumps (73, 86) and industrial activities such as stone processing (42), lumber, brick and feed plants (75), and foundries and other industrial sources (54).

Table IX

Summary of Air Pollutant Emissions in the
Metropolitan Charlotte Study Area, 1968

(tons per year)

<u>Source</u>	<u>Sulfur Oxides</u>	<u>Partic- ulates</u>	<u>Carbon Monoxide</u>	<u>Hydro- carbons</u>	<u>Nitrogen Oxides</u>
Transportation	(3,626)	(7,880)	(499,850)	(44,425)	(34,914)
Road Vehicles	3,039	6,031	492,362	41,085	31,215
Other Vehicles	587	1,849	7,488	3,339	3,699
Fuel Combustion	(196,235)	(278,091)	(7,586)	(2,382)	(107,604)
Industrial	16,748	28,910	1,055	415	13,347
Power Generation	171,934	246,001	2,246	901	89,960
Residential	5,044	1,354	2,360	653	2,785
Commercial and Institutional	2,508	1,825	1,923	411	1,511
Refuse Disposal	(311)	(3,261)	(17,102)	(5,381)	(2,102)
Incineration	187	954	4,842	1,054	515
Open Burning	144	2,307	12,260	4,327	1,586
Industrial Process Losses	273	78,299	7,676	229	1,376
Evaporation Losses	--	--	--	23,252	--
Total Emissions	<u>200,465</u>	<u>367,531</u>	<u>532,213</u>	<u>75,669</u>	<u>145,996</u>

Table X

Relative Contribution of Each County
to Total Air Pollution Emissions

<u>Counties</u>	(percent)				
	<u>Sulfur</u> <u>Oxides</u>	<u>Partic-</u> <u>ulates</u>	<u>Carbon</u> <u>Monoxide</u>	<u>Hydro-</u> <u>carbons</u>	<u>Nitrogen</u> <u>Oxides</u>
North Carolina Portion					
Cabarrus	1	1	7	7	3
Catawba	22	10	8	9	18
Cleveland	7	11	.1	1	5
Gaston	49	32	13	15	40
Iredell	.5	1	6	6	2
Lincoln	.2	.1	3	3	.8
Mecklenburg	2	9	37	34	10
Rowan	13	23	8	9	11
Union	.3	5	4	4	1
South Carolina Portion					
Chester	.2	.1	2	3	.8
Lancaster	1	3	5	5	2
York	3	4	6	4	7

Table XI

Air Pollutant Emissions in the Metropolitan Charlotte Study Area,
by Emissions Sources and by County, 1968
 (tons per year)

Fuel Combustion

	County	Indus- trial	Commer- cial and Institu- tional	Residen- tial	Power Plants	Total, Fuel Combustion	Industrial Process Losses	Transportation	Refuse Disposal	Grand Total ^{a/}
Particulates	Cabarrus, N.C.	3,498	150	75	0	3,723	0	498	311	4,529
	Catawba	728	55	65	32,443	33,292	2,996	581	45	36,914
	Cleveland	1,628	114	84	33,339	35,167	5,861	85	296	41,409
	Gaston	2,152	110	596	107,215	110,074	6,880	1,784	496	119,234
	Iredell	219	64	55	0	339	2,715	457	114	3,625
	Lincoln	117	19	34	0	171	7	204	32	414
	Mecklenburg	2,057	606	239	0	2,903	25,407	2,518	304	31,132
	Rowan	3,905	537	87	73,002	77,533	4,379	546	511	82,969
	Union	56	53	35	0	145	19,556	302	124	20,127
	Chester, S.C.	27	17	20	0	64	0	178	139	381
Sulfur Oxides	Lancaster	10,692	46	32	0	10,771	1,295	291	390	12,747
	York	3,828	48	27	0	3,904	9,197	431	493	14,025
	Cabarrus, N.C.	1,596	240	298	0	2,136	0	244	28	2,408
	Catawba	507	108	286	42,107	43,011	0	284	2	43,297
	Cleveland	953	174	291	12,760	14,180	0	36	29	14,245
	Gaston	1,518	205	2,182	93,717	97,623	0	764	48	98,435
	Iredell	362	136	207	0	705	0	224	15	944
	Lincoln	178	48	129	0	356	0	99	5	460
	Mecklenburg	1,436	999	830	0	3,266	3	1,119	60	4,448
	Rowan	1,704	303	361	23,348	25,718	0	266	41	26,025
Carbon Monoxide	Union	172	84	154	0	411	0	147	13	571
	Chester, S.C.	127	42	64	0	235	0	86	12	333
	Lancaster	2,692	68	116	0	2,877	0	142	29	3,048
	York	5,498	92	121	0	5,713	270	209	41	6,233
	Cabarrus, N.C.	104	226	193	0	525	0	35,772	1,595	37,892
	Catawba	28	76	130	554	789	240	39,948	972	41,949
	Cleveland	54	169	280	152	656	0	2,750	1,392	4,798
	Gaston	59	152	508	1,232	1,953	0	64,771	2,522	69,246
	Iredell	13	77	142	0	233	0	29,227	553	30,013
	Lincoln	6	23	105	0	135	40	13,457	146	13,778
	Mecklenburg	81	644	541	0	1,268	580	192,756	1,341	195,945
	Rowan	107	301	216	307	933	0	39,220	2,654	42,807
	Union	5	76	85	0	166	456	20,741	623	21,986
	Chester, S.C.	2	25	57	0	86	0	11,192	713	11,991
	Lancaster	204	75	91	0	370	5,620	20,551	2,035	28,576
	York	387	75	5	0	468	737	29,458	2,550	33,213

Note: ^{a/} Totals have been rounded.

