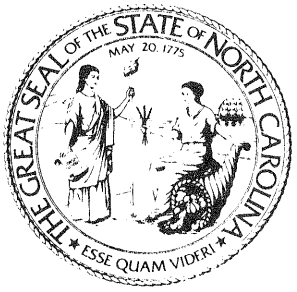
1988 AMBIENT AIR QUALITY REPORT

PUBLISHED FEBRUARY 1990

North Carolina Department
of Environment, Health,
and Natural Resources

Division of Environmental Management
Air Quality Section

1988 AMBIENT AIR QUALITY



STATE OF NORTH CAROLINA
James G. Martin, Governor

DEPARTMENT OF
ENVIRONMENT, HEALTH,
AND NATURAL RESOURCES
William W. Cobey, Jr., Secretary

DIVISION OF ENVIRONMENTAL MANAGEMENT
George T. Everett, Director

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State of North Carolina
Department of Environment, Health, and Natural Resources
512 North Salisbury Street • Raleigh, North Carolina

James G. Martin, Governor

William W. Cobey, Jr., Secretary

February 1990

My Fellow North Carolinians:

Air quality affects us all. Maintaining excellent air quality is a challenge we face daily. From acid rain in our mountains to ozone problems in the Piedmont, North Carolinians must deal with air degradation. We must identify and prevent these problems to keep our air clean.

The Department of Environment, Health, and Natural Resources and four local air pollution control agencies monitor air pollution across the state. That information, together with other research, gives us the basis for regulations that will protect our state's air quality.

We are dedicated to preserving, maintaining, and improving the quality of the air we breathe.

William W. Cobey, Jr., Secretary

North Carolina Department of
Environment, Health, and Natural Resources

FOREWORD

This report is issued by the Division of Environmental Management of the Department of Environment, Health, and Natural Resources to inform the public of air pollution levels throughout the State of North Carolina. It presents the results of the monitoring that was conducted in 1988 to measure the outdoor concentrations of the following pollutants for which the U.S. Environmental Protection Agency and the State of North Carolina have established ambient air quality standards:

Particulate Matter	Sulfur Dioxide
Carbon Monoxide	Nitrogen Dioxide
Ozone	Lead

The data are presented graphically and as statistical summaries, including comparisons to the ambient air quality standards. The report discusses the recorded data, seasonal variability of some pollutants, and the sources and effects of each pollutant. Data and areas exceeding the ambient air quality standards are identified. Factors which have contributed to those exceedances are also described.

A brief discussion of the ambient air monitoring program, including a description of the monitoring network, is provided.

Additionally, current air pollution information is available 24 hours a day in four areas of the State through the use of the air quality index telephone numbers listed below:

Charlotte	704-333-SMOG
Durham	919-733-DATA
Fayetteville	919-486-9413
Raleigh	919-733-DATA

Additional copies of this report and the previous reports are available from:

Department of Environment, Health, and Natural Resources
Division of Environmental Management
Air Quality Section
512 North Salisbury Street
PO Box 27687
Raleigh, North Carolina 27611

Comments regarding this report or suggestions for improving future reports are welcomed.

George T. Everett

George T. Everett, Director
Division of Environmental Management

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EXECUTIVE SUMMARY

Ambient air monitoring is performed by the North Carolina Division of Environmental Management (DEM) and four local air pollution agencies. A listing of these agencies is provided in Appendix A.

A total of 265,381 air quality measurements were made in 1988 for five of the six criteria pollutants. Data summaries, graphs, maps, and discussions of the reported data as well as a description of each pollutant are presented.

Particulate Matter

During 1988, two types of particulate matter were collected in North Carolina. One type, **Total Suspended Particulate (TSP)**, includes particles in a size range of 0.3 micrometers to about 45 micrometers. The other type of particulate matter, **Particulate Matter - 10 micrometers (PM-10)**, includes particles in a size range of 0.3 micrometers to 10 micrometers (aerodynamic diameter). A micrometer is approximately 1/25000 of an inch. There were 15 exceedances of the State TSP ambient air quality standard (150 ug/m^3) in 1988. Of these, 9 were affected by exceptional events including pollen, re-roofing and construction activities. Six TSP exceedances occurred in 1988 that were not affected by exceptional events. Five of the six exceedances occurred in Canton near a major source of particulate emissions. No exceedances have been reported at the site since June, 1988. According to the recommendations of the local air pollution agency, the source has agreed to develop and implement control strategies for reduction of particulate emissions. The remaining exceedance occurred at Lincolnton in April during the pollen season. The monitoring site is not located near any major source of particulate emissions. Additional monitoring is needed to determine the extent of the particulate matter problems in the Canton and Lincolnton areas.

On July 31, 1987, the Federal Environmental Protection Agency (EPA) replaced the national TSP ambient air quality standard with a national standard for PM-10. Subsequently, the North Carolina EPA PM-10 standard became effective July 1, 1988. There were 11 sites that collected PM-10 data in 1988. Of the 579 samples collected there were no exceedances of the new PM-10 National Ambient Air Quality Standard. Based upon the average PM-10 to TSP ratio, there is a likelihood that sixteen of the TSP sites will exceed the PM-10 annual standard if PM-10 monitors were installed. More PM-10 monitoring is needed to determine if a PM-10 problem exists.

Carbon Monoxide

Carbon monoxide (CO) is the most abundant air pollutant in North Carolina. More than 80 percent of the CO is believed to be emitted by motor vehicles. The most likely areas to have excessive CO concentrations are the larger cities where there are more cars and sometimes congested city streets.

In Charlotte, no exceedances were reported in 1986, 1987 and 1988. The motor vehicle Inspection and Maintenance program, which has been in operation in Mecklenburg County since December 1982, deserves some of the credit for this CO improvement.

Excessive CO readings continue to be reported in Wake and Durham Counties. There were a total of five 8-hour average CO exceedances in the Raleigh and Durham areas in 1987 and 1988. This is much improved when compared to a total of 45, 8-hour averages above the ambient air quality standard reported in 1986. The combined effects of newer cars in the vehicle fleet, traffic control strategies, and the Wake County Inspection and Maintenance program have helped decrease the number and intensity of CO exceedances. However, more ambient monitoring data will need to to be collected and evaluated to confirm this improvement.

Ozone

Ozone (O_3) is a major component of smog and forms when numerous chemical compounds react together in the presence of sunlight. Hydrocarbons and nitrogen dioxide are important reactants in the formation of ozone; therefore, nationwide the main emphasis in control of ozone has been to control hydrocarbon emissions. More ozone exceedances occurred at higher concentrations in 1988 than in any prior year. There were a total of 69 exceedances of the ozone air quality standard in 1988.

To date, only Mecklenburg County has been designated as an ozone nonattainment area. In 1988, at three Mecklenburg County ozone monitoring sites, there were a total of twenty-four values exceeding the ambient air quality standard. More strict hydrocarbon control strategies are being used in Mecklenburg County to reduce the ozone problem. Six exceedances at the Butner ozone site in 1988 and one exceedance in 1987 establish the need for development of ozone control strategies in the Raleigh and Durham areas. In 1988, several other areas of the state exceeded the ambient air quality standard for ozone. In 1988, Winston Salem, Fayetteville and Wake Forest monitors reported at least three exceedances each. In 1987, these sites reported at least one exceedance each. These areas, as well as several others, are being carefully watched. The 1988 data indicates that ozone control plans will be required for at least 19 counties near the monitors that reported exceedances. As part of the strategy development, monitoring is planned in 1989 for Charlotte and Raleigh for nitrogen dioxide (NO_2) and nonmethane organic carbon (NMOC) compounds. NO_2 and NMOC are precursor pollutants which react together to form ozone. **Ozone has become the most widespread and most serious criteria air pollutant problem in North Carolina.**

Sulfur Dioxide

In 1988 no **sulfur dioxide (SO_2)** ambient concentrations were measured above the ambient air quality standard at state and local agency monitoring sites. The sites measuring the highest concentrations are near major sulfur dioxide sources such as those burning large quantities of fossil fuels and manufacturing sulfuric acid. Remote and rural SO_2 concentrations are very low, frequently near the lower measurement capability of the monitors. SO_2 data continues to be collected and evaluated to aid new and expanding industry in the permitting process.

Nitrogen Dioxide

Nitrogen oxides are emitted into the atmosphere as a result of burning fuel by both stationary sources and motor vehicles. These nitrogen oxides, particularly nitric oxide, convert to **nitrogen dioxide (NO_2)** in the atmosphere. In 1988, only limited ambient air monitoring for nitrogen dioxide was conducted. Two sites were operated in Winston Salem for the entire year. No exceedances of the nitrogen dioxide ambient air quality standard have been measured at these sites or at other sites in recent years. More NO_2 monitoring will begin in 1989 in Charlotte and Raleigh as a part of data gathering for development of control strategies for ozone nonattainment areas.

Lead

Lead (Pb) analysis was performed routinely at five North Carolina TSP sites. Lead emissions from sandblasting of bridges, overpasses, and water tanks have the potential to be the most significant sources of lead contamination in the state. There have been no exceedances of the lead ambient air quality standard in recent years. The ambient air lead concentrations continue to drop due to a steady decrease in the use of leaded fuels which is the most significant source of airborne lead in North Carolina.

I. AMBIENT AIR QUALITY STANDARDS

Ambient air quality progress is determined by measuring ambient pollutant concentrations and comparing the concentrations to the corresponding standard. The "ambient air" is defined by the Environmental Protection Agency (EPA) as "that portion of the atmosphere, external to buildings, to which the general public has access." The ambient air quality standards are classified as primary standards, secondary standards, or both. The primary standards were established allowing an adequate margin of safety for protection of public health. Secondary standards were established with an adequate margin of safety to protect the public welfare from adverse effects associated with pollutants in the ambient air.

In protecting public welfare, air pollution effects on the following are considered: soils, water, crops, vegetation, man-made materials, animals, wildlife, weather, visibility, climate, property, transportation, economy, personal comfort, and well-being. The scientific criteria upon which the standards are based are periodically reviewed by EPA and the standards are re-established or changed based upon the findings. The national primary and secondary standards and the North Carolina ambient air quality standards are summarized in Table I. Brief descriptions of air pollutants for which ambient air quality standards exist are included in Section III of this report.

TABLE I: Summary Of National And N.C. Ambient Air Quality Standards

POLLUTANT	TIME OF AVG.	NAT. PRIM. STD	NAT. SEC. STD	N.C. STD
TSP [a]	Ann. Geo. Mean	75 ug/m^{3a}	None	75 ug/m^3
	24 Hour[b]	260 ug/m^{3a}	150 ug/m^{3a}	150 ug/m^3
PM-10	Ann. Arith. Mean [a]	50 ug/m^{3a}	Same as prim.[a]	50 ug/m^{3a}
	24 Hour [a,c]	150 ug/m^{3a}	Same as prim.[a]	150 ug/m^{3a}
SO_2	Ann. Arith. Mean	80 ug/m^3	None	80 ug/m^3
	24 Hour [b]	365 ug/m^3	None	365 ug/m^3
	3 Hour [b]	None	1300 ug/m^3	1300 ug/m^3
NO_2	Ann. Arith. Mean	.053 ppm	Same as prim.	.053 ppm
CO	8 Hour [b]	9 ppm	None	9 ppm
	1 Hour [b]	35 ppm	None	35 ppm
O_3	1 Hour [c]	0.12 ppm	Same as prim.	0.12 ppm
Pb	Quarterly			
	Arith. Mean [b]	1.5 ug/m^3	Same as prim.	1.5 ug/m^3

a. The National Total Suspended Particulate (TSP) standards were replaced by National Particulate Matter-10 micrometer, aerodynamic diameter, (PM-10) standards on 7-31-87 by EPA. The North Carolina PM-10 standard is effective July 1, 1988.

b. Not to be exceeded more than once per year.

c. Not to be exceeded on more than an average of one day per year. (Four days with an exceedance at a site in three years or less is a violation.)

ug/m^3 - micrograms per cubic meter of air
ppm - parts per million
microgram - one millionth of a gram, where 454 grams = 1 pound

II. 1988 AMBIENT AIR QUALITY DATA

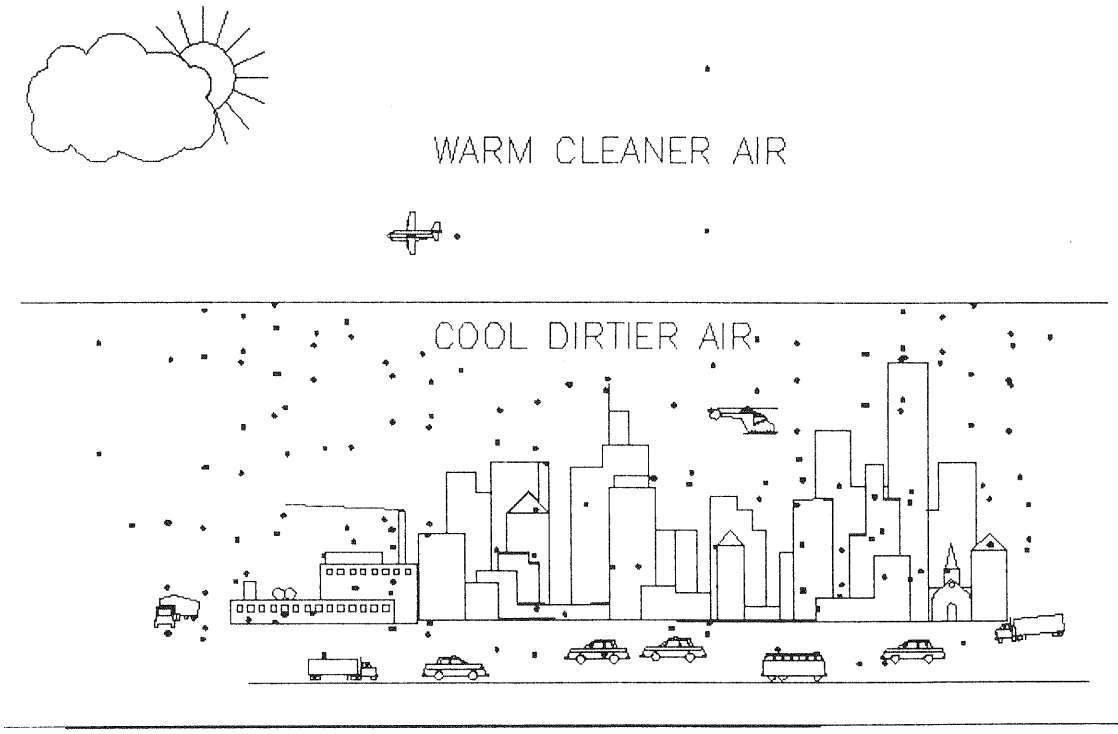
There are many factors that affect the quality of air in an area. Air quality is a function of meteorological conditions as well as location and size of pollution sources. The speed and direction of air movement determine whether pollutant emissions cause exceedances of the ambient air quality standards and where those exceedances occur. Other meteorological factors that affect pollutant concentrations include atmospheric stability (e.g., inversions), precipitation, solar radiation and temperature. The diagram below demonstrates a temperature inversion where the "cooler dirtier air" is trapped beneath a layer of "cleaner warmer air." In this illustration, the atmospheric conditions are stable with minimal wind flow and vertical mixing; therefore, poor dispersion of the air pollutants. Geographic factors that affect concentrations include variables such as whether an area is urban or rural, has mountains, valleys or plains. Economic factors that are important include concentration of industries, boom or recession, weekday or weekend. All of these variations may affect air pollution patterns either on a short-term or long-term basis

Air quality may also be influenced by an "exceptional event." Such an event may be natural or man-made and may cause the data to be biased. Most high data and all exceedances are examined to detect "exceptional events" and to avoid misuse or misinterpretation of the data. All valid data, whether "exceptional events" or not, are included in these data summaries. Data known to have been affected by exceptional events are not included in the figures and graphs. A listing of typical exceptional events is given in Appendix B.

Ambient Data

There were 125 air pollutant monitors operated by state and local agencies in North Carolina in 1988.* A summary of the valid 1988 ambient air quality data collected is presented following a discussion of the data. To save operating costs, the monitor operations at some sites are suspended for two years and operated on the third year. For those monitors not operating during 1988, data for the most recent sampling year (1987 or 1986) are included in this report.

*A listing of these agencies is provided in Appendix A.