Air Pollutant Emissions from All Sources
in the Metropolitan Charlotte Study Area, 1968

(Annual Average Tons Per Day)

<u>Grid</u>	<u>Land Area</u> <u>(Sq. Mi.)</u>	<u>Sulfur</u> <u>Oxides</u>	<u>Partic-</u> <u>ulates</u>	<u>Carbon</u> <u>Monoxide</u>
1	154.4	0.3	1.0	8.6
2	38.6	0.0	0.0	0.0
3	38.6	0.1	0.1	1.6
4	38.6	1.1	1.8	41.8
5	38.6	0.6	8.8	22.7
6	154.4	0.4	0.5	13.7
7	38.6	0.2	0.2	7.9
8	38.6	0.2	0.2	6.8
9	38.6	0.5	4.7	16.4
10	38.6	0.5	2.5	17.3
11	154.4	0.5	0.4	7.4
12	38.6	0.1	10.1	3.2
13	38.6	66.0	206.9	4.7
14	154.4	0.2	0.2	3.2
15	154.4	0.6	0.6	18.6
16	154.4	0.7	0.7	21.6
17	38.6	0.1	0.1	2.0
18	38.6	0.1	0.1	4.2
19	38.6	0.1	0.1	2.4
20	38.6	0.1	0.1	1.6
21	38.6	2.9	5.7	50.3
22	38.6	0.4	0.6	12.6
23	38.6	115.4	88.9	2.1
24	38.6	0.4	1.0	13.3
25	38.6	0.2	0.2	6.3
26	38.6	1.0	3.5	21.5
27	38.6	0.1	0.1	4.4
28	38.6	0.1	0.2	4.2
29	154.4	0.1	0.1	2.2
30	154.4	0.9	1.4	5.1
31	154.4	1.5	16.9	40.9
32	154.4	0.9	1.6	20.8
33	154.4	90.7	214.8	10.6
34	38.6	0.3	0.3	7.5
35	38.6	3.9	8.6	45.1
36	38.6	0.3	0.3	5.8
37	38.6	2.1	3.8	28.1
38	154.4	0.5	0.5	15.5
39	38.6	35.1	91.5	1.0
40	38.6	0.1	0.1	0.4
41	154.4	2.0	6.3	6.5
42	154.4	1.9	17.9	18.8
43	38.6	4.2	3.7	68.1
44	9.6	0.2	0.2	2.1
45	9.6	0.9	2.1	10.1
46	9.6	0.2	0.4	4.1

Table XII (continued)

Air Pollutant Emissions From All Sources
in the Metropolitan Charlotte Study Area, 1968

(Annual Average Tons Per Day)

<u>Grid</u>	<u>Land Area</u> <u>(Sq. Mi.)</u>	<u>Sulfur</u> <u>Oxides</u>	<u>Partic-</u> <u>ulates</u>	<u>Carbon</u> <u>Monoxide</u>
47	9.6	0.1	0.1	7.2
48	9.6	0.2	0.2	6.2
49	9.6	0.2	0.2	7.7
50	9.6	1.0	0.7	20.6
51	9.6	0.9	0.8	24.7
52	9.6	0.3	0.4	20.4
53	9.6	0.8	0.9	25.9
54	9.6	2.0	34.9	40.7
55	9.6	1.3	1.6	37.0
56	38.6	1.2	0.9	2.3
57	9.6	2.6	3.4	2.9
58	9.6	0.5	0.4	1.5
59	9.6	0.1	0.1	3.4
60	9.6	1.1	1.8	39.2
61	9.6	1.0	4.7	113.9
62	9.6	1.9	6.7	78.9
63	9.6	0.1	0.1	0.7
64	9.6	167.2	79.8	2.3
65	9.6	0.0	0.0	3.1
66	9.6	0.1	0.1	9.3
67	9.6	0.6	1.2	30.5
68	9.6	0.4	0.9	21.7
69	154.4	0.6	10.7	45.9
70	154.4	0.1	0.1	4.1
71	154.4	0.6	1.7	11.9
72	154.4	0.3	0.6	9.8
73	154.4	0.7	21.5	37.1
74	154.4	0.5	0.5	23.2
75	154.4	0.5	54.1	21.4
76	154.4	0.1	0.2	2.9
77	38.6	0.1	0.1	1.8
78	38.6	5.8	5.9	39.4
79	38.6	0.0	0.0	0.5
80	38.6	0.1	0.2	2.9
81	154.4	10.1	29.7	18.2
82	154.4	0.4	0.4	13.9
83	154.4	0.3	0.3	11.4
84	154.4	0.2	0.2	5.7
85	154.4	0.7	1.4	16.1
86	154.4	6.6	29.0	20.4
87	154.4	1.2	4.7	40.3
88	154.4	0.1	0.1	2.9
89	154.4	0.0	0.0	1.3
90	154.4	0.1	0.1	2.1
91	154.4	0.2	0.2	5.8
92	154.4	0.2	0.4	6.3

Carbon monoxide concentrations of significance are in grid zones where automobile traffic densities are heavy (61).

The nature of industrial development in the study area as described in the urban factors analysis is reflected in this analysis of pollutant emissions: there is no single, highly concentrated source of emissions in the area, but substantial and well-distributed emission sources over the whole area. Sources are found in grid zones to the north, east, south, and west of the central city. To the extent there is a discernible pattern, sources occur along the various waterways in the area.

AIR QUALITY ANALYSIS

The boundaries of an air quality control region should be designed to include both pollution sources and people and property affected by those sources. Sources and source areas have been identified in the preceding section presenting the emission inventory. The inventory does not, however, provide information about the dispersion of pollutants and that relationship to affected people and property. Further examination of air quality data in the study area is necessary before the regional boundary can be determined.

The best way to determine the atmospheric distribution of pollutants is to review air quality sampling data which have been collected at sufficient points over enough time to be useful. Such data, however, are not presently available for the study area, so an alternative modeling technique has been used. It is possible through the use of meteorological diffusion model to predict theoretical concentrations of pollutants in the air. The model, based on mathematical treatment of pollutant emission from the inventory and meteorological factors such as wind speeds, direction, and mixing depths has generated the theoretical dispersion maps shown in Figures 12, 13, and 14. Although the model has certain inherent limitations, it can be used as an indicator of probable relative concentrations throughout the study area.

Meteorology and Climatology

The ebb and flow of air through the study area is, of course, an important consideration in the determination of appropriate regional boundaries.

The study area, located in the southern Piedmont, is sheltered from extreme effects of polar air masses and enjoys a moderate climate characterized by cool winters and quite warm summers.

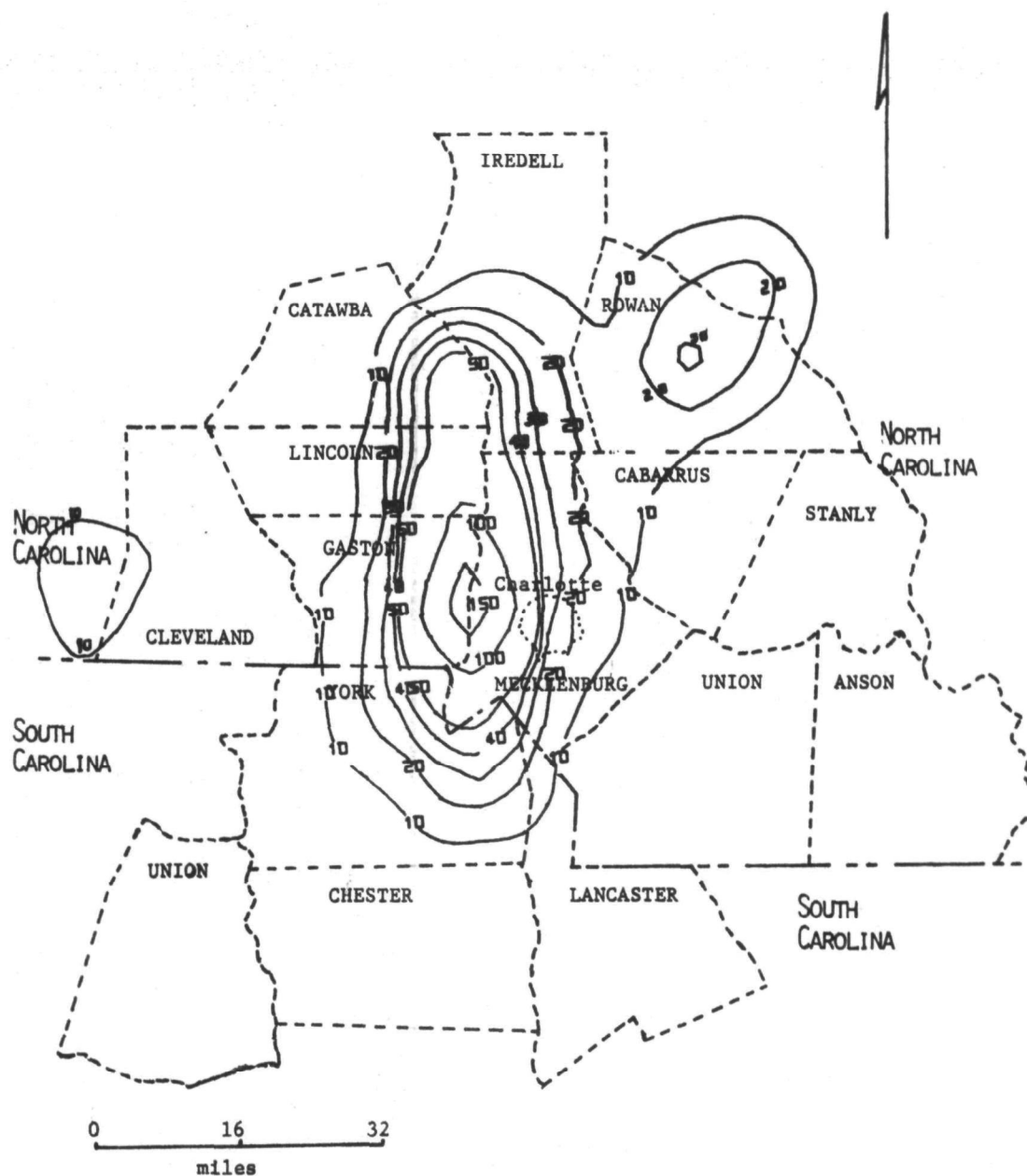


FIGURE 12 - Theoretical Annual Average Concentrations of Sulfur Oxides.
Values in Micrograms per Cubic Meter

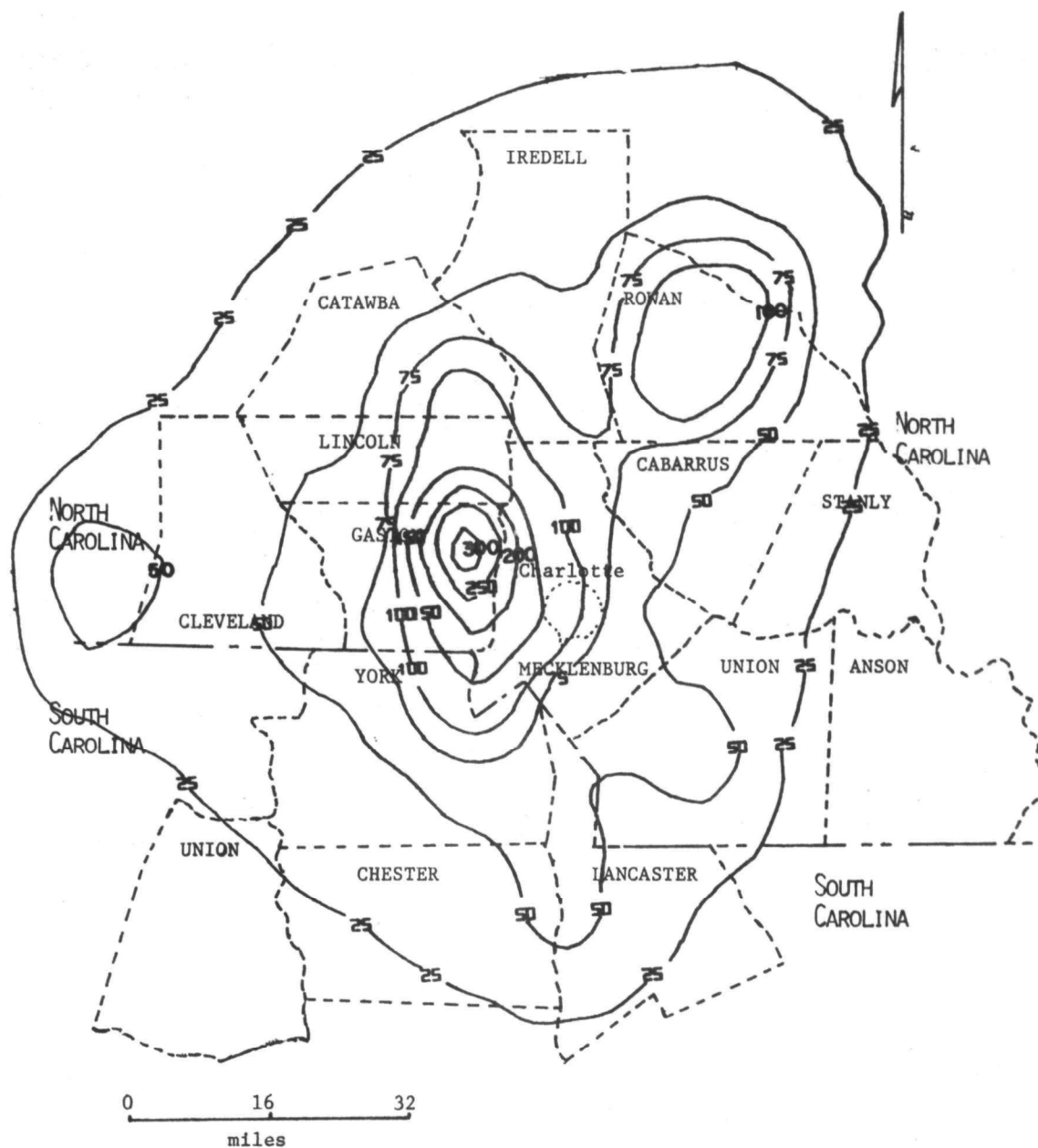


FIGURE 13 - Theoretical Annual Average Concentrations of Particulates.
Values in Micrograms per Cubic Meter