II. A. Particulate Matter - Total Suspended Particulate

Total Suspended Particulate (TSP) matter is collected using high volume samplers and a gravimetric analysis procedure (EPA Reference Method) by the state and four local program agencies. A description of the sources and health effects of TSP are provided in Section III.A. There were 74 network sites measuring TSP in 1988 across the state. A total of 3984 TSP samples were collected. A summary of these data appears in Table II.

Of these, 15 samples exceeded the ambient air quality standards. This compares to 25 samples which exceeded the standard in 1987. Most of these exceedances were affected by exceptional events. Exceptional events which affected the samples were dust from construction activities, re-roofing operations and naturally occurring pollen. Pollen biases are considered exceptional events, and are not used to determine an area's attainment status with the ambient air quality standard. Detailed analyses were performed on the exceedance samples to determine the kind and amount of particulate matter present. Microscopic analysis, wind data, and reports of events near the sites are also used to identify and confirm data affected by exceptional events. A listing of all exceedances and a comment about each is given in Table III.

One of the six TSP exceedances which has not been identified as affected by exceptional events occurred at Lincolnton on April 15, 1988. The sampling site is located between commercial and residential areas remote from any major particulate sources. The objective of the location is to measure particulate matter in the vicinity and determine population exposure. Additional monitoring data needs to be collected and evaluated to determine health effects of the surrounding population.

The remaining five exceedances which were not affected by exceptional events occurred at Canton between January and June of 1988. The monitoring site is located near a major manufacturing facility which releases particulate matter from industrial processes and miscellaneous fugitive sources. The objective of the monitoring location is to measure particulate emissions from the source and determine population exposure. Following an inquiry by the local monitoring agency, the facility agreed to install and operate control equipment to reduce particulate emissions. Monitoring by the local agency and the source will continue in an effort to determine particulate emissions from the source and effectiveness of control equipment. In addition to the five exceedances in 1988, the Canton site has the highest annual arithmetic and geometric means in the monitoring network. As a result of these high values, the Canton site should get highest priority for PM-10 sampling.

The second highest 24-hour measurement, not affected by an exceptional event, is compared to the ambient air quality standard to determine attainment status. Figure 1 presents these second highest values with the data affected by exceptional events excluded for each county monitored. With the exception of the Canton site, no population-oriented sites measured two nonbiased valid exceedances of the 24-hour TSP ambient air quality standard. **Since the ambient air concentrations have been reduced by source controls, all areas of the state are considered to be attaining the state ambient air quality standards for total suspended particulate.**

The annual geometric mean is also compared to the annual ambient air quality standard to determine attainment status. There are no sites violating the state annual TSP ambient air quality standard. Figure 2 presents the highest annual geometric mean for each county monitored.

TABLE II: Total Suspended Particulates [A] In Micrograms Per Cubic Meter (ug/m^3) For 1988

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-HOUR MAXIMA 1ST	2ND	3RD	ARITH MEAN	GEO MEAN	GEO STD	EXCEEDANCES PRIMARY[B] #>260	PRIMARY[B] GM>75	SECONDARY[B] #>150
37-001-0001	Alamance	Burlington	1136 E. Webb Ave.	54	126	104	90	52	47	1.6			
37-003-0003	Alexander	Taylorsville	SR 1107 & 1117	61	102	91	88	42	37	1.7			
37-013-1003	Beaufort	Washington	400 E. Third St.	59	100	86	81	44	41	1.5			
37-021-0003	Buncombe	Asheville	Health & Social Services Bldg.	61	102	101	90	45	40	1.6			
37-021-0025	Buncombe	Regional Airport	I-26 S.	54	133	112	86	48	42	1.7			
37-021-0026	Buncombe	Grovestone	WNC Shopping Center	58	110	99	96	46	41	1.6			
37-021-0027	Buncombe	Candler	US 19-23	61	104	95	91	48	43	1.7			
37-025-0004	Cabarrus	Kannapolis	Floyd St.	58	107	106	99	53	49	1.6			
37-027-0003	Caldwell	Lenoir	Hwy 321 N.	56	109	95	89	42	42	1.6			
37-031-0003	Carteret	Morehead City	Arendell & 4th Streets	61	107	86	82	51	47	1.5			
37-035-0004	Catawba	Hickory	1650 First St.	56	134	126	125	67	62	1.5			
37-047-0001	Columbus	Acme Delco	SR 1878	54	80	71	68	41	38	1.5			
37-051-0004	Cumberland	Fayetteville	Fire Sta. 5, 3296 Village Dr.	56	205	112	108	52	48	1.5			1
37-057-0002	Davidson	Lexington	S. Salisbury St.	58	122	120	112	60	57	1.5			
37-057-1001	Davidson	Thomasville	City Hall, 7 West Guilford St.	56	155	130	114	63	56	1.5			1
37-063-0001	Durham	Durham	Health Dept, 300 E. Main St.	54	106	104	94	53	48	1.5			
37-065-0002	Edgecombe	Rocky Mount	Legett Rd., Waste Treatment	48	135	118	109	56	51	1.6			
37-067-0001	Forsyth	Walkertown	Grubbs Road	60	105	94	91	43	38	1.6			
37-067-0004	Forsyth	Winston Salem	Old Walkertown Rd., PI School	15	66	52	52	36	32	1.6			
37-067-0009	Forsyth	Winston Salem	Indiana Ave. & Akron Dr.	60	127	127	125	62	56	1.6			
37-067-0013	Forsyth	Winston Salem	720 Ridge Avenue	58	122	119	101	58	54	1.5			
37-067-0014	Forsyth	Winston Salem	Stadium Drive	60	114	107	87	52	49	1.5			
37-067-0015	Forsyth	Winston Salem	Hutton Street	56	108	103	97	52	47	1.6			
37-067-0020	Forsyth	Winston Salem	Silas Creek Pkwy At Hawthorn	59	118	106	102	52	48	1.5			
37-067-0021	Forsyth	Winston Salem	Sixth & Broad St., Friends Ch.	60	116	107	92	51	46	1.6			

(A) This Table includes all valid TSP Data, including those affected by exceptional events.
(B) A more detailed listing of exceedances is given in Table III

(TABLE II: Continued Next Page)

TABLE II: Total Suspended Particulates [A] In Micrograms Per Cubic Meter (ug/m^3) For 1988 (Continued)

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-HOUR MAXIMA 1ST	2ND	3RD	ARITH MEAN	GEO MEAN	GEO STD	EXCEEDANCES PRIMARY[B] #>260	PRIMARY[B] GM>75	SECONDARY[B] #>150
37-067-1001	Forsyth	Kernersville	Bodenheimer St.	59	130	123	104	62	58	1.5			
37-071-0014	Gaston	Gastonia	Rankin Lake Rd.	54	125	86	81	48	43	1.6			
37-081-0004	Guilford	High Point	650 Francis St.	61	112	91	88	45	40	1.7			
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade St.	53	125	110	101	50	44	1.7			
37-081-0010	Guilford	Greensboro	1305 Merritt Dr.	61	135	135	132	56	50	1.7			
37-081-0012	Guilford	Greensboro	Western Guilford High School	58	114	101	100	51	44	1.7			
37-081-1003	Guilford	High Point	National Guard Armory	59	143	126	99	56	50	1.6			
37-081-1005	Guilford	High Point	E. Green & S. Centennial St.	61	171	133	127	66	61	1.5			1
37-083-0002	Halifax	Roanoke Rapids	Fifth & Carolina Streets	56	139	100	100	54	49	1.6			
37-085-0001	Harnett	Dunn	Municipal Building	59	134	126	117	62	57	1.5			
37-087-0002	Haywood	Canton	Roof, Canton Fire Dept	60	216	175	174	78	69	1.7			5
37-087-0006	Haywood	Hazelwood	Fire Station Brown Ave.	57	138	115	101	50	44	1.6			
37-089-1005	Henderson	Hendersonville	US 25 & US 64	61	157	143	132	59	53	1.7			1
37-097-0002	Iredell	Troutman	SR 2350	15	55	52	46	33	30	1.5			
37-097-2002	Iredell	Statesville	300 South Tradd St.	13	127	115	106	67	59	1.7			
37-107-0003	Lenoir	Kinston	1700 Market St.	57	97	77	66	39	36	1.5			
37-109-0002	Lincoln	Lincolnton	Jail	55	185	135	126	60	54	1.6			1
37-111-0002	McDowell	Marion	Courthouse	61	145	129	128	66	60	1.6			
37-119-0001	Mecklenburg	Charlotte	600 E. Trade St.	56	132	117	116	62	56	1.6			
37-119-0002	Mecklenburg	Charlotte	Community Hospital 801, S. Gr	61	131	117	111	59	54	1.5			
37-119-0003	Mecklenburg	Charlotte	Fire Sta. #11, 620 Moretz St.	55	137	122	108	65	60	1.5			
37-119-0010	Mecklenburg	Charlotte	Fire Sta. #10, 2136 Remount Rd.	61	93	87	83	47	43	1.6			
37-119-0011	Mecklenburg	Charlotte	Co. Hlt. Dept. Roof, 1200 Blythe	58	108	100	99	48	43	1.6			
37-119-0026	Mecklenburg	Charlotte	Woodlawn, Nations Ford Rd.	56	108	97	97	45	45	1.5			
37-119-0028	Mecklenburg	Charlotte	1501 N. I-85	58	106	95	88	47	42	1.6			

(A) This Table includes all valid TSP Data, including those affected by exceptional events.
(B) A more detailed listing of exceedances is given in Table III

(TABLE II: Continued Next Page)

TABLE II: Total Suspended Particulates [A] In Micrograms Per Cubic Meter (ug/m^3) For 1988 (Continued)

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-HOUR MAXIMA 1ST	2ND	3RD	ARITH MEAN	GEO MEAN	GEO STD	EXCEEDANCES PRIMARY[B] #>260	PRIMARY[B] GM>75	SECONDARY[B] #>150
37-119-0901	Mecklenburg	Charlotte	7400 Tuckasegee	59	122	97	87	48	44	1.6			
37-119-1001	Mecklenburg	Davidson	Filter Plant	61	88	80	78	42	37	1.7			
37-119-1003	Mecklenburg	Huntersville	Holbrook Road	60	102	92	80	41	37	1.7			
37-119-1005	Mecklenburg	Charlotte	400 Arrowood Blvd.	57	138	107	103	58	52	1.7			
37-119-1006	Mecklenburg	Charlotte	Neck Road, Duke Power #2	57	85	78	76	35	31	1.7			
37-119-2001	Mecklenburg	Mint Hill	Telephone Substation	60	98	90	88	46	41	1.6			
37-121-0001	Mitchell	Spruce Pine	City Hall, Summit St.	61	134	112	98	59	54	1.6			
37-129-0005	New Hanover	Wilmington	Ninth And Orange Streets	61	88	72	68	44	41	1.4			
37-129-1002	New Hanover	Wilmington	N. Walnut St.	14	58	57	56	39	37	1.5			
37-133-0004	Onslow	Jacksonville	2553 Onslow Drive	61	92	84	81	47	44	1.4			
37-139-0001	Pasquotank	Elizabeth City	Water Plant, N. Wilson St.	60	80	65	64	38	35	1.4			
37-145-0001	Person	Roxboro	Water Plant, Chub Lake Road	13	62	51	40	30	28	1.6			
37-147-0002	Pitt	Greenville	North Plant St.	58	88	86	68	38	35	1.5			
37-151-0003	Randolph	Asheboro	1462 Winslour St.	56	176	107	101	50	44	1.7			1
37-155-0003	Robeson	Lumberton	South Water St.	62	118	106	93	50	46	1.5			
37-159-1005	Rowan	Salisbury	Church St.	42	857	152	122	52	47	1.6	1		1
37-163-0002	Sampson	Clinton	Well #3, South Blvd.	12	69	66	61	45	42	1.5			
37-165-0003	Scotland	Laurinburg	Waste Treatment Plant	60	151	137	87	46	41	1.6			1
37-171-0002	Surry	Mount Airy	Hwy 52 S.	13	82	75	70	47	42	1.7			
37-175-0002	Transylvania	Brevard	Hwy 64	58	120	101	98	48	44	1.5			
37-183-0003	Wake	Raleigh	Fire Station #9, Six Forks Rd.	61	98	93	91	51	47	1.5			
37-187-0002	Washington	Plymouth	Old Acre Rd.	58	121	78	73	42	39	1.5			
37-191-0004	Wayne	Goldsboro	Hwy 70 West, Patrol Station	57	126	99	97	53	48	1.6			
37-195-0002	Wilson	Wilson	Kenan St. & Tarboro St.	58	165	127	126	53	48	1.6			1

(A) This Table includes all valid TSP Data, including those affected by exceptional events.
(B) A more detailed listing of exceedances is given in Table III.

Table III: 1988 TSP Exceedances

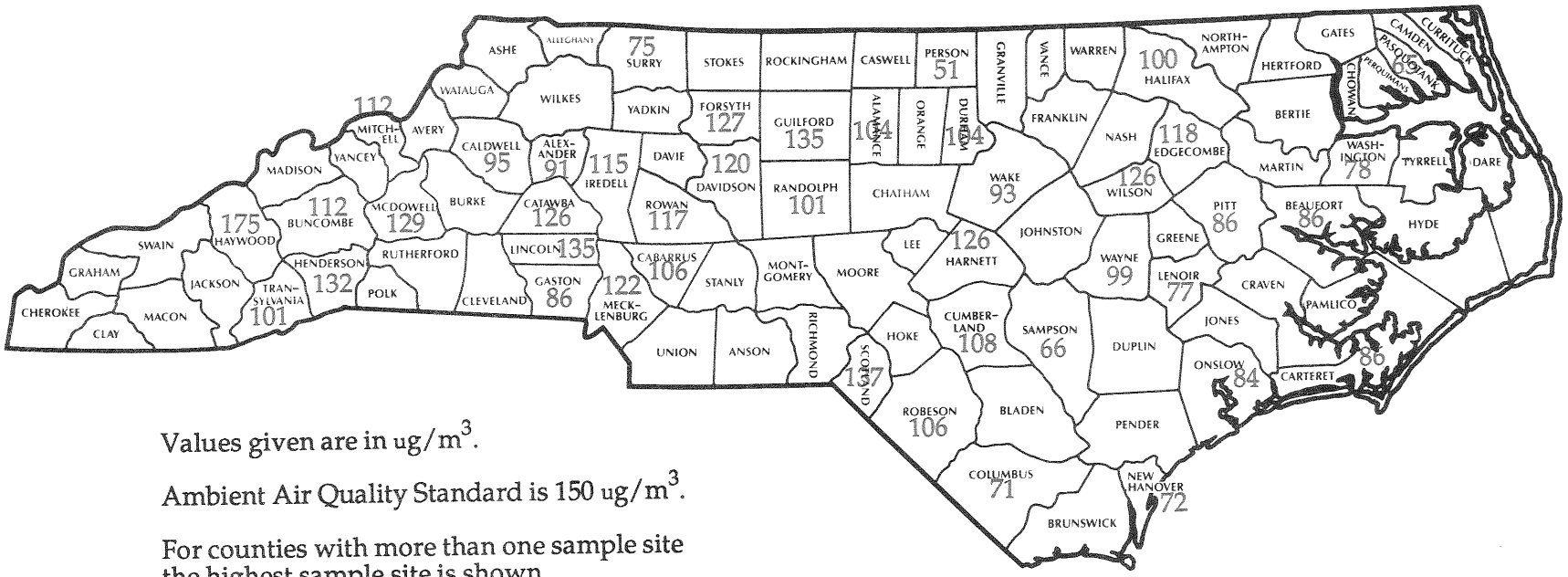
Site Number	Site Name	Date	TSP Value (ug/m^3)	Exceptional Event(s)
37-051-0004	Fayetteville	6-8-88	205	Roofing Operations
37-057-1001	Thomasville	1-28-88	155	Roofing Operations
37-081-1005	High Point	1-28-88	171	Pollen
37-087-0002	Canton	1-4-88	175	None
37-087-0002	Canton	2-27-88	174	None
37-087-0002	Canton	4-21-88	162	None
37-087-0002	Canton	6-2-88	161	None
37-087-0002	Canton	6-8-88	216	None
37-089-0005	Hendersonville	3-4-88	157	Pollen
37-109-0002	Lincolnton	4-15-88	185	None(A)
37-151-0003	Asheboro	5-3-88	176	Pollen
37-159-1005	Salisbury	5-21-88	857	Sandblasting
37-159-1005	Salisbury	6-15-88	152	Sandblasting
37-165-0003	Laurinburg	6-20-88	151	Pollen
37-195-0002	Wilson	1-6-88	165	Sanding/Salting Roads

(A) This sample was a valid exceedance of the ambient air quality standard, but since a second exceedance was not measured at this site no violation occurred.