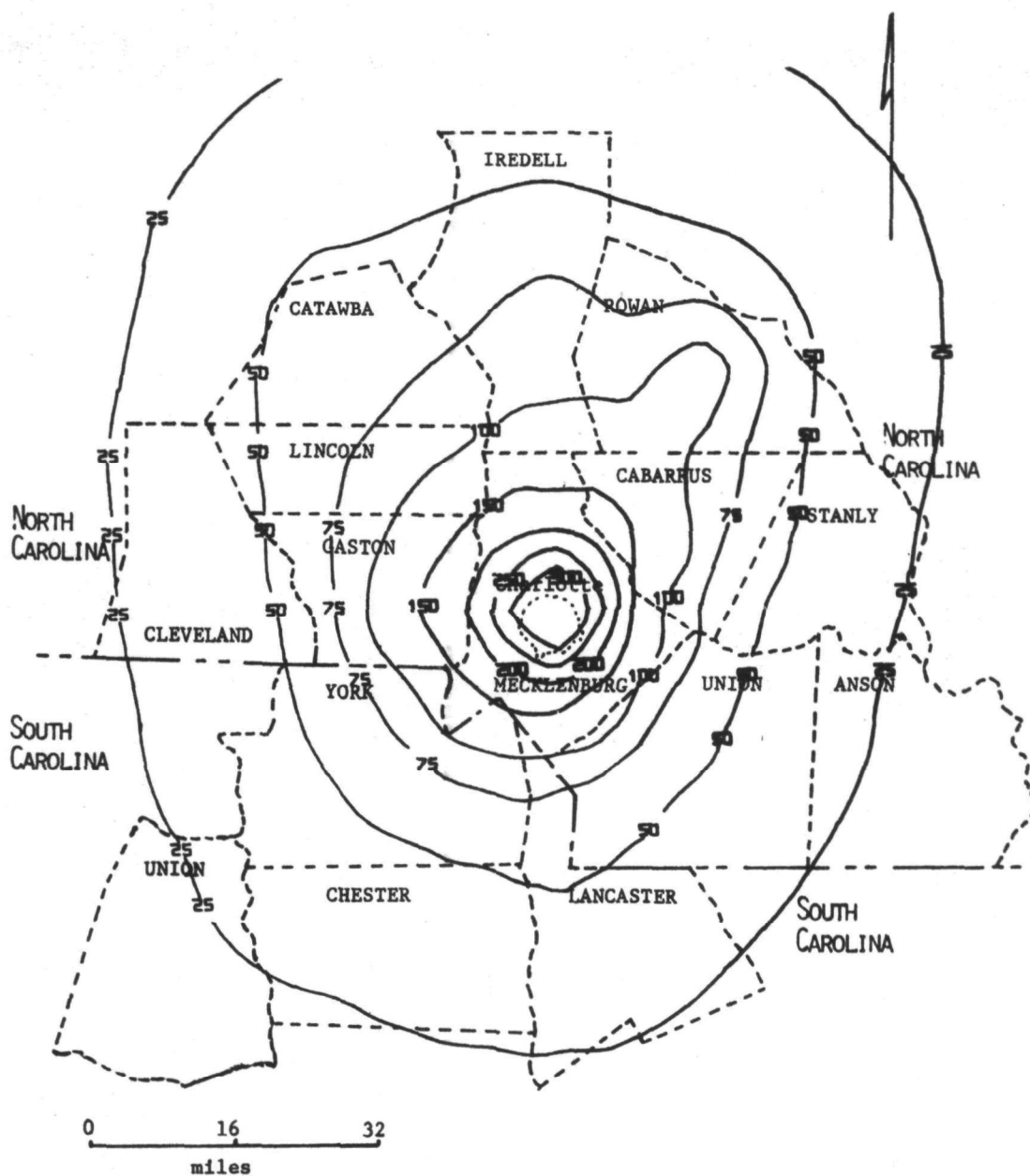


FIGURE 14 - Theoretical Annual Average Concentrations of Carbon Monoxide.
Values in Micrograms per Cubic Meter

Winter weather is changeable, alternating between mild and cool and only occasional cold periods. Summers are long and warm with considerable cooling at night and frequent thunderstorms. The area is far enough inland not to be severely affected by coastal storms and hurricanes. Average wind speeds in the area are about 7 m.p.h. and tend to be southwesterly.

The region is characterized by frequent low wind speeds, stagnant air masses, and temperature inversions. Over the past twenty years, stagnation periods of over four days each have been noted 70 times. Inversions are present over 45 percent of the time, and nighttime winds of less than seven miles per hour can be expected 70 percent of the time (Figure 15, Table XIII).

Table XIII

Air Mixing Depths, Metropolitan Charlotte Study Area

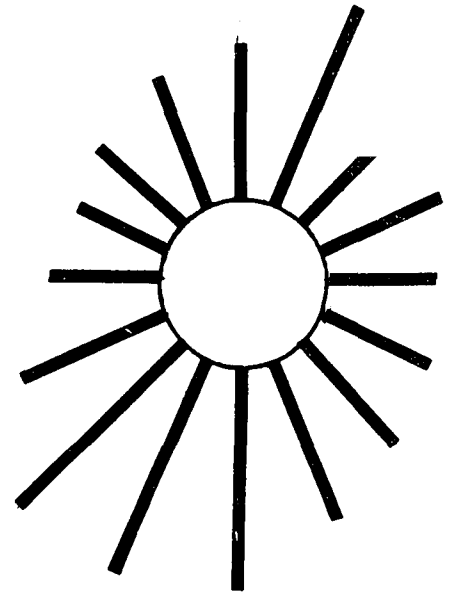
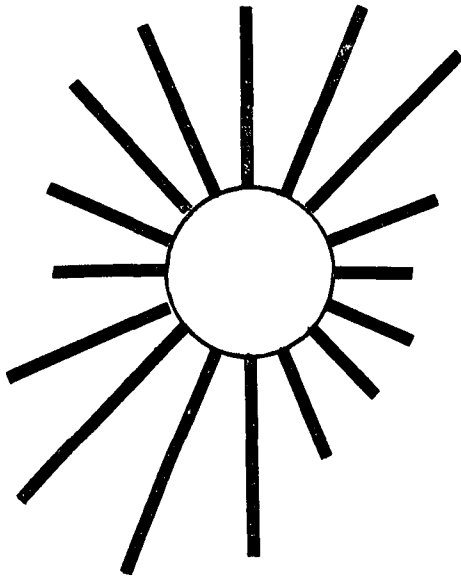
	(meters)		
	<u>Winter</u>	<u>Summer</u>	<u>Annual</u>
MORNING	330	370	335
AFTERNOON	930	1,700	1,410
AVERAGE	630	1,035	870

These weather conditions, coupled with extensive use of coal as an energy source, create air pollution potentials of a serious nature which will require a strong regional program.

WINTER

SUMMER

43



ANNUAL

(Includes All Four Averaging Periods)

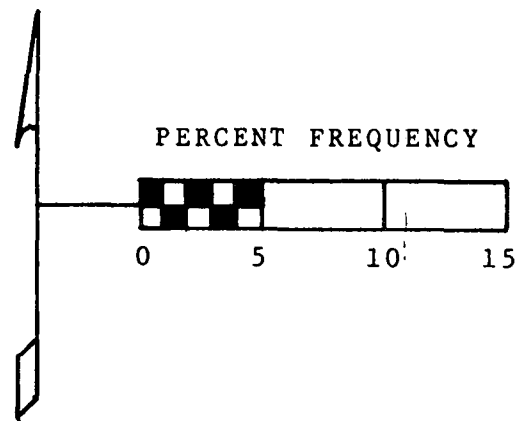
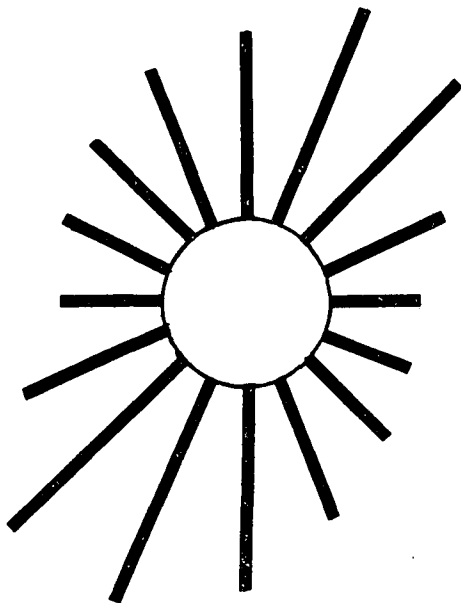


FIGURE 15 - Wind Direction Percent Frequency of Occurrence for Various Averaging Times

Air quality data collected by the Charlotte-Mecklenburg County Health Department appear to be consistent with the conclusions of the inventory and diffusion model. The annual average (1969) air quality measurements from the Health Department are shown below.

<u>Measured</u>	<u>Range</u>	<u>Average</u>
Suspended particulates	13 - 251 $\mu\text{g}/\text{m}^3$	78 $\mu\text{g}/\text{m}^3$
Dustfall	2.74 - 60.1 tons/ $\text{mi}^2/\text{mo.}$	17.41 tons/ $\text{mi}^2/\text{mo.}$
Soiling index	0 - 3.2 COH	0.6 COH
Nitrogen oxides	0.014 - 0.400 ppm	0.111 ppm
Sulfur oxides	0.000 - 0.060 ppm	0.009 ppm

REGIONAL GOVERNMENTAL ORGANIZATION

In the Metropolitan Charlotte study area, eight types of regional entities may be distinguished:

- 1) regional planning bodies
- 2) sub-state planning districts
- 3) clearinghouses for Federally assisted projects
- 4) law enforcement districts
- 5) a resource conservation and development area
- 6) a health planning area
- 7) manpower planning districts
- 8) air pollution control agencies

The study area counties have combined in many different ways to form these regional organizations. For example, the County of Mecklenburg is in itself a Comprehensive Health Planning Area; it has joined with Union, Cabarrus, and Iredell Counties to form a law enforcement district; it cooperates in an eight-county council of government; and so on.

Regional Planning Bodies

There are two regional planning bodies in the study area-- a Council of Governments (COG) and a regional planning commission.

The Central Piedmont Regional Council of Local Governments (CPRCLG), a voluntary public agency, was formed in 1968 to undertake

regional and intergovernmental coordination and to help member local governments meet various planning requirements for Federal grants-in-aid. Membership consists of eight counties and fifteen municipalities in the North Carolina portion of the Metropolitan Charlotte study area (Figure 16). A majority of the representatives on the Council's policy board are elected local officials--mayors and county commissioners. The Council's work program stresses environmental problems: water and sewer system planning, solid waste disposal, and air pollution. In the next two years, substantial effort will also be directed toward airports, highway and transit systems, land use patterns, housing, and health.

In the South Carolina portion of the study area, a four-county regional agency, the Central Piedmont Regional Planning Commission (CPRPC) has recently been established for the purpose of areawide planning (Figure 16).

Sub-state Planning Districts

Both North and South Carolina have divided their respective state areas into multi-county sub-state planning districts. North Carolina has proposed, but not yet officially designated, a ten-county district, and South Carolina has designated a four-county district in the Charlotte area. These are shown in Figure 17).