FIGURE 1

TOTAL SUSPENDED PARTICULATE

1988 Second Highest 24-Hour Averages*



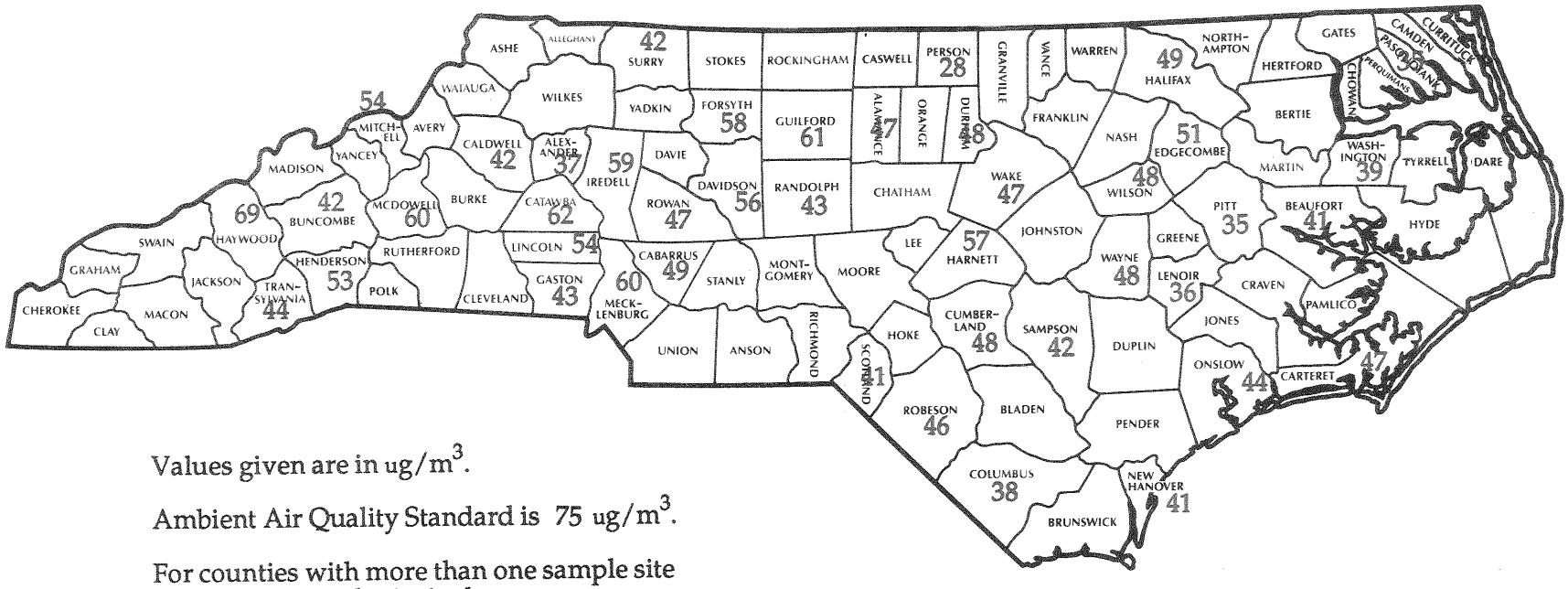
Values given are in ug/m^3.

Ambient Air Quality Standard is 150 ug/m^3.

For counties with more than one sample site the highest sample site is shown.

*Data known to have been affected by exceptional events are not included in this figure.

FIGURE 2
TOTAL SUSPENDED PARTICULATE
1988 Annual Geometric Means*



Values given are in ug/m^3.

Ambient Air Quality Standard is 75 ug/m^3.

For counties with more than one sample site the highest sample site is shown.

*Data known to have been affected by exceptional events are not included in this figure.

II. B. Particulate Matter - PM-10

Particulate Matter-10 micrometers or less (PM-10) is collected using high volume samplers and size selective inlets and is analyzed using a gravimetric analysis procedure (EPA Reference Method) by the state and four local program agencies. A description of PM-10 sources and health effects is included in Section III. A. There were eleven sample sites measuring PM-10 during all or part of 1988. The PM-10 monitors are installed in areas expected to experience PM-10 problems as indicated by complaints and TSP data. Most of these monitors are in major cities.

In October of 1988, a special study was started in Shallotte, Brunswick County to measure the impact of open burning and land clearing on PM-10 concentrations. Because the Shallotte site is not part of the regular monitoring network and was installed to characterize the local PM-10 problem, it is defined as a special purpose monitor (SPM). The Shallotte SPM was installed due to numerous citizen complaints in southwest Brunswick County of smoke and ash. PM-10 samples are collected every three days. The findings to date have been inconclusive due to an extreme amount of rain and little open burning. Sampling at the Shallotte site will continue into 1990.

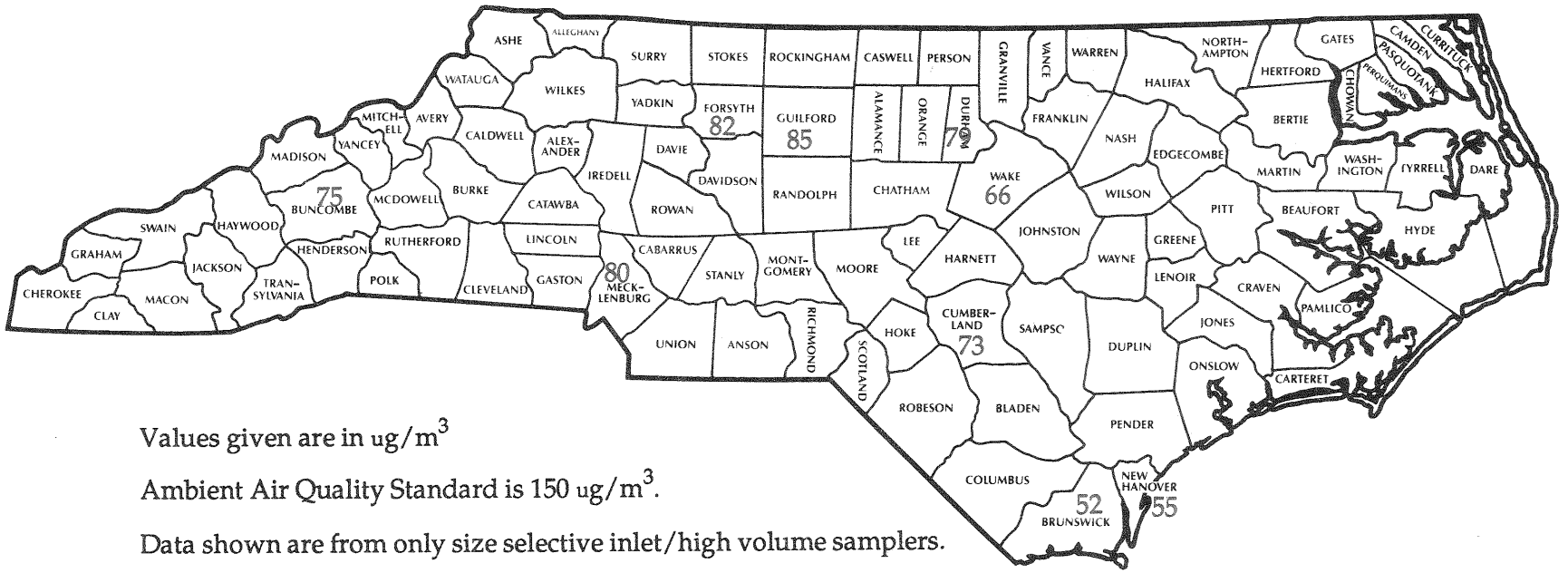
A total of 579 PM-10 samples were collected. A summary of these data appears in Table IV. **There were no PM-10 values exceeding the national ambient air quality 24-hour or annual standards.** Figure 3 presents the second highest 24-hour values for each county monitored. The highest 24-hour value is 69 percent of the new ambient air quality standard of 150 ug/m^3. Figure 4 presents the annual arithmetic mean for each county monitored. The highest annual arithmetic mean is 74 percent of the new ambient air quality annual standard of 50 ug/m^3.

PM-10 to TSP ratios are useful in estimating PM-10 concentrations from existing TSP data. Based upon the annual arithmetic means, the PM-10 to TSP ratios vary from 55/100 to 77/100 with an average ratio of 67/100. . . meaning that generally 67 percent of the TSP collected is PM-10. At the highest of these ratios, sites having TSP annual arithmetic means above 58 ug/m^3 have a reasonable likelihood of exceeding the PM-10 annual standard. In 1988 there were 16 TSP sites having annual arithmetic means above 58 ug/m^3. Due to the elevated PM-10 annual arithmetic means and the potential for PM-10 exceedances at some TSP sites, more PM-10 monitoring is needed.

TABLE IV: PM-10 In Micrograms Per Cubic Meter (ug/m^3) For 1988

SITE NUMBER	COUNTY	CITY	ADDRESS	NUM OBS	24-HOUR MAXIMA 1st	2nd	3rd	4th	ARITH MEAN
37-019-0004	Brunswick	Shallotte	State Road 1163	27	66	52	42	29	22
37-021-0003	Buncombe	Asheville	Health & Social Services	53	78	75	58	56	29
37-051-0004	Cumberland	Fayetteville	Fire Sta. #5, 3296 Village Dr.	58	79	73	69	66	33
37-063-0001	Durham	Durham	Health Dept. 300 E. Main St.	61	83	79	71	65	37
37-067-0009	Forsyth	Winston Salem	Indiana Ave. & Akron Dr.	52	96	70	61	58	34
37-067-0014	Forsyth	Winston Salem	Stadium Drive	59	88	82	76	70	37
37-067-0020	Forsyth	Winston Salem	Silas Creek Pkwy. at Hawthorn	48	73	58	54	53	28
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade	53	103	85	70	69	36
37-119-0010	Mecklenburg	Charlotte	Fire Sta. #10, 2136 Remount Rd.	50	90	80	73	70	36
37-129-0005	New Hanover	Wilmington	Ninth and Orange Streets	60	57	55	54	48	29
37-183-0003	Wake	Raleigh	Fire Sta. #9, Six Forks Rd.	61	75	66	65	58	32

FIGURE 3
PM-10
1988 Second Highest 24-Hour Values



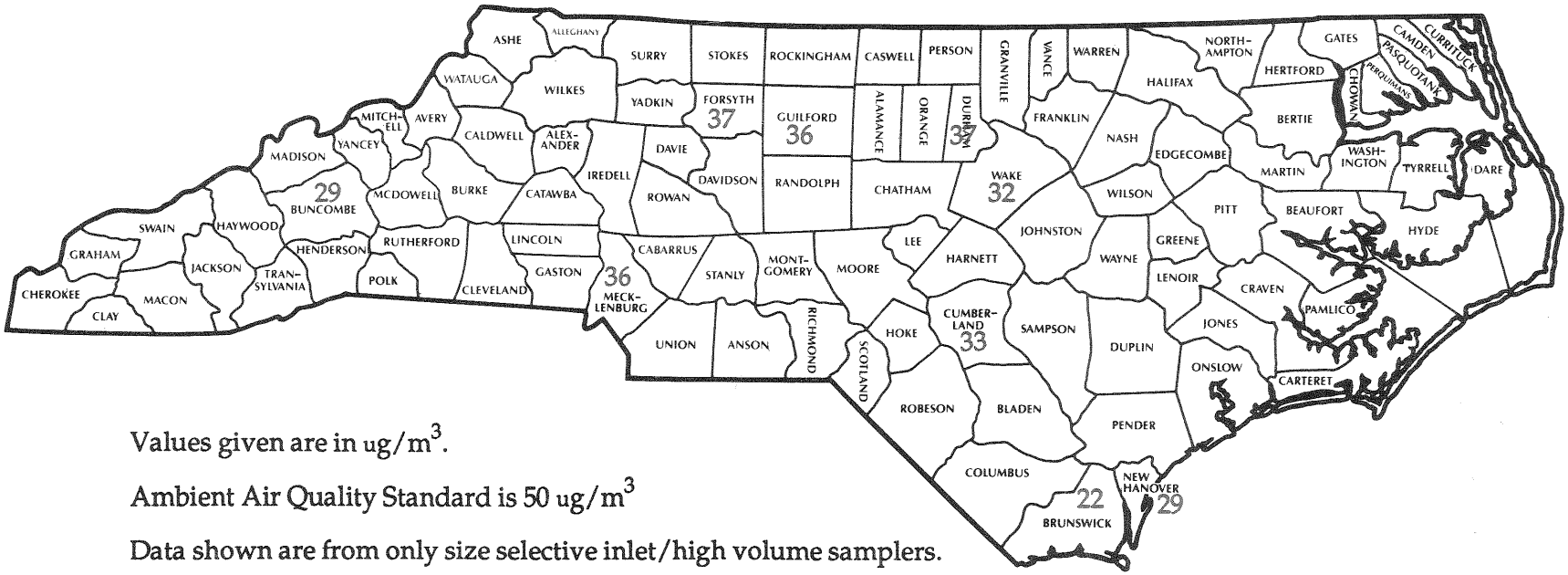
Values given are in ug/m^3

Ambient Air Quality Standard is 150 ug/m^3.

Data shown are from only size selective inlet/high volume samplers.

For counties with more than one sample site
the highest sample site is shown.

FIGURE 4
PM-10
1988 Annual Arithmetic Means



Values given are in ug/m^3.

Ambient Air Quality Standard is 50 ug/m^3

Data shown are from only size selective inlet/high volume samplers.

For counties with more than one sample site
the highest sample site is shown.

II. C. Carbon Monoxide

Carbon monoxide (CO) concentrations are measured using EPA Reference or Equivalent continuous monitors in Raleigh, Durham and Fayetteville by the state and in Forsyth and Mecklenburg counties by the two local program agencies in those counties. There were 15 carbon monoxide monitoring sites in the five major cities monitored in 1988. A total of 89,743 CO hourly measurements were made. A summary of these data appears in Table V. The second highest 1-hour CO measurement is compared to the 1-hour ambient air quality standard to determine attainment status. A discussion of CO and ozone nonattainment in North Carolina is provided in Appendix C. Figure 5 presents these second highest 1-hour CO measurements. There were no hourly periods exceeding the hourly ambient air quality standard.

The second highest 8-hour average CO value is compared to the ambient air quality standard to determine attainment status with the 8-hour standard. Figure 6 presents these second highest values for each county monitored. **The 8-hour CO ambient air quality standard was exceeded a total of 5 times in 1988 in the Durham and Raleigh areas** as compared to 45 exceedances in 1986 and 5 exceedances in 1987. In Forsyth County, two CO exceedances were reported in 1988 as compared to no exceedances in 1987 and 1986. Mecklenburg County reported no CO exceedances in 1988, 1987, and 1986. The causes for these CO exceedances include the following: The number of vehicles traveling in nearby streets, the amount of stop and go traffic, and the existence of meteorological conditions which promote poor dispersion of the carbon monoxide. The daily patterns of highest carbon monoxide measurements further confirm these as the major causes. CO measurements are high during morning and evening "rush" hours with high measurements extending into late evening and early morning hours due to poor dispersion which frequently occurs during the night.

The reduction in the number of CO exceedances is attributable to a number of factors in Durham and Raleigh. Some of these factors were due to increased news media interest and reporting of air quality index (refer to Section V), there is greater public awareness of the problem. This increased awareness has contributed to more people keeping their cars in better running condition; therefore, operating cleaner. Older, more polluting vehicles are gradually being replaced with newer and more efficient vehicles. New streets and roads, improved traffic signal coordination, and reducing onstreet parking in some areas have improved traffic flow. Additionally, in Raleigh/Wake County, a motor vehicle Inspection and Maintenance (I/M) program was started in November of 1986. This program has been in full operation since fall of 1987. Motor vehicle I/M programs will likely be a part of control strategies for all areas reporting CO exceedances in the near future.