Clearinghouses

In accordance with the Intergovernmental Cooperation Act of

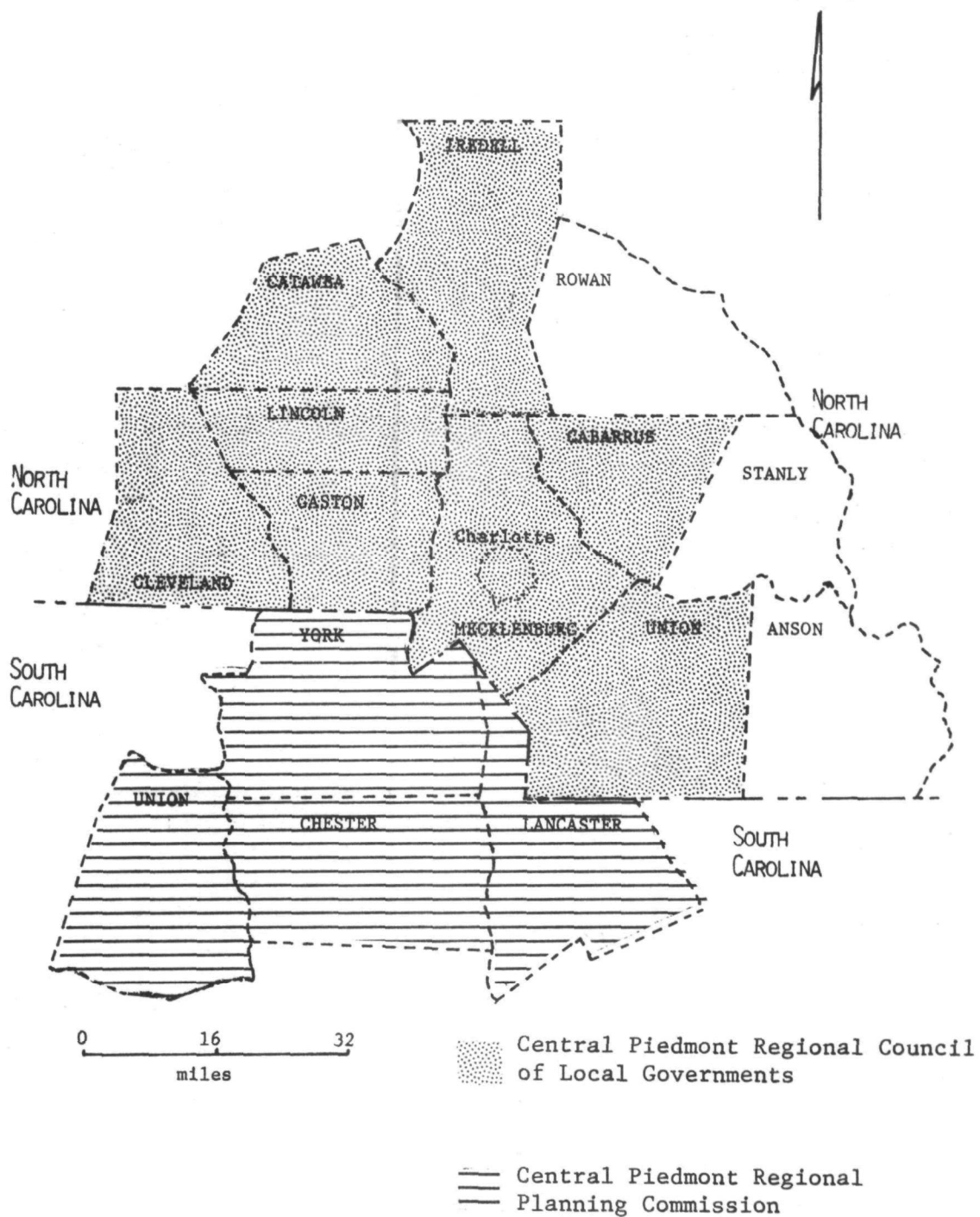


FIGURE 16 - Regional Planning Bodies in the Metropolitan Charlotte Study Area.

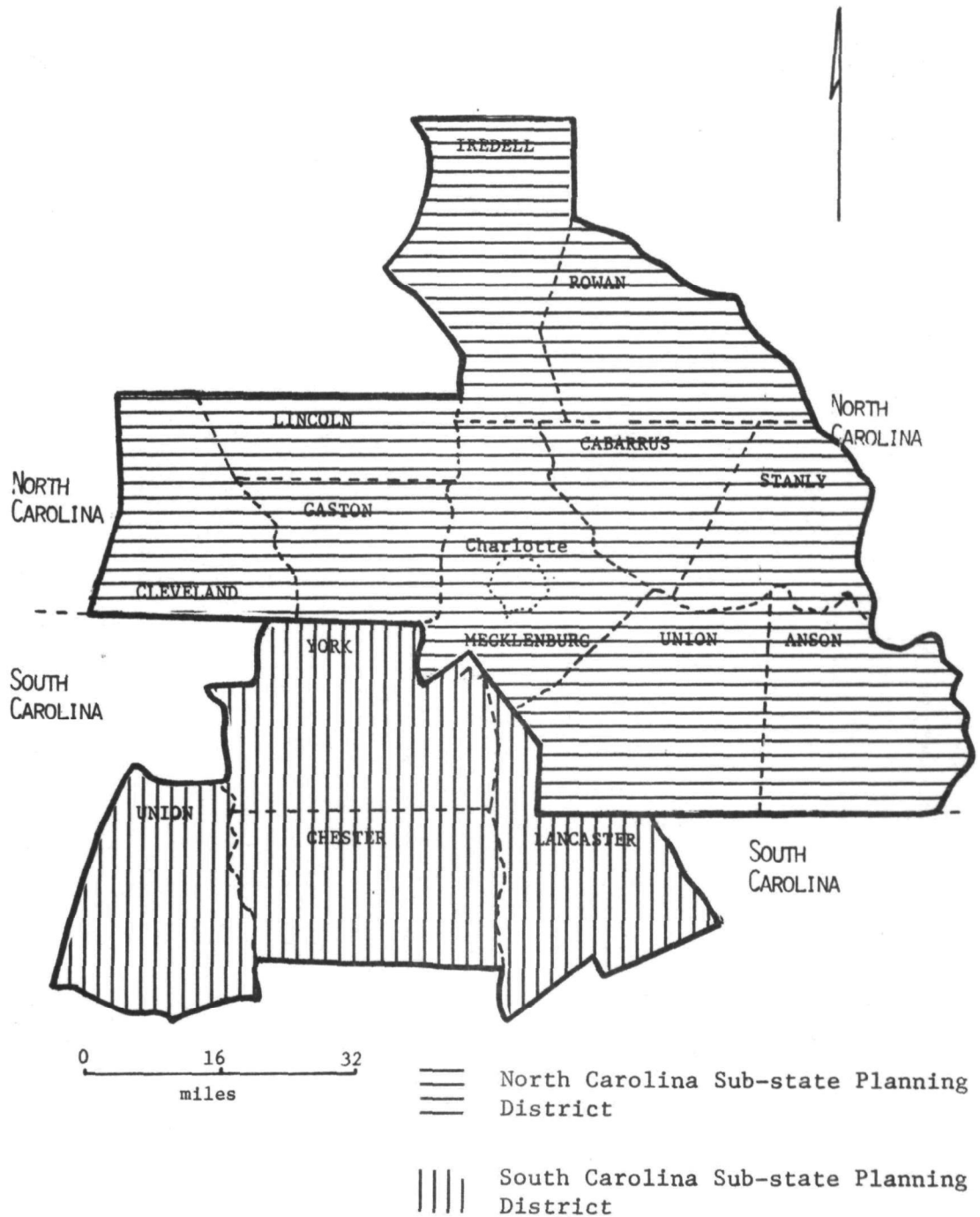


FIGURE 17 - Sub-state Planning District, Metropolitan Charlotte Study Area.