Since ambient carbon monoxide exceedances are still occurring, changes in the control strategies will be needed for Raleigh and Durham areas. The collection of more CO data will be useful in ensuring the success of these control strategies. Figure 7 identifies the areas not attaining the CO ambient air quality standard in recent years.

The Fayetteville CO site began operation in late 1988. This monitoring site was installed to provide seasonal CO Air Quality Index (AQI) information and data for the second largest urbanized area in North Carolina. The monitor is located off a heavily travelled city street and near a major four-way intersection. The areas immediately surrounding the monitor are primarily commercial businesses followed by residential areas. The Fayetteville CO monitor is not part of the regular ambient monitoring network and is defined as a special purpose monitor (SPM). The monitor will be operated again in the 1989 season.

A new CO monitoring site will be added to the network by late 1989. The site will be located in Greensboro near a major four-way intersection and city park. The purpose of monitoring at this location is to measure the impact of CO in a worst case situation and to determine population exposure.

In 1986, 1987, and 1988 no CO 8-hour violations were reported in Mecklenburg County. The motor vehicle Inspection and Maintenance program, traffic flow improvements, and the gradual "turn-over" in the motor vehicle fleet to better controlled vehicles are helping to improve the air quality in Mecklenburg County.

The 1988 and historical data demonstrate that in the autumn and winter more frequent and higher CO exceedances occur than during the warmer seasons. There are several reasons for these seasonal variations:

a. In the colder months, North Carolina usually experiences more atmospheric inversions which means a lower atmospheric "mixing height" resulting in poor dispersion of air pollutants. These air pollutants become trapped under a warm layer of air in our atmosphere. We become exposed to higher and higher concentrations until the atmospheric mixing improves.

b. In colder months, motor vehicles emit more CO due to inefficient combustion during cold starts and warmups. Further, due to seasonal shopping, particularly in November and December, there are more cars operating in the urban areas. It is estimated that more than 80 percent of the CO found in urban areas results from motor vehicle emissions.

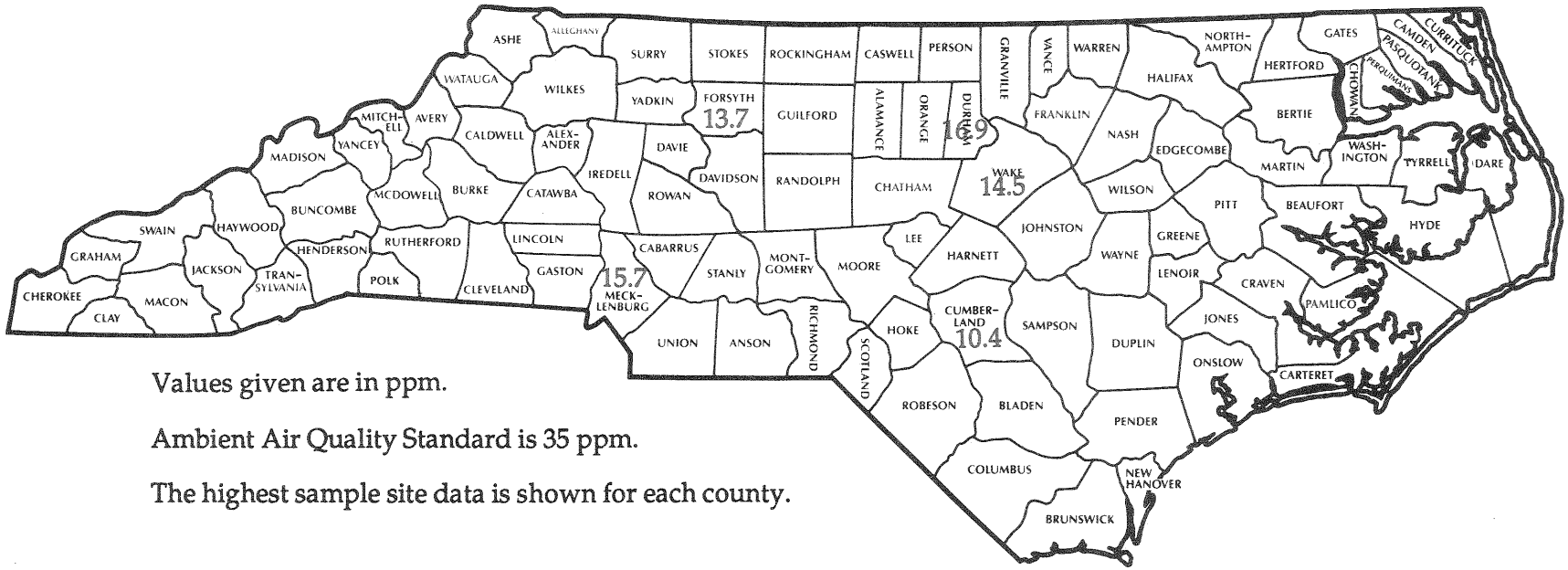
c. During colder temperatures, there is more fuel being burned in urban areas for comfort heating which adds to the total CO emitted into the atmosphere.

The monthly frequency of CO exceedances from all sites for both 1986, 1987, and 1988 is shown in Figure 8. Additional information about CO sources and effects of exposure is provided in Section III. B. Carbon Monoxide.

TABLE V: Carbon Monoxide In Parts Per Million (PPM) For 1988

					1-HOUR		8-HOUR		EXCEEDANCES	
				NUM	MAXIMA		MAXIMA		1-hour	8-hour
SITE NUMBER	COUNTY	CITY	ADDRESS	OBS	1st	2nd	1st	2nd	#>35	#>9
37-051-0007	Cumberland	Fayetteville	Cumberland Co., ABC Board	2196	12.7	10.4	8.9	7.0		
37-063-0008	Durham	Durham	302 East Main St.	8644	19.4	16.9	11.2	9.2		1
37-063-0010	Durham	Durham	City Park on University	8563	10.5	9.8	7.7	6.7		
37-067-0018	Forsyth	Winston Salem	301 N. Main St.	8656	19.1	13.7	6.8	6.3		
37-067-0019	Forsyth	Winston Salem	Queen Street, Miller Park	8670	7.3	7.3	6.2	6.0		
37-067-0023	Forsyth	Winston Salem	1401 Corp. Parkway	1124	14.3	12.7	10.7	9.7		2
37-119-0029	Mecklenburg	Charlotte	401 South Tryon	8491	16.2	12.0	7.5	7.4		
37-119-0031	Mecklenburg	Charlotte	Park Road	2287	11.5	11.2	8.5	8.4		
37-119-0032	Mecklenburg	Charlotte	5137 Central Ave.	8426	16.4	15.7	8.2	8.0		
37-119-0034	Mecklenburg	Charlotte	Plaza Road and Lakedell	8287	13.9	13.5	8.2	6.7		
37-119-0035	Mecklenburg	Charlotte	Greenville Neighborhood Ctr.	8368	11.7	11.0	6.7	6.4		
37-119-0037	Mecklenburg	Charlotte	415 E. Woodlawn Road	2175	14.8	12.6	7.6	6.2		
37-183-0010	Wake	Raleigh	309 S. Wilmington St.	8621	15.4	12.5	9.7	8.1		1
37-183-0011	Wake	Raleigh	420 S. Person St.	4134	16.1	14.5	11.6	10.0		2
37-183-0012	Wake	Raleigh	EF Hutton, Hwy 70 West	1101	14.4	12.0	9.9	6.9		1

FIGURE 5
CARBON MONOXIDE
1988 Second Highest 1-Hour Average



Values given are in ppm.

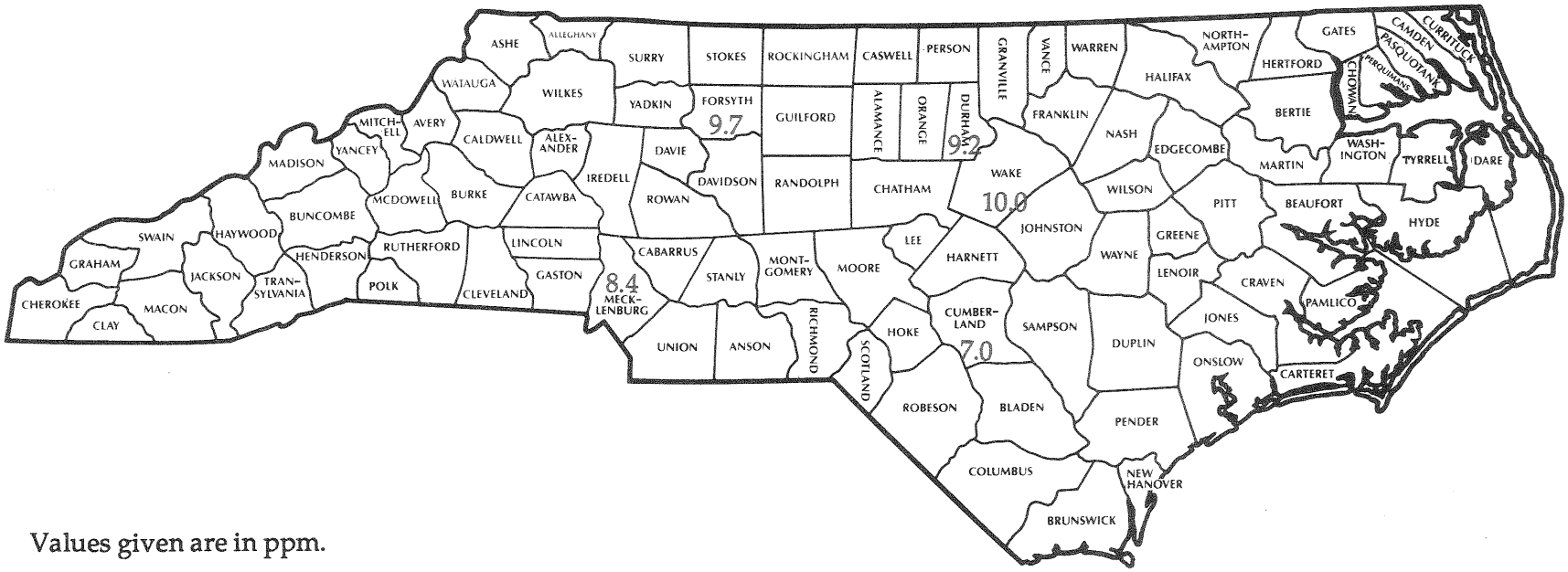
Ambient Air Quality Standard is 35 ppm.

The highest sample site data is shown for each county.

FIGURE 6

CARBON MONOXIDE

1988 Second Highest Non-overlapping 8-Hour Average

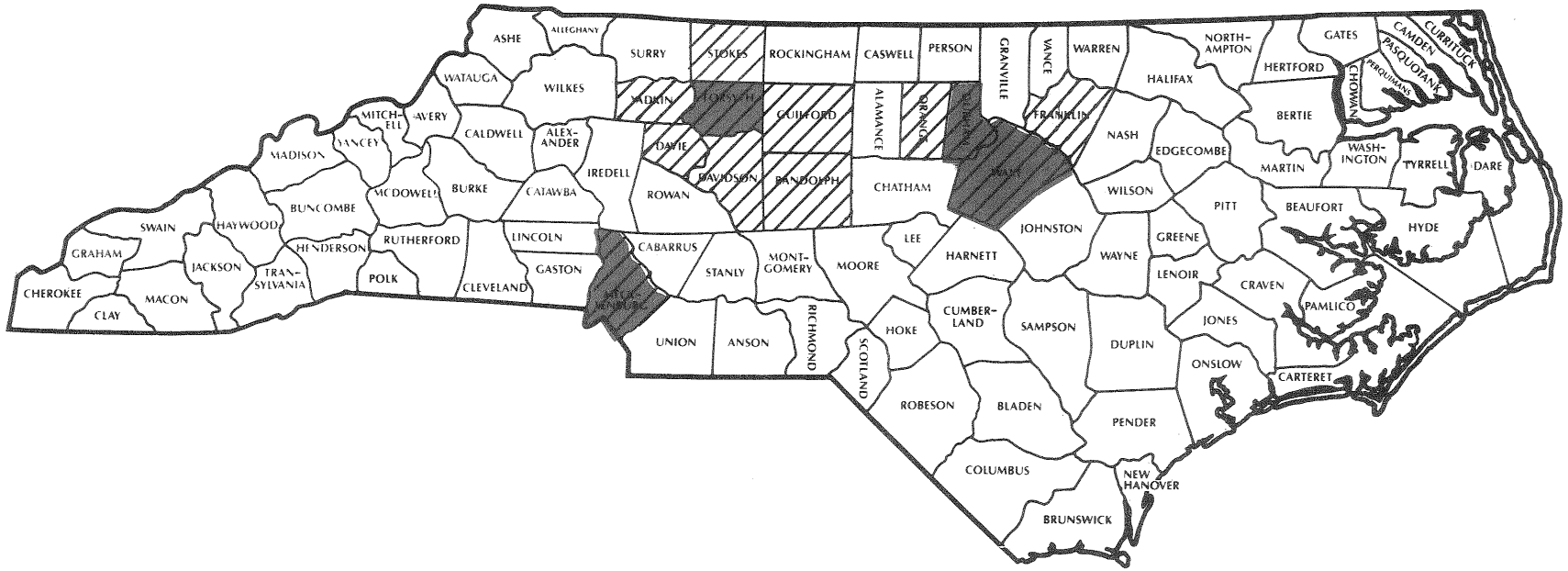


Values given are in ppm.

Ambient Air Quality Standard is 9 ppm (values greater than 9.4 ppm exceed standard).

The highest sample site data is shown for each county.

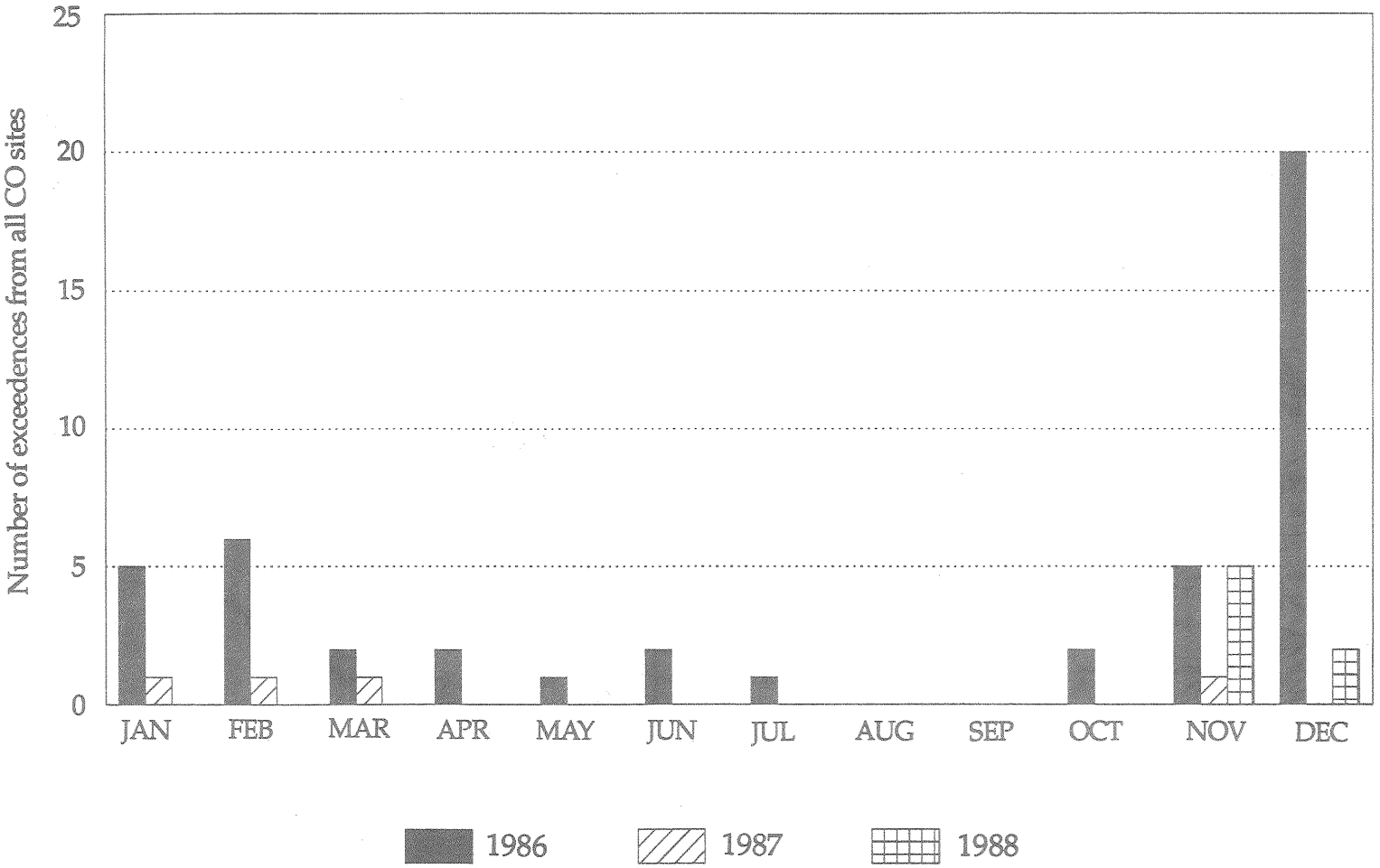
FIGURE 7
AREAS WITH EXCESSIVE CARBON MONOXIDE



Areas not attaining the CO Ambient Air Quality Standard in recent years.