1968, the Central Piedmont Regional Council of Local Governments and the Central Piedmont Regional Planning Commission have been designated as clearinghouses. Through the clearinghouses, Federal development assistance is coordinated with State, regional, and local comprehensive planning.

As clearinghouses, CPRCLG and CPRPC are responsible for review of project proposals and applications for Federal assistance submitted by localities.

Law Enforcement Districts

The Justice Department is authorized to make grants to States for planning and improvement of public protection, recruitment, construction of facilities, education, training, and other aspects of law enforcement in local areas.

North Carolina has four law enforcement districts in the Metropolitan Charlotte study area, having the following composition of counties: (1) Gaston County; (2) Lincoln and Cleveland Counties; (3) Mecklenburg, Union, Cabarrus, and Iredell Counties; and (4) Catawba. South Carolina has one law enforcement district affecting the study area which includes York, Union, Chester, and Lancaster Counties.

Resource Conservation and Development Project Areas

The Department of Agriculture makes grants to local governments for resource conservation and land use planning. A six-

county Resource Conservation and Development Project Area has been designated in northern South Carolina which includes four counties in the study area (York, Union, Chester and Lancaster Counties).

Comprehensive Health Planning Area

The Public Health Service provides, through state health planning agencies, grants to local governmental organizations for comprehensive health planning. Within the study area, Mecklenburg County is the only Comprehensive Health Planning Area.

Cooperative Area Manpower Planning System Areas

The Federal Cooperative Area Manpower Planning System (CAMPS) provides for committees made up of local representatives of Federal, or Federally-supported, manpower programs. The responsibility of a CAMPS committee is the coordinated planning of all manpower programs for a particular area. Four CAMPS committee areas have been established in the Metropolitan Charlotte area having the following County composition: (1) Mecklenburg, Cabarrus and Union (N.C.) Counties; (2) Gaston, Cleveland, Lincoln, and Catawba Counties; (3) Union County (S.C.); and (4) York, Chester, and Lancaster Counties.

Air Pollution Control Agencies

In North Carolina, the State agency responsible for air pollution control is the North Carolina Board of Air and Water Resources. The Air Pollution Control Division of the State Board has a staff of thirteen and a budget of \$163,500 for fiscal year 1970, with about \$350,000 anticipated for fiscal year 1971.

Five local air pollution programs established in the North Carolina portion of the study area include the following County groups: (1) Mecklenburg County; (2) Gaston County; (3) Rowan County; (4) Lincoln and Catawba Counties; and (5) Cleveland County. These local programs are administered either by air pollution boards or by county health departments. They are responsible directly to the North Carolina Air and Water Resources Board. Mecklenburg County is providing technical assistance to Gaston County and to Lincoln and Catawba Counties on their programs. Similar cooperative arrangements between Mecklenburg County and Iredell and Union (N.C.) Counties have been discussed.

In the South Carolina portion of the study area, the South Carolina Pollution Control Authority is the State agency responsible for air quality control. The Authority has a present staff of ten with 31 additional positions authorized for 1971. Its 1970 budget is \$240,000 and the 1971 budget is expected to be \$415,000. No local control agencies have been created in the South Carolina portion of the study area.

The States of North and South Carolina have the power to cooperate in an Interstate Air Quality Control Region. North Carolina statutes permit cooperation between localities (both inside and outside North Carolina), but North Carolina law may reserve to the State exclusive authority to regulate air quality. In both States, authority to form interstate planning agencies (as distinguished from regulatory agencies) has been given to local governments.

PROPOSED AIR QUALITY CONTROL REGION

Subject to the scheduled consultation, NAPCA proposes for designation an air quality control region in the Metropolitan Charlotte area consisting of the following counties shown on Figure 18:

In North Carolina

Cabarrus
Cleveland
Gaston
Mecklenburg
Union

In South Carolina

Lancaster
York

An air quality control region should meet three basic criteria:

1. It should encompass most pollution sources as well as most people and property affected by the sources.
2. It should include those areas where industrial and residential growth may create significant future problems.
3. It should be consistent with unified and cooperative administration of the region's air resources.

The proposed seven-county region for Metropolitan Charlotte is the minimum area which satisfies the criteria.

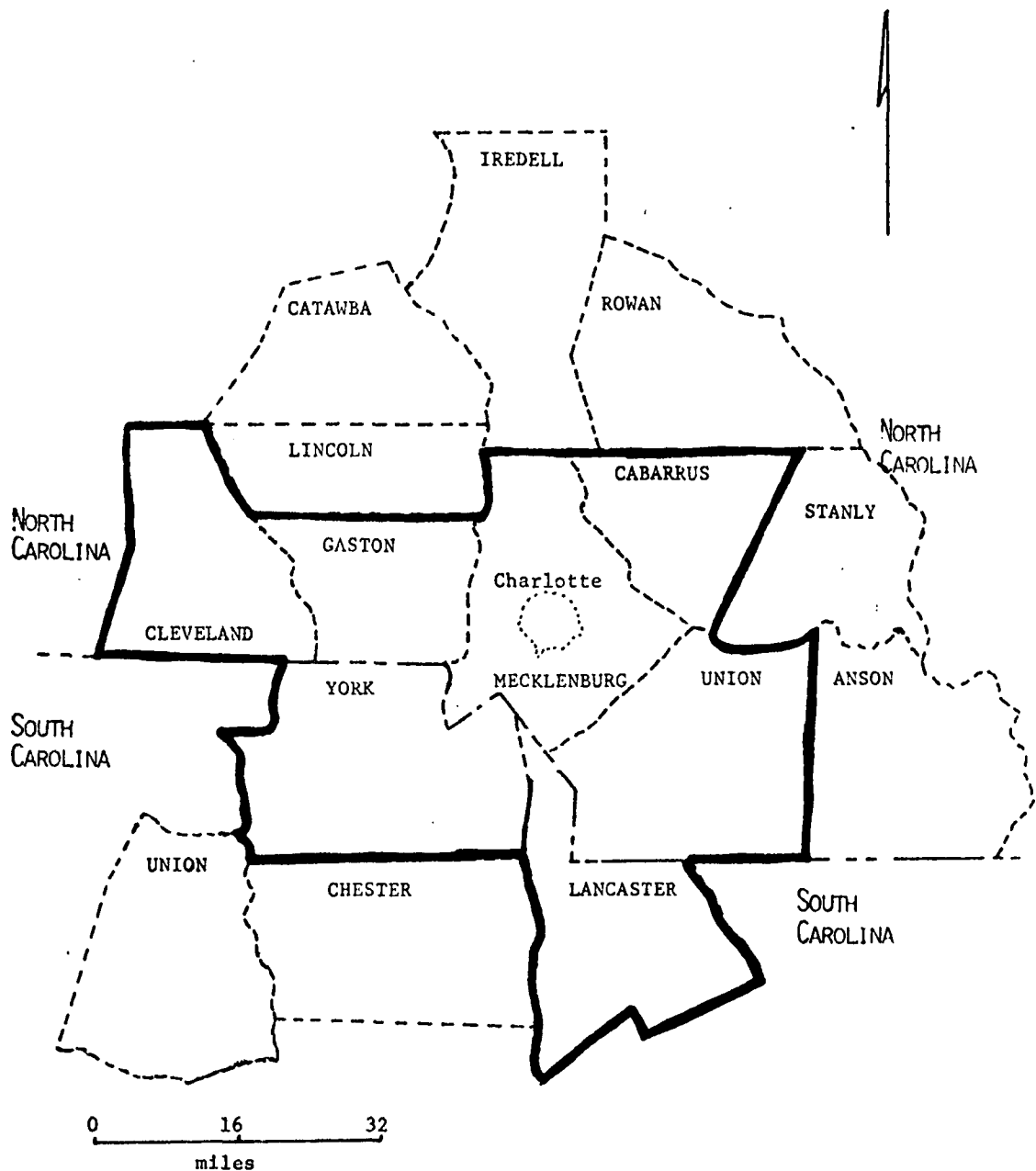


Figure 18:

Proposed
Metropolitan Charlotte Interstate
Air Quality Control Region

The discussions in preceding sections of technical, urban, and governmental factors relevant to a determination of the Region's boundaries lead to the following conclusions:

1. Sulfur oxides, particulates, and nitrogen oxides pollution sources are concentrated mainly in Gaston, Catawba, Rowan, and Cleveland Counties. The remaining major sources are in York and Mecklenburg Counties. If present plans for construction of new power plants are carried out, Iredell County may also become a major source of these pollutants and the contribution of Catawba and Cleveland Counties may increase.

Carbon monoxide and hydrocarbon sources are widely dispersed throughout the study area counties, but primary concentrations exist in Mecklenburg, Gaston, Rowan, and Catawba Counties.

The people and property in these major pollution source counties are affected by the dispersion of pollutants. Lower level effects encompass portions of Cabarrus, Lincoln, Iredell, Union (N. C.), and Lancaster Counties, despite the fact that these counties are not major pollution sources at the present time.

2. Population densities are highest in Mecklenburg, Gaston

and Catawba Counties, with Rowan and Cleveland following close behind. Growth of population during the last decade has been most pronounced in Mecklenburg, Gaston, Iredell, and Catawba. Due to the influence of Interstate 77 and Interstate 85, it is anticipated that future urban development in Iredell, Cabarrus, and Cleveland Counties will be significant.

Manufacturing employment is largest in Gaston, Mecklenburg, Catawba, and Cabarrus Counties. Growth of manufacturing employment during the period between 1962 and 1968 was most noticeable in Catawba, Gaston, and Mecklenburg Counties. A large portion of the manufacturing employment in the area is involved in textiles, apparel, and furniture production. The city of Charlotte serves as a financial and service center for the regional economy.

3. A multiplicity of intergovernmental cooperation organizations exist in the study area. In North Carolina, local air pollution control districts have been established on a single county basis in Mecklenburg, Gaston, Rowan, and Cleveland Counties, and for the two-county area of Lincoln and Catawba Counties. South Carolina has not established local air pollution control districts.

It appears from these conclusions that the seven-county proposed region constitutes the minimum area for a comprehensive approach to the region air pollution problem. Although Catawba is not among the seven counties proposed, there are strong reasons for adding Catawba to the region. It has nearly the same manufacturing employment as Gaston and Mecklenburg, and the growth of manufacturing employment during the middle sixties was greater in Catawba than in either Gaston or Mecklenburg. Catawba emits a greater percentage of the sulfur oxides and particulates than Mecklenburg. Production of electrical power from plants in Catawba may be increased in the near future. Catawba has recognized the need for air pollution control by forming a local program with Lincoln County. On the basis of these facts, it would seem that Catawba would be a natural candidate for inclusion in the air quality control region. It can be argued that Catawba does not need to be included in the region because it is separated from Gaston and Mecklenburg by Lincoln County, which has a low population density, low manufacturing employment, and low growth expectation. On the other hand, since Lincoln County is not large, the buffer zone is relatively narrow, if it can be said to exist at all. Therefore, the National Air Pollution Control Administration recommends that Catawba County should be carefully considered for inclusion in the Charlotte Region during the discussion at the consultation,

and further suggested that if Catawba is not included in the initial designation of the Charlotte Region following the consultation, it should be reconsidered periodically for possible inclusion at a later date. It is evident that the inclusion of Catawba in the Region would require the inclusion of Lincoln County also, since Lincoln lies between Catawba and the remainder of the Region.

Iredell is another county which has links with the Charlotte area but which is not included in the proposal. Population, manufacturing employment, and recent growth in manufacturing employment for Iredell are all smaller than for Catawba, but the population growth of Iredell for the past decade has been larger than for Catawba. Interstate 77 will promote rapid development in Iredell County in the future. The possibility that a new power plant may be located in Iredell is another indication of its interdependence with the metropolitan Charlotte area. If future population and industrial growth in Iredell create an increasing linkage with the regional air pollution problem, the situation should be reviewed to determine if inclusion of Iredell is warranted by the altered conditions.

Rowan is a third County which deserves further consideration even though it is not included in the proposed region. The population density and manufacturing employment of Rowan are comparable to those of Cleveland County. Population growth during the sixties was similar for Rowan and Cleveland. They are both linked to Charlotte by Interstate 85. Pollutant

emissions from Rowan are generally somewhat higher than those from Cleveland. Therefore, it might seem inconsistent to include Cleveland in the proposed region but exclude Rowan. However, Rowan appears to be more closely linked to the Greensboro and Winston-Salem area than to the Charlotte area. Therefore, Rowan was not included in the proposal in anticipation of the possibility that it might be included in a regional approach to air pollution control focussed on the Greensboro and Winston-Salem area.

It appears at the present time that additional counties on the periphery of those discussed are not required in the air quality control region in order to provide for a comprehensive approach to the regional problem.