Areas where CO control strategies or maintenance demonstrations are likely.

FIGURE 8. FREQUENCY OF EXCEEDANCES OF THE 8-HOUR CARBON MONOXIDE STANDARD



Ozone is a seasonal pollutant. Ozone is formed in the atmosphere as a result of many chemical reactions which occur in sunlight (photochemical reactions) mostly during the warmer months. For this reason, most of the ozone monitors only operate April through October. The number of days with high ozone readings from 1988 (readings $\geq$.099 ppm) is shown on a monthly basis in Figure 9. Section III. C. provides information about the sources of ozone precursors and health effects of ozone.

Ozone (O_3) concentrations are measured using EPA Reference or Equivalent continuous monitors by the state and three local program agencies. There were 19 ozone monitoring sites operated in 1988. Most of these sites operated only during the ozone season, April through October. A total of 87,918 O_3 hourly measurements were made during 1988. A summary of these data appears in Table VI. Prior years' data from other sites which did not operate in 1988 are also included in Table VI. For some sites, monitor operations are suspended for two years and operated on the third year. By using this rotational operating strategy, data current within the last three years is available and operating costs are kept to a minimum.

The ozone ambient air quality standard is exceeded when one valid one-hour measurement exceeds .124 parts per million (ppm) at a site and a statistically derived expected number of exceedances exceeds 1. (.124 ppm when rounded to two decimal places is not greater than the standard of .12 ppm; however, .125 ppm, when rounded to two decimal places is .13 and is greater than .12 ppm.) **Thirteen ozone monitoring sites exceeded .124 ppm on at least one occasion during 1988.** There were a total of 69 exceedances occurring at these thirteen sites. These 69 exceedances occurred from May to September.

The 1988 ozone season produced the greatest number and intensity of ozone exceedances on record in North Carolina. All but eleven exceedances occurred on workdays when motor vehicle and industrial emissions can be expected to be higher.

The days having exceedances do not appear to be meteorologically unusual, though the daily high temperatures were in the 90's on almost all days with exceedances. The average winds were between 6.3 and 6.7 mph for the Forsyth and Mecklenburg County areas and between 7.0 and 7.6 mph for the Raleigh and Durham areas.

Examination of the second highest measurement each year is a way to simply estimate the attainment status of an area. The second highest one hour values are shown in Figure 10 for the most recent season of data for all monitored areas. The areas for which ozone control strategies must be developed are shown in Figure 11.

Mecklenburg County has been designated as an ozone nonattainment area. See Appendix C for a discussion of ozone nonattainment in North Carolina. At three Mecklenburg County ozone monitoring sites, the ambient air quality standard was exceeded twenty-four times between June and September. More strict hydrocarbon control strategies are being used in Mecklenburg County to reduce the ozone problem. The control strategies that will be developed as a result of the exceedances measured at the Charlotte area monitors will effect the surrounding counties in the Charlotte-Gastonia-Rock Hill, NC-SC metropolitan statistical area (MSA). These counties are Cabarrus, Gaston, Lincoln, Mecklenburg, Rowan, Union, North Carolina; and York, South Carolina. Listed below are the days of ozone exceedances in 1988 for this MSA.

Site	County	# of days $\geq$.125 ppm ozone
37-109-0099	Lincoln	2
37-119-1005	Mecklenburg	8
37-119-0034	Mecklenburg	7
37-119-1009	Mecklenburg	9

For the Durham area, the ambient air quality standard was violated at the "downwind"

ozone site in Butner six times between June and August. Ten exceedances were measured in 1988 for the Raleigh area at the ozone monitor located in Wake Forest. The Raleigh area exceedances also occurred "downwind" between June and August. Due to these exceedances of the ambient air quality standard, control strategies will need to be developed for the entire metropolitan statistical area represented by the Butner and Wake Forest ozone sites. The five counties affected are Durham, Granville, Orange, Franklin and Wake. Additional counties will also be examined. Listed below are the days of ozone exceedances in 1988 for this MSA.

Site	County	# of days ≥.125 ppm ozone
37-077-0001	Granville	6
37-183-2001	Wake	10

The ozone control strategies will also be based on monitoring data collected in 1989 for nitrogen dioxide (NO_2) and nonmethane organic carbon (NMOC). To gather this additional data, a NO_2 monitor and NMOC sampler and an additional ozone monitor will be operated at a new site in the northeast Raleigh area in 1989. The NO_2 and NMOC data will be used in a computerized air quality model to determine which pollutant contributes most to the ozone problem and what control strategies should be developed to reduce the presence of that pollutant.

Between June and August 1988, the ozone monitors located in Davie, Forsyth, and Guilford counties measured 23 exceedances of the ambient air standard. Control strategies will have to be developed for the Greensboro-Winston Salem-High Point metropolitan statistical area. Counties in this area are Davidson, Davie, Forsyth, Guilford, Randolph, Stokes and Yadkin. Listed below are the days of ozone exceedances in 1988 for this MSA.

Site	County	# of days ≥.125 ppm ozone
37-059-0099	Davie	7
37-081-0011	Guilford	8
37-067-0006	Forsyth	3
37-067-0007	Forsyth	3
37-067-1008	Forsyth	2

The ozone monitor located in the Fayetteville metropolitan statistical area measured 3 exceedances between May and June of 1988. Control strategies will also need to be developed for Cumberland County.

An ozone monitoring site was installed and operated during the 1988 ozone season in Camden. The Camden site was located and operated on the northeast coast downwind from the Virginia coast during the late summer months. The purpose of monitoring at this location is to determine the impact of nitrogen oxides and hydrocarbons originating in Virginia on formation of ozone in North Carolina. The Camden site reported no exceedances in 1988 and will be operated during the 1989 ozone season. Since the Camden site is operated only for this special purpose, it is defined as a special purpose monitor and is not part of the regular monitoring network.

A preliminary look at the 1989 ozone data is included in Appendix D of this report, "Ozone Exceedances in the Last Three Years". In 1985, there were no reported ozone exceedances in the state. From 1985 through 1988, there have been progressively more frequent ozone exceedances with 69 occurring in 1988. More and higher ozone exceedances occurred in more areas in 1988 than any other year on record. **Ozone has become the criteria pollutant of greatest concern in North Carolina.**

TABLE VI: Ozone in Parts Per Million (PPM) for 1988

Site Number	County	City	Address	NUM OBS	DAILY 1-HOUR MAXIMA 1st	2nd	3rd	4th	VALS ≥.125 MEAS	EST
1988 Data										
37-003-0003	Alexander	Taylorsville	SR 1107 & 1117	1131	.117	.094	.086	.086		
37-021-0029	Buncombe	Fairview	Hwy 74 SE	2944	.118	.110	.106	.104		
37-029-0099	Camden	Camden	County Road	2442	.119	.111	.100	.087		
37-051-0001	Cumberland	Eastover	Old US Hwy 301 N.	6890	.141	.131	.130	.121	3	3.1
37-059-0099	Davie	Fork	Recreation Center	7980	.153	.151	.145	.139	7	7.2
37-067-1006	Forsyth	Winston Salem	Goodwill Church	5069	.142	.137	.120	.122	3	3.0
37-067-0007	Forsyth	Winston Salem	5337 Old Rural	8488	.137	.134	.134	.122	3	3.0
37-067-1008	Forsyth	Winston Salem	3656 Piedmont	4910	.138	.128	.120	.119	2	2.1
37-077-0001	Granville	Butner	Water Treatment Plt.	4495	.137	.132	.131	.129	6	6.5
37-081-0011	Guilford	McLeansville	Keely Park	4841	.150	.144	.144	.144	8	8.1
37-109-0099	Lincoln	Iron Station	SR 1315 & SR 131	4875	.141	.126	.117	.115	2	2.0
37-119-0034	Mecklenburg	Charlotte	Plaza & Lakedale	7076	.169	.158	.158	.148	7	7.1
37-119-1005	Mecklenburg	Charlotte	400 Arrowood Blvd.	7110	.167	.158	.149	.143	8	8.0
37-119-1009	Mecklenburg	Charlotte	29 N.	6891	.169	.156	.144	.134	9	9.5
37-129-0002	New Hanover	Castle Hayne	Blue Berry Farm	4740	.097	.091	.090	.088		
37-145-0099	Person	Gordonton	US 49 and SR 1102	968	.100	.091	.086	.085		
37-147-0099	Pitt	Farmville	US 264 Water Tank	4777	.125	.116	.114	.112	11	1.0
37-155-0099	Robeson	St. Pauls	Nat. Guard Armory	4748	.120	.119	.112	.111		
37-183-2001	Wake	Wake Forest	Hwy 98 Wake Forest	4764	.159	.157	.142	.141	10	10.2

(Table VI: Continued Next Page)

TABLE VI: Ozone In Parts Per Million (PPM) for 1988 (Continued)

Site Number	County	City	Address	NUM OBS	DAILY 1-HOUR MAXIMA 1st	2nd	3rd	4th	VALS ≥.125 MEAS	EST
1987 Data										
37-003-0003	Alexander	Taylorsville	SR 1107 & 1117	4533	.097	.096	.096	.094		
37-021-0029	Buncombe	Fairview	Hwy 74 SE	4907	.097	.086	.086	.085		
37-037-0098	Chatham	Moncure	Moncure Plant	4523	.115	.109	.108	.103		
37-051-0001	Cumberland	Eastover	Old US Hwy 301 N.	5441	.125	.114	.113	.110	1	1.2
37-065-0099	Edgecombe	Leggett	NC 97	4845	.105	.105	.103	.100		
37-067-0004	Forsyth	Winston Salem	Old Walkertown Rd.	5051	.129	.103	.100	.098	1	1.0
37-067-0006	Forsyth	Winston Salem	Belews Creek	4896	.129	.093	.090	.090	1	1.0
37-077-0001	Granville	Butner	Water Treatment Plt.	4618	.126	.126	.125	.120	3	3.2
37-081-0011	Guilford	McLeansville	Keely Park	4804	.117	.106	.104	.104		
37-101-0099	Johnston	Micro	SR 2141	4715	.116	.112	.112	.110		
37-119-0034	Mecklenburg	Charlotte	Plaza & Lakedale	8353	.127	.127	.119	.114	2	2.0
37-119-1005	Mecklenburg	Charlotte	400 Arrowood Blvd.	8501	.151	.135	.131	.128	4	4.0
37-119-1009	Mecklenburg	Charlotte	29 N.	8263	.138	.121	.120	.119	1	1.0
37-183-2001	Wake	Wake Forest	Hwy 98 Wake Forest	4673	.129	.125	.111	.109	2	2.1
1986 Data										
37-027-0003	Caldwell	Lenoir	US 321 N	4820	.095	.090	.088	.087		
37-067-0006	Forsyth	Winston Salem	Belews Creek	4993	.122	.111	.100	.098		
37-117-0099	Martin	Farmlife	NC 171	4722	.107	.095	.094	.093		
37-145-0099	Person	Gordonton	US 49 and SR 1102	4289	.110	.108	.106	.106		

FIGURE 9. FREQUENCY OF HIGH OZONE VALUES

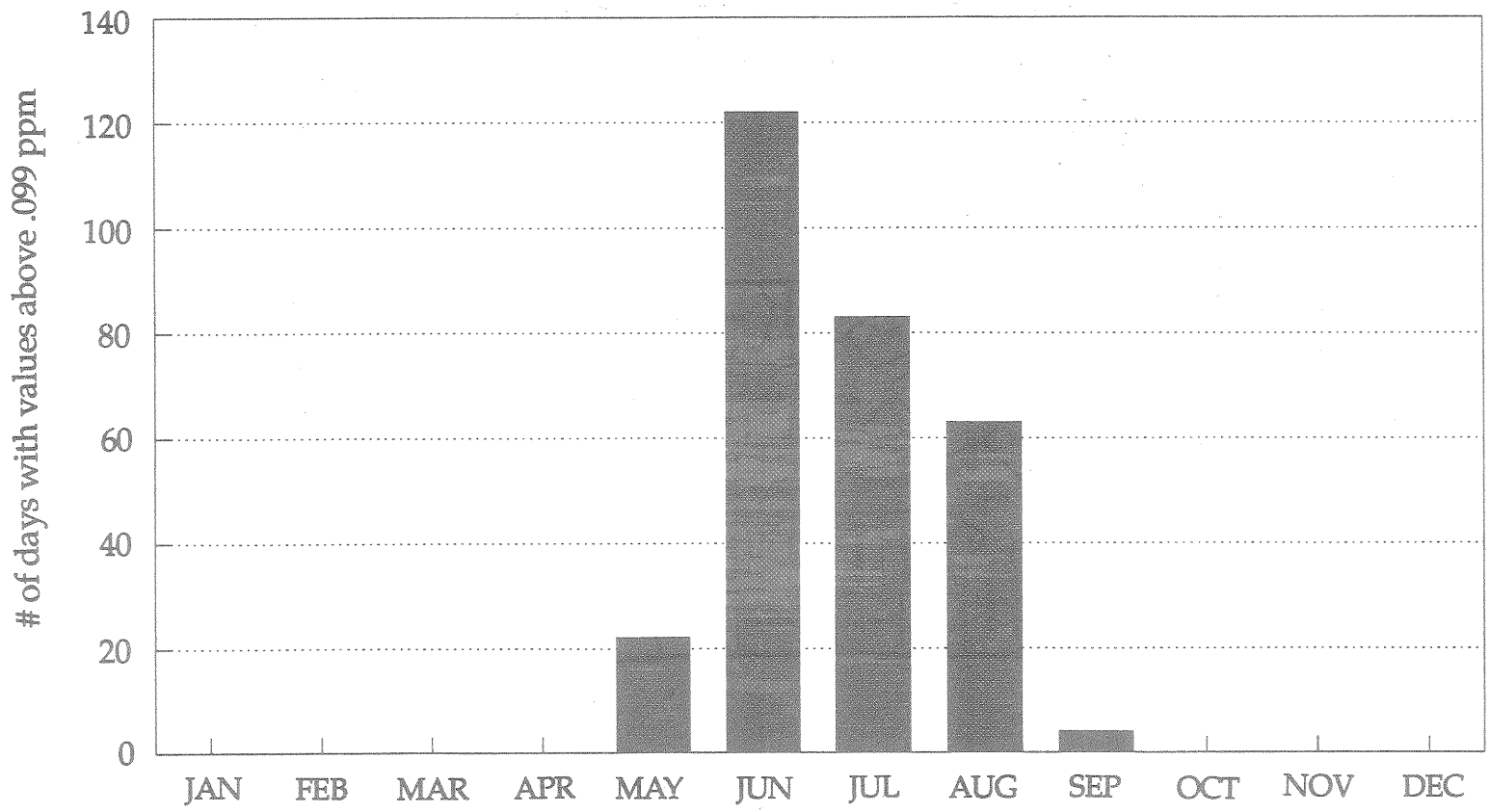
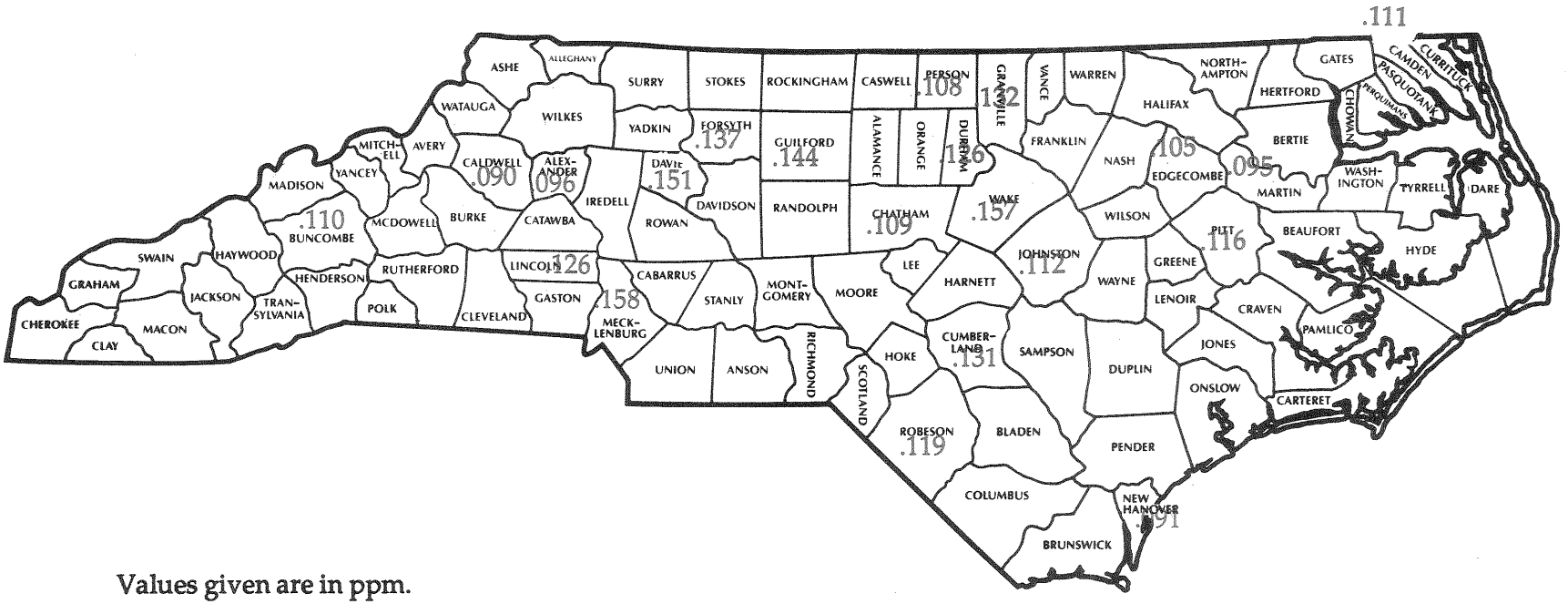


FIGURE 10

OZONE

1988, 1987, or 1986 Second Highest 1-Hour Averages*

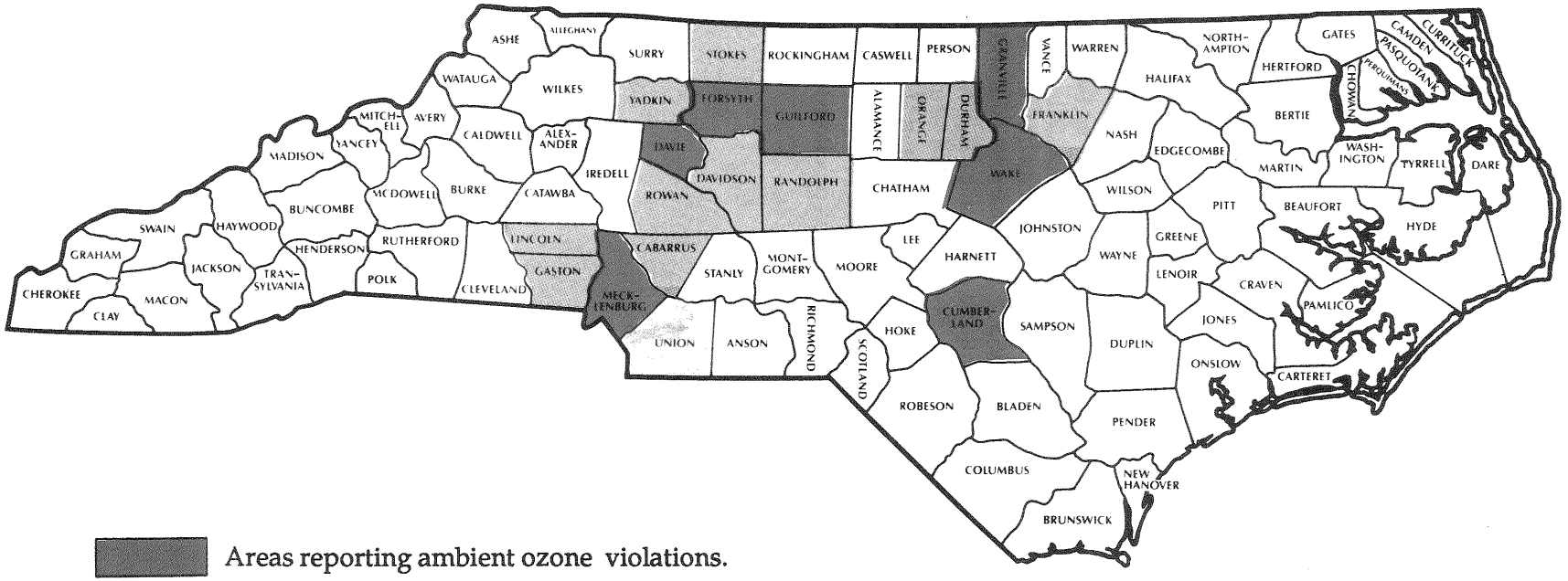


Values given are in ppm.

Ambient Air Quality Standard is .12 ppm (Values greater than .124 ppm exceed standard).

*The most recent year of data are shown, because some sites do not operate every year.

FIGURE 11
AREAS WITH EXCESSIVE OZONE



Areas reporting ambient ozone violations.

Areas where ozone control measures are expected.

II. E. Sulfur Dioxide

Sulfur dioxide (SO_2) concentrations were measured using EPA Reference or Equivalent continuous monitors by the state and two local program agencies. Nine SO_2 monitoring sites reported a total of 66,414 SO_2 hourly measurements during 1988. A summary of these data appears in Table VII. Prior years' data from other sites which did not operate in 1988 are also included in Table VII. For some sites, monitor operations are suspended for two years and operated on the third year. Using this rotating operating schedule, data current within the last three years is available for use and operating costs are kept to a minimum. Source and health effects information for SO_2 is included in Section III.D.

To determine attainment status with the SO_2 ambient air quality standard, the data must be evaluated in three ways: 3-hour averages, 24-hour averages, and the annual arithmetic mean. **There were no exceedances of the SO_2 ambient air quality standards reported by these monitors.** High ambient SO_2 concentrations do not exist over large areas (e.g. county wide), as ozone does. The highest ambient SO_2 concentrations existed for short periods near major SO_2 sources. In 1988 the Acme-Delco site in Columbus County measured the highest values, reporting a three hour average concentration that was 22 percent of the three hour standard, and a 24-hour average that was 31 percent of the 24-hour ambient air quality standard.

It appears that the size of an urban area has little effect on the ambient concentrations of SO_2 in North Carolina. Further, there do not appear to be large seasonal variations in average SO_2 concentrations as evident with carbon monoxide or ozone. Major source characteristics such as type, size, distribution, control devices, operating conditions, and dispersion situations significantly affect the amount of SO_2 measured in ambient air. The second highest 3-hour values are shown in Figure 12 for the most recent year of data for all monitored areas.

TABLE VII: Sulfur Dioxide in Micrograms Per Cubic Meter (ug/m^3) For 1988

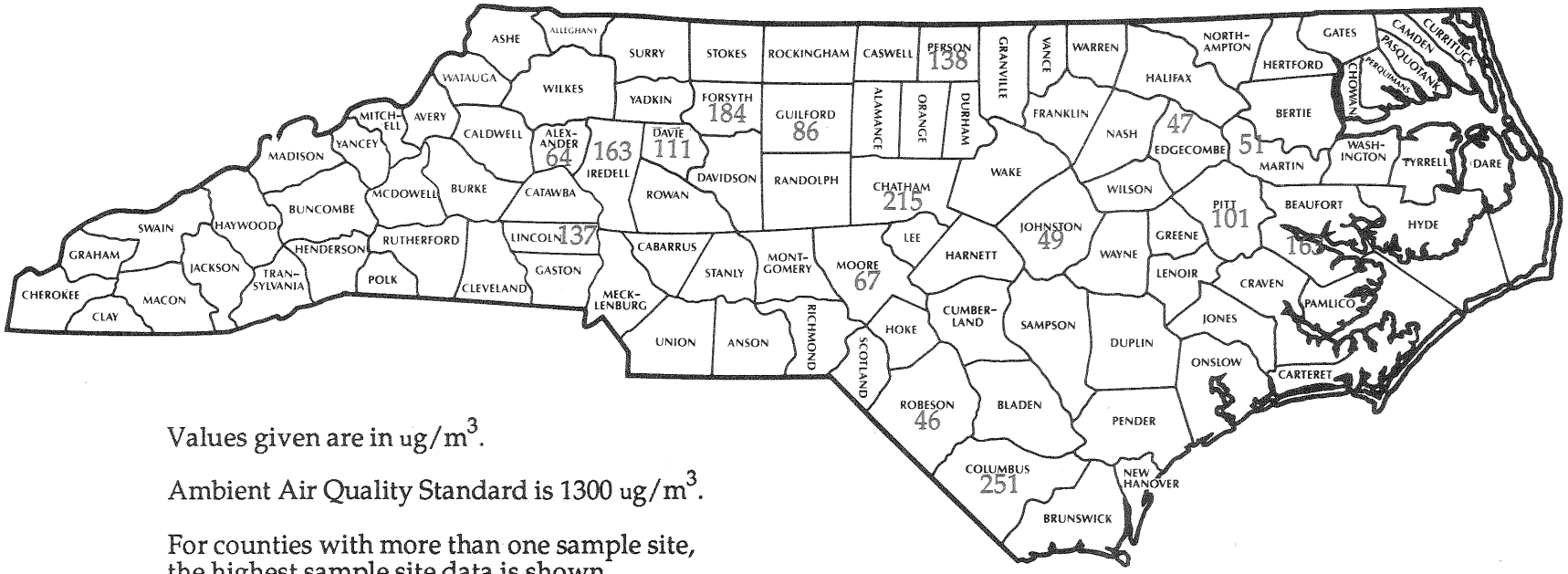
SITE ID	COUNTY	CITY	ADDRESS	NUM OBS	MAX 1-HR 1st	MAX 1-HR 2nd	MAX 3-HR 1st	MAX 3-HR 2nd	MAX 24-HR 1st	MAX 24-HR 2nd	ARIT MEAN
37-013-0003	Beaufort	Aurora	NC Highway 306	8217	242	210	201	163	60	55	9
37-047-0001	Columbus	Acme	Delco Tel Substa.	7937	494	481	285	251	114	96	16
37-059-0099	Davie	Fork	Recreation Center	7980	219	192	149	111	61	52	10
37-067-0007	Forsyth	Winston Salem	Ferguson School	8488	263	255	240	184	72	68	21
37-067-0022	Forsyth	Winston Salem	1300 Block Hattie St.	8562	193	192	147	141	83	83	19
37-081-0010	Guilford	Greensboro	1305 Merritt Dr.	7176	113	107	89	86	52	40	12
37-097-0002	Iredell	Troutman	SR 2350 Troutman	2019	462	274	164	163	71	71	20
37-109-0099	Lincoln	Iron Station	SR 1315 & SR 1313	7987	327	278	157	137	62	52	9
37-147-0099	Pitt	Farmville	US 264 Water Tank	8048	136	131	104	101	81	50	9
1987 Data											
37-003-0003	Alexander	Taylorsville	SR 1107 & 1117	8294	102	90	67	64	43	42	8
37-013-0003	Beaufort	Aurora	NC Highway 306	8025	510	476	185	180	62	59	9
37-037-0098	Chatham	Moncure	Moncure Plant	8188	619	615	394	215	94	87	12
37-047-0001	Columbus	Acme	Delco Tel. Substa..	7899	1399	1019	673	617	304	153	15
37-065-0099	Edgecombe	Leggett	NC 97	8013	222	90	47	47	26	23	7
37-067-0007	Forsyth	Winston Salem	Ferguson School	8380	335	313	231	188	60	55	20
37-067-0022	Forsyth	Winston Salem	1300 Block Hattie St.	8477	314	243	199	191	75	74	18
37-081-0010	Guilford	Greensboro	1305 Merritt Dr.	7719	182	162	90	90	63	57	14
37-097-0002	Iredell	Troutman	SR 2350 Troutman	8223	403	372	204	189	82	60	13
37-101-0099	Johnston	Micro	US 301 & SR 2141	8065	55	54	51	49	37	29	8
37-155-0099	Robeson	St. Pauls	National Guard Armory	8194	64	60	46	46	36	35	9
1986 Data											
37-117-0099	Martin	Farmlife	NC 171 & SR 1538	7575	64	64	62	51	35	29	7
37-145-0099	Person	Gordonton	NC 49 & SR 1102	7804	236	183	178	138	55	53	11

There were no exceedances of the SO_2 ambient air standards at any of these sites during this three year period.

FIGURE 12

SULFUR DIOXIDE

Second Highest 3-Hour Averages for Most Recent Year



Values given are in ug/m^3.

Ambient Air Quality Standard is 1300 ug/m^3.

For counties with more than one sample site, the highest sample site data is shown.

II. F. Nitrogen Dioxide

Nitrogen dioxide (NO_2) concentrations were measured using EPA Reference or Equivalent continuous monitors at two sites in Forsyth County. These monitors were operated by the Forsyth County local program agency. A total of 16,743 NO_2 hourly measurements were reported. A summary of these data appears in Table VIII. Section III.E. contains source and health effects information for NO_2.

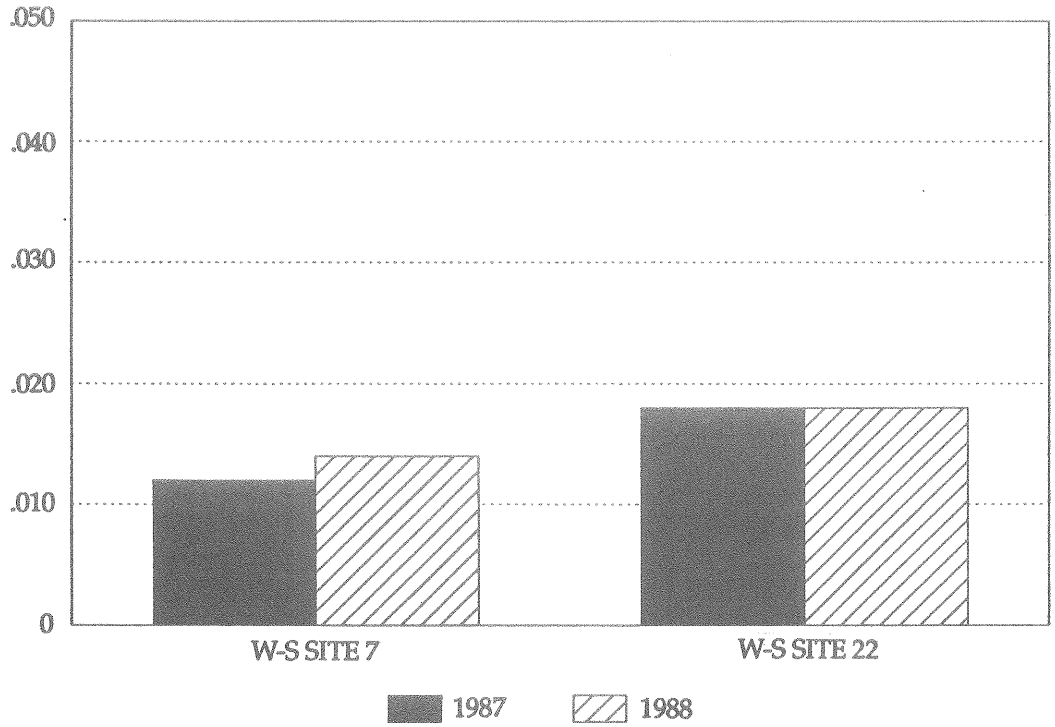
NO_2 has been determined not to be a "problem" pollutant in North Carolina based on recent continuous monitor data and a long history of manually collected NO_2 data

No exceedances of the NO_2 ambient air quality standard have ever been reported from continuous air monitors operated at state, local, and industrial sites in the state. Furthermore, the operation of NO_2 monitors has been shown to be the most difficult, manpower intensive, and costly of all criteria pollutant monitors. For these reasons, only a few NO_2 monitors are currently being operated. More NO_2 monitoring will begin in 1989 to gather data needed to develop an ozone control strategy in the Raleigh and Durham areas. A comparison of the 1988 NO_2 data with the standard is shown below in Figure 13 .

TABLE VIII: Nitrogen Dioxide In Parts Per Million (PPM) For 1988

SITE ID	COUNTY	CITY	ADDRESS	NUM OBS	MAX 1-HR 1st	MAX 1-HR 2nd	ARITH MEAN
37-067-0007	Forsyth	Winston Salem	Ferguson School	8546	.070	.068	.014
37-067-0022	Forsyth	Winston Salem	1300 Hattie Avenue	8197	.206	.116	.018

FIGURE 13. 1988 NITROGEN DIOXIDE
COMPARISON TO ANNUAL STANDARD, .053 PPM



II. G. Lead

The state and local program agencies have not performed routine lead (Pb) analysis in North Carolina since 1982. **This ambient air lead monitoring was stopped as a result of the low values measured and as a result of the continuing decrease in the lead concentrations being reported.** The 1982 ambient lead concentrations were approximately one-half of the 1979 levels. Lead sources and health effects are discussed in III.F.

Five state and local program agency TSP sites have been selected by the federal EPA as National Filter Analysis Network (NFAN) sites. The EPA performs lead analysis on filters provided by the state and local program agencies. The most recent two quarters of data available from the NFAN is 1987. The 1987 data is included below in Table IX. Lead concentrations in 1987 are approximately one-quarter of the 1982 levels. The 1988 lead concentrations are expected to continue to decrease, but at a slower rate.

Two factors are believed to be responsible for the decrease in lead being emitted from cars and thus the decrease in the ambient air lead concentrations: (1) The amount of leaded gasoline being used in North Carolina is decreasing each year. (2) The quantity of lead in leaded fuel is being reduced by EPA regulation.

TABLE IX: Lead in Micrograms Per Cubic Meter (ug/m^3) For 1986 and 1987

				QUARTERLY ARITH MEANS				MEANS
				1986		1987		>
SITE ID	COUNTY	CITY	ADDRESS	3rd	4th	1st	2nd	1.5
37-063-0001	Durham	Durham	300 East Main St.	.05	.08	.05	.04	0
37-067-0021	Forsyth	Winston Salem	Sixth & Broad St.	.05	.06	.06	.03	0
37-081-0009	Guilford	Greensboro	Edgeworth & Bellemeade St.	.05	.10	.06	.04	0
37-119-0001	Mecklenburg	Charlotte	600 East Trade St.	.05	.10	.06	.04	0
37-183-0003	Wake	Raleigh	Fire Station #9, Six Forks Rd.	.06	.06	.04	.03	0

III. DESCRIPTION OF POLLUTANTS

III. A. Particulate Matter

Atmospheric particulate matter is defined as any airborne material, except uncombined water, (water, mist, steam, etc.) which exists in a finely divided form as a liquid or solid at standard temperature and pressure (25° C and 760 mm mercury) and has an aerodynamic diameter of less than 100 micrometers. Currently, the monitoring network is measuring two sizes of particulate matter; total suspended particulate (TSP), and PM-10. Total suspended particulate is any particulate matter measured by the method described in EPA regulation 40CFR50, Appendix B and is generally believed to be particles having an aerodynamic diameter of 45 micrometers or less. A 20-year history of measurements of TSP exists in North Carolina.

PM-10 is defined as particulate matter with an aerodynamic diameter of less than or equal to a nominal 10 micrometers as measured by the method described in EPA regulation 40CFR50, Appendix J. Some PM-10 monitoring was conducted in North Carolina during 1988. More PM-10 monitoring is being planned in 1989 and 1990. On July 31, 1987, the Environmental Protection Agency adopted new ambient air quality standards for PM-10 which replace the national TSP ambient air quality standards. However, the state TSP ambient air quality standard has been retained. The state adopted the new PM-10 standard effective July 1, 1988.

Particulate Sources

Particulates are emitted by many of man's activities, such as fuel used in combustion, motor vehicle operation and movement, industrial processes, grass mowing, agricultural tilling and open burning. Natural sources include wind-blown dust, forest fires, volcanic eruptions and vegetation which releases pollen.

Particles that are emitted directly from a source may be either fine or coarse, but particles which are formed in the atmosphere will usually be fine. Generally, coarse particles (2.5 - 60 micrometers) have very slow settling velocities and are characterized as suspended particulate matter. Fine particles (less than 2.5 micrometers) typically originate by condensation of materials produced during combustion or atmospheric transformation.

Particulate Effects

Health effects of particulate matter include: effects on the breathing system, aggravation of existing lung and heart disease, effects on lung clearance, changes in form and structure of organisms and development of cancer. The individuals most sensitive to the effects of particulate matter include: individuals with chronic obstructive lung or heart disease, individuals with flu, asthmatics, the elderly, children and mouth breathers. Health effects from inhaled particles are influenced by the depth of penetration of the particles into the respiratory system, the amount of particles deposited in the respiratory system, and by the biological reaction to the deposited particles. The risks of adverse health effects are greater when particles enter the tracheobronchial and alveolar (bronchial tubes and lungs) portions of the respiratory system. Small particles can penetrate into these deeper regions of the respiratory system. For the particles larger than 10 micrometers, healthy respiratory systems can trap the particles more efficiently before they move deep into the system and can more effectively remove those that do move deep into the system.

Welfare effects are those that influence one's quality of life other than human health effects. Particulate matter can form a film on plant leaves, reducing sunlight and subsequently interfering with photosynthesis. Other effects of particles include soiling and degradation of property, which can be costly in terms of cleaning and maintaining surfaces. Reduction of visibility occurs when small particles absorb or scatter visible light. Visibility is a national and state concern, particularly in areas such as national parks, historic sites, and scenic attractions that are visited by sightseers.

III. B. Carbon Monoxide

Carbon monoxide (CO) is the most commonly occurring air pollutant. It is estimated that total CO emissions to the atmosphere comprise approximately 60 percent of all pollutant emissions in North Carolina.

CO Sources

Most atmospheric CO is produced by incomplete combustion of fuels used for vehicles, space heating, industrial processes and solid waste combustion. Transportation activities account for the majority of the CO emissions. Boilers and other fuel burning heating systems are also significant sources of CO.

CO Effects

Breathing carbon monoxide affects the oxygen carrying capacity of the blood in both sick and healthy individuals. Hemoglobin in the blood attaches to CO more readily than it does to oxygen, thus depriving the body of vital oxygen.

Carbon monoxide diminishes the pulmonary function of even healthy individuals. Individuals with anemia, lung, and heart diseases are particularly sensitive to CO effects. At low concentrations, mental function, vision, and alertness are affected. At high concentrations, CO exposure can increase fatigue, reduce work capacity, and may adversely effect fetal development. Cardiac damage may result from chronic exposure to CO at levels as low as 70 ppm (80 mg/m^3). Other health effects associated with exposure to CO include central nervous system effects and pulmonary function difficulties.

Ambient concentrations apparently do not adversely affect vegetation or materials. The effects on animals are similar to those on humans.

III. C. Ozone

The ozone ambient air quality standards and statewide ozone monitoring are concerned with the ozone concentrations in the lower atmosphere where we live and breathe. Ozone in the stratosphere acts to shield the earth from harmful effects of ultraviolet radiation. However, at ground level, high concentrations of ozone are a major health and environmental concern. Ozone in the lower atmosphere is harmful to people, animals, vegetation, and materials even in low concentrations. From 1987 and 1988 data, ozone has become the most widespread and serious criteria air pollutant problem in North Carolina.

Ozone Sources

Ozone (O_3) is the major compound of the complex mixture of compounds known as photochemical oxidants. Ozone is not usually emitted directly into the atmosphere as are the other criteria pollutants, but is formed by a series of complex reactions involving hydrocarbons, nitrogen oxides and sunlight. Ozone concentrations are higher during the daytime in late spring, summer and early autumn when the temperature is above 60°F and the sunlight is more intense. North Carolina's ozone season is April through October.

Two natural sources of ozone are electrical discharge during thunderstorms and solar radiation in the stratosphere. These two sources are not believed to be significant in the lower atmosphere.

Ozone Effects

Ozone is a pulmonary irritant and affects the respiratory mucous membranes as well as other lung tissues and respiratory functions. Studies have demonstrated ozone impairment of the normal function of the lung, causing shallow, rapid breathing and a decrease in pulmonary function. Other symptoms of ozone exposure include chest tightness, coughing and wheezing. People with asthma, bronchitis, or emphysema will probably experience breathing difficulty when exposed to short-term concentrations between 0.15 and 0.25 ppm. With continued or repeated long-term exposure, permanent lung structure damage may occur even in healthy people. Ozone has also been shown to interfere with the immune system function in animals. Recent studies have indicated that ozone concentrations of less than 0.12 ppm may have

health effects on certain people. The federal EPA is continuing to evaluate the health effects data.

Ozone accelerates the aging of many materials, causing rubber cracking, dye fading, paint erosion, and plant damage. In general, ozone injury to vegetation develops initially at the tips of young leaves and becomes more widespread as the leaves mature. The most common ozone symptoms on broad-leaved plants are small flecks visible on the upper leaf surface. This problem has been severe on sensitive varieties of tobacco and is generally referred to as weather fleck. Some of the agricultural and garden vegetation affected include tobacco, corn, soybeans, tomato, rye, wheat, beans, potatoes, melons, alfalfa, spinach, onions and grapes. Other vegetation affected includes gladiolus, azalea, eastern white pine, loblolly pine, Virginia pine, locust, white oak and poplar. Many of these plants are of economic importance in North Carolina. Adverse effects on sensitive vegetation have been observed from exposure to ozone concentrations of 0.05 ppm (100 ug/m^3) for four hours.

Good Ozone

Not all ozone is bad for us. High concentrations of ozone in the upper atmosphere protect us. Upper atmospheric ozone is needed to absorb the high energy sunlight (ultraviolet light). Without sufficient upper atmospheric ozone, more ultraviolet light will reach the surface of the earth. Too much exposure to ultraviolet light has been shown to cause skin cancer. It is believed many air pollutants are causing depletion of the upper atmospheric ozone. One type of chemical, chlorofluorocarbons, is believed to play a major part in the upper atmospheric ozone depletion. International studies and conferences are underway to develop strategies to reduce this problem.

III. D. Sulfur Dioxide

More than 90 percent of sulfur oxide emissions occur as sulfur dioxide (SO_2); the balance occurs as sulfur trioxide (SO_3) and various forms of sulfates. For this reason nearly all sulfur oxide ambient monitoring nationwide is for sulfur dioxide. It is a colorless gas that can be detected by taste at concentrations of 0.38 to 1.15 ppm.

SO_2 Sources

The main sources of SO_2 are the combustion of fossil fuels containing sulfur compounds and the manufacturing of sulfuric acid. Other sources include refining of petroleum and smelting of sulfur containing ores.

SO_2 Effects

The most obvious health effects of sulfur dioxide are irritation and inflammation of body tissues that are contacted by the gas. Sulfur dioxide can increase the severity of existing respiratory diseases such as asthma, bronchitis, or emphysema. Breathing SO_2 causes bronchial constriction, which results in increased resistance to air flow, reduction of air volume and increased respiratory rate and heart rate. Asthmatics showed increases in airway resistance after exposures of only 5 to 10 minutes of SO_2 concentrations even below 0.5 ppm (1300 ug/m^3). The federal EPA is evaluating the health effects data and is considering adoption of a more "restrictive" 1-hour ambient air quality standard. Transformation products of SO_2 such as sulfuric acid aerosol and fine particulate sulfates may also cause significant health problems.

Sulfur dioxide can damage many types of vegetation. The injury symptoms usually consist of a bleaching appearance and can occur both between the veins and on the margins. Many plants of economic importance are sensitive to SO_2, including cotton, sweet potatoes, wheat, cucumber, alfalfa, peas, oats, gladiolus, tulips, blue grass, violet, zinnia, apple trees and several types of pine trees.

Another effect of SO_2 transformation products is the reduction of visibility. Sulfates are a major component of atmospheric fine particulate material, and because some sulfates have a water absorbing capacity, their impact on visibility is greatly increased at high humidities. Observations of widespread hazes in the eastern United States appear to be increasing with SO_2 emissions.

Another of the principal concerns is the suspected role of sulfur dioxide in causing acid rain, which is usually observed in regions of high sulfate concentrations. Acid rain can lower the pH of soils and natural waters, cause mineral leaching, damage vegetation and deplete fish populations in some lakes.

III. E. Nitrogen Oxides

There are several oxides of nitrogen in the atmosphere, but the most prevalent ones are nitric oxide (NO) and nitrogen dioxide (NO_2). Nitrogen oxides play a role in the formation of ozone during the summer months. For this reason, new monitoring sites are scheduled to be established in areas exceeding the ozone standard.

NO_2 Sources

The most important nitrogen oxide emissions occur as a result of man's burning of fossil fuels such as coal, oil and gasoline. Air is used to support most combustion processes. The nitrogen in air is oxidized as well as the fuel being burned which forms nitrogen oxide compounds. Nitrogen oxides are emitted from combustion sources primarily as nitric oxide (NO). Through reactions with other atmospheric compounds such as hydrocarbons and ozone, the NO is converted to nitrogen dioxide. Nitrogen dioxide may undergo further transformation into gaseous nitric acid (HNO_3) and nitrate particulates.

NO_2 Effects

Nitrogen dioxide has effects on human health, especially the sensitive members of the population. Asthmatics and children are likely to be affected by NO_2 concentrations as low as 0.5 ppm.

Nitrogen oxides also indirectly affect human health by their contribution to the formation of ozone. Researchers have suggested that the control of NO_x emissions maybe more effective in control of ozone than the control of hydrocarbons.

Some types of vegetation are very sensitive to nitrogen dioxide; they include oats, alfalfa, tobacco, peas and carrots. The one primary symptom of chronic NO_2 exposure is chlorosis (yellowing), while acute NO_2 exposure usually causes the appearance of irregular shaped lesions within the leaves. Earliest indications of injury are gray-green water-soaked areas located on the upper leaf surface.

Nitrogen dioxide and particulate nitrates are among the pollutants that cause visibility impairment. In high concentrations NO_2 gas is reddish-brown and thought to contribute a significant portion of the brownish coloration often observed in polluted air in colder months.

Nitrogen oxides also contribute to acid deposition by forming nitric acid. It has been estimated that nitric acid comprises approximately 25 to 30 percent of the acidity in precipitation.

III. F. Lead

Lead (Pb) compounds exist in the atmosphere as gases or particles.

Lead Sources

The major source of atmospheric lead is the combustion of leaded gasoline (tetraethyl lead is added as an antiknock agent). Battery manufacturers are a minor source of lead in this state. Lead is also used in paints, insecticides and newspaper inks. With the continued decrease in the amount of leaded fuels used and the decreased concentration of lead in those fuels, lead emissions from sandblasting of bridges, overpasses, and water tanks have the potential to be the most significant sources of lead air contamination in the state. Fortunately, these sources only impact small areas. The Department of Transportation (DOT) has been studying ways to reduce lead emissions from sandblasting of bridges and overpasses.

Lead Effects

Lead persists and accumulates in the environment and in the human body. It enters the body through eating and breathing and is eventually absorbed into the blood stream and distributed to all body tissues. Exposure to low concentrations interferes with specific en-

zyme systems and blood production. It is also believed to be a cause of kidney and nerve cell damage. Brain damage has been documented in cases of severe lead poisoning in children. Also noted were headaches, restlessness, tremors and general symptoms of mental retardation. Convulsions are not uncommon and may be followed by coma. People at greatest risk include battery workers, solderers, sandblasters, and small children who play near lead sources.

Ambient monitoring and analysis of samples were conducted by the Division of Environmental Management and four local air pollution control programs. These programs are listed in Appendix A. The collected air monitoring data are used to determine if air quality standards are being met, to assist in enforcement actions, to determine the improvement or decline of air quality and to determine the extent of allowable industrial expansion. The sites are listed in alphabetic order by county in Table X at the end of this section. A map showing the general locations of the ambient air monitoring sites is shown below in Figure 14.

Specific monitor siting involves considerations such as representativeness of site, distance from roadways and nearby sources, unrestricted air flow, safety, and availability of electricity and security.

All sites have a defined monitoring objective and annual evaluations are made to ensure that the objectives are met. The four basic monitoring objectives are:

1. to determine the highest concentration expected in an area,
2. to determine representative concentrations in areas of high population density,
3. to determine the impact of significant sources or source categories on ambient air quality, and
4. to determine general background concentration levels.

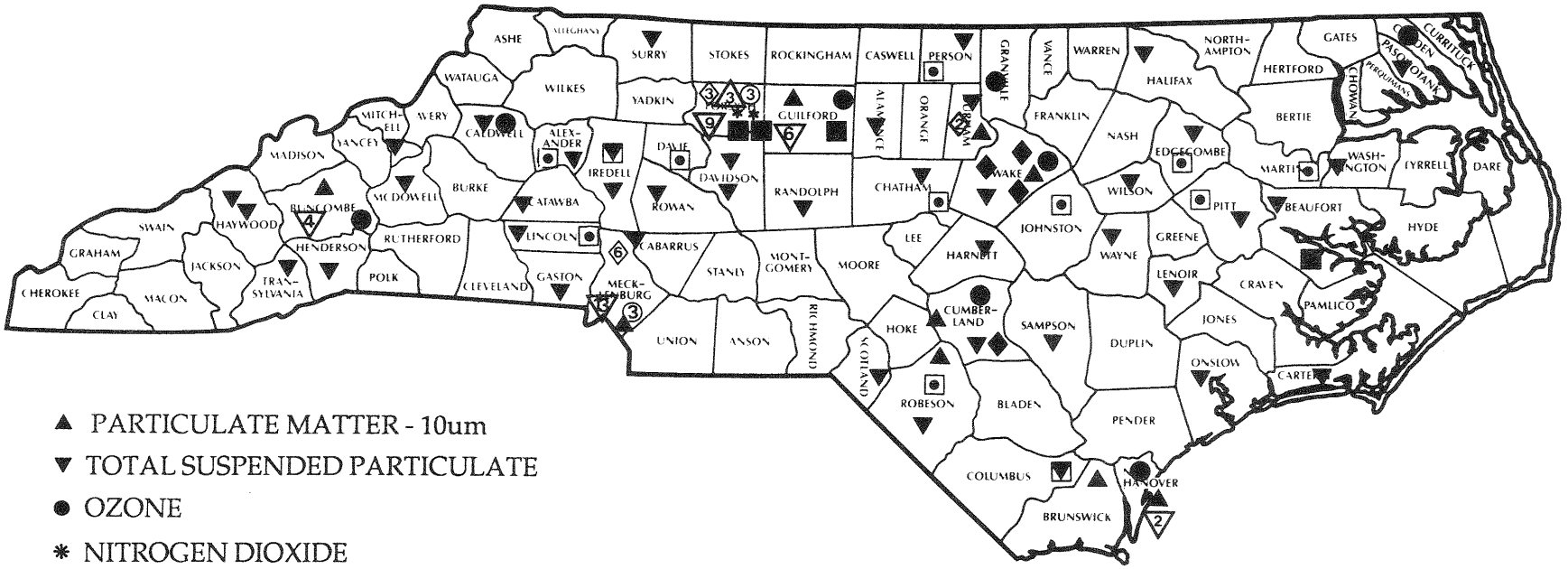
All monitors have known precision, accuracy, interferences and operational parameters. The monitors, as well as all measurement devices, are carefully calibrated at predetermined frequencies, varying from daily to quarterly. Measurements are traceable to the National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) when standards are available.

Standard operating procedures are followed in monitoring and analyses. Field personnel visit the manual sites once every sixth day to replace sample media and check the operation and calibration of the monitors. Continuous monitors are checked at least twice weekly for correct instrument operation.

The collected ambient air monitoring data must be of known quality due to the importance of the decisions made using the data. Quality assurance activities determine the quality of the collected ambient data, improve the quality of the data and evaluate how well the monitoring system operates. The objectives of the quality assurance activities are to produce high quality air pollution data with defined completeness, precision, accuracy, representativeness and comparability.

At most sites, microprocessors are being used to collect the data. The system assembles the data for submission to the US Environmental Protection Agency. This enhances data validity, minimizes travel cost, and allows real-time data to be available by computer polling when needed. Numerous checks are performed to ensure that only valid data are reported from these systems.

FIGURE 14
LOCATIONS OF MONITORING SITES



V. AIR QUALITY INDEX

In addition to this annual data report, up-to-date air quality information is available 24-hours a day in four areas of the state through the use of the air quality index (AQI) telephone numbers. These numbers are listed below:

Charlotte 704-333-SMOG
Durham 919-733-DATA
Fayetteville 919-486-9413
Raleigh 919-733-DATA

Citizens of these areas can check the quality of the air in their area on a nearly real-time basis by calling the listed telephone number. The Durham AQI is included as a part of the Raleigh AQI and is a long distance call from Durham, but the other numbers are local calls from the respective areas.

When any of the numbers are called, a recorded message will provide the current air quality report, which is updated every four hours based on information from the local area air pollutant monitors.

The report provides the air quality index for the pollutant with the highest concentration and a word describing the expected effect of the pollutant on human health. The descriptions are good, moderate, unhealthful, very unhealthful, and hazardous. Index levels do not normally exceed the unhealthful range (AQI>199), with most reports in the good-moderate range, between zero and 100. A nationwide method of assigning the index numbers is used so travelers from other parts of the country can interpret a local index. For 1988, the highest air quality indices for these four cities is shown below.

City	Ozone Index	CO Index
Charlotte	161	144
Durham	121	137
Fayetteville	126	149
Raleigh	149	143

The index rates the air quality from zero to 500. Index numbers of zero to 49 are considered good and indexes of 50-99 are considered moderate with no adverse health effects expected and no protective actions recommended.

An index of 100-199 is described as unhealthful and can produce mild aggravation of symptoms in susceptible persons and possible irritation in healthy persons. People with existing heart or lung ailments should reduce physical exertion and outdoor activity when the index is in this range.

Ratings of 200 to 299 are considered very unhealthful and can produce significant aggravation of symptoms and decreased exercise tolerance in persons with heart or lung disease. A variety of symptoms may occur in healthy persons. Elderly people and those with existing heart or lung problems should stay indoors and reduce physical activity.

An index above 299 is considered hazardous. When an index ranges from 300 to 399, premature onset of certain diseases can be expected in addition to significant aggravation of symptoms and decreased exercise capability in healthy persons. Elderly people and individuals with existing diseases should stay indoors and avoid physical exertion. The general population should avoid outdoor activity when the air quality index exceeds 299.

An index between 400 and 500 can be expected to cause premature death of ill and elderly people. Healthy persons will experience adverse symptoms that affect their normal activity. All persons should remain indoors, keeping windows and doors closed, and everyone should minimize physical exertion and avoid motor vehicle traffic.

An example of an Air Quality Index Report is as follows:

This is the North Carolina Department of Environment, Health and Natural Resources Air Quality Report.

The air quality index for most of Cumberland County is 88 for the four-hour period ending at 12 noon. This index is regarded as moderate. The responsible pollutant is ozone.

This report will be updated at 4 pm. Thank you for calling.

TABLE X: North Carolina Ambient Air Monitoring Sites Operating in 1988

County	Site	Site Number	Pollutant(s)
Alamance	Burlington, 1136 E. Webb Ave.	37-001-0001	TSP
Alexander	Taylorsville, SR 1107 & 1117	37-003-0003	TSP, O_3, SO_2
Beaufort	Aurora, NC HWY 306	37-013-0003	SO_2
Beaufort	Washington, 400 E. Third St.	37-013-0003	TSP
Brunswick	State Road 1163	37-019-0004	PM-10
Buncombe	Airport, Airport Rd.	37-021-0025	TSP
Buncombe	Asheville Health & Welfare Bldg.	37-021-0003	TSP, PM-10
Buncombe	Candler, Candler	37-021-0027	TSP
Buncombe	Fairview, HWY 74 S.E.	37-021-0029	O_3
Buncombe	Grove Stone, Grove Stone	37-021-0026	TSP
Cabarrus	Kannapolis, Floyd St.	37-025-0004	TSP
Caldwell	Lenoir, HWY 321 N.	37-027-0003	TSP, O_3
Carteret	Morehead City, Arendell & 4th	37-031-0003	TSP
Catawba	Hickory, 1650 1st Street	37-035-0004	TSP
Columbus	Acme, Acme-Delco	37-047-0001	TSP, SO_2
Cumberland	Eastover, Old U.S. Hwy 301	37-051-0001	O_3
Cumberland	Fayetteville, 3296 Village Dr.	37-051-0004	TSP, PM-10
Davidson	Lexington, S. Salisbury St.	37-057-0002	TSP
Davidson	Thomasville, City Hall 7 W. Guilford	37-057-1001	TSP
Davie	Fork, Fork Recreation	37-059-0099	O_3, SO_2
Durham	Durham, Old Sears Bldg, Dillard & Main St.	37-063-0001	TSP, PM-10
Durham	Durham, Old Health, Roxboro Rd. & Main St.	37-063-0008	CO
Durham	Durham Park, 1639 University Dr.	37-063-0010	CO
Edgecombe	Rocky Mount, Leggett Rd. WTP	37-065-0002	TSP
Forsyth	Kernersville, Bodeheimer St.	37-067-1001	TSP
Forsyth	Walkertown, Grubbs Rd.	37-067-0001	TSP
Forsyth	Belews Creek Rd., Goodwill Church	37-067-0006	O_3
Forsyth	Prince Ibraham Sch., Old Walkerton Rd.	37-067-0004	TSP, O_3
Forsyth	Winston-Salem, Ferguson Sch., 5337 Old Rural	37-067-0007	SO_2, NO_2
Forsyth	Winston-Salem, Friends Church, Sixth & Broad	37-067-0021	TSP
Forsyth	Winston-Salem, Hanes Park, Indiana Ave.	37-067-0009	TSP
Forsyth	Winston-Salem, Hutton St.	37-067-0015	TSP
Forsyth	Winston-Salem, Main St.	37-067-0018	CO
Forsyth	Winston-Salem, Queen St. & Leisure Lane	37-067-0019	CO
Forsyth	Winston-Salem, 720 Ridge Ave.	37-067-0013	TSP
Forsyth	Winston-Salem, Silas Creek Pkwy	37-067-0020	TSP
Forsyth	Winston-Salem, Stadium Dr.	37-067-0014	TSP, PM-10
Forsyth	Winston-Salem, 13th & Hattie St.	37-067-0022	SO_2, NO_2
Gaston	Gastonia, Rankin Lake Rd.	37-071-0014	TSP
Granville	Butner, Water Treatment Plant	37-077-0001	O_3
Guilford	Greensboro, Edgeworth & Bellemead	37-081-0009	TSP, PM-10
Guilford	Greensboro, 409 Friendway Dr.	37-081-0012	TSP
Guilford	Greensboro, 1305 Merritt Dr.	37-081-0010	TSP, SO_2
Guilford	High Point, 650 Francis St.	37-081-0004	TSP
Guilford	High Point, National Guard Armory 2210	37-081-1003	TSP
Guilford	High Point, East Green & S. Centennial	37-081-1005	TSP
Guilford	McLeansville, Keely Park	37-081-0011	O_3
Halifax	Roanoke Rapids, NE Corner of 5th & Carolina	37-083-0002	TSP
Harnett	Dunn, Municipal Bldg.	37-085-0001	TSP
Haywood	Canton, Canton Fire Dept.	37-087-0002	TSP

(Table X: Continued Next Page)

TABLE X: North Carolina Ambient Air Monitoring Sites Operating in 1988 (Continued)

County	Site	Site Number	Pollutant(s)
Haywood	Hazelwood, Brown Ave.	37-087-0006	TSP
Henderson	Hendersonville, US 25 & US 64	37-089-1005	TSP
Iredell	Statesville, 300 S. Tradd St.	37-097-2002	TSP
Iredell	Troutman, SR 2350	37-097-0002	TSP, SO_2
Lenoir	Kinston, 2700 Market St.	37-107-0003	TSP
Lincoln	Iron Station, SR 1315 & SR 131	37-109-0099	O_3, SO_2
Lincoln	Lincolnton, Jail	37-109-0002	TSP
McDowell	Marion, Courthouse	37-111-0002	TSP
Mecklenburg	Arrowood, 400 Arrowood Blvd.	37-119-1005	TSP, O_3
Mecklenburg	Cabarrus Co. Line, 29 N.	37-119-1009	O_3
Mecklenburg	Charlotte, Central Ave.	37-119-0032	CO
Mecklenburg	Charlotte, 600 E. Trade St.	37-119-0001	TSP
Mecklenburg	Charlotte, 800 S. Graham St.	37-119-0002	TSP
Mecklenburg	Charlotte, Co. Health Dept., 1200 Blyth	37-119-0011	TSP
Mecklenburg	Charlotte, Federal Reserve	37-119-0029	CO
Mecklenburg	Charlotte, 2136 Remount Rd.	37-119-0010	TSP,PM-10
Mecklenburg	Charlotte, 620 Moretz St.	37-119-0003	TSP
Mecklenburg	Charlotte, Greenville Neighborhood Ctr.	37-119-0035	CO
Mecklenburg	Charlotte, 1501 N I-85	37-119-0028	TSP
Mecklenburg	Charlotte, 415 E. Woodlawn	37-119-0037	CO
Mecklenburg	Charlotte, Plaza Rd. & Lakedale	37-119-0034	CO, O_3,
Mecklenburg	Charlotte, Woodlawn VFD	37-119-0026	TSP
Mecklenburg	Charlotte, W. Mecklenburg, 7400 Tuckasegee	37-119-0901	TSP
Mecklenburg	Davidson, Filter Plant	37-119-1001	TSP
Mecklenburg	Duke Power, Neck Road	37-119-1006	TSP
Mecklenburg	Huntersville, Holbrook Rd.	37-119-1003	TSP
Mecklenburg	Mint Hill, Telephone Substation	37-119-2001	TSP
Mitchell	Spruce Pine, Summit St.	37-121-0001	TSP
New Hanover	Castle Hayne, SR 1002	37-129-0002	O_3
New Hanover	Wilmington, Walnut & Waters	37-129-1002	TSP
New Hanover	Wilmington, Ninth & Orange	37-129-0005	TSP
Onslow	Jacksonville, 2553 Onslow Dr.	37-133-0004	PM-10, TSP
Pasquotank	Elizabeth City, N. Wilson St.	37-139-0001	TSP
Person	Gordonton, SR 1102 & NC 49	37-145-0099	O_3
Person	Roxboro, Chub Lake Rd.	37-145-0001	TSP
Pitt	Farmville, US 264	37-147-0099	O_3
Pitt	Greenville, N. Plant St.	37-147-0002	O_3, SO_2
Randolph	Asheboro, 1462 Winslow St.	37-151-0003	TSP
Robeson	Lumberton, S. Water St.	37-155-0003	TSP
Robeson	St. Pauls, St Pauls Nat. Guard Arm.	37-155-0099	TSP
Rowan	Salisbury, Church St.	37-159-1005	SO_2
Sampson	Clinton, Phillips St. and South Blvd.	37-163-0002	TSP
Scotland	Laurinburg, Laurinburg WTP	37-165-0003	TSP
Surry	Mount Airy, HWY 52 South	37-171-0002	TSP
Transylvania	Brevard, HWY 64	37-175-0002	TSP
Wake	Raleigh, Crabtree HWY 70 West	37-183-0013	CO
Wake	Raleigh, Person St., 420 S. Person St.	37-183-0011	CO
Wake	Raleigh, North Hills, Six Forks Rd.	37-183-0003	TSP, PM-10
Wake	Raleigh, 309 S. Wilmington St	37-183-0010	CO
Wake	Wake Forest, HWY 98 Wake Forest Rd.	37-183-2001	O_3
Washington	Plymouth, Old Acre Rd.	37-187-0002	TSP
Wayne	Goldsboro, HWY 70 W. Patrol Sta.	37-191-0004	TSP
Wilson	Wilson, S.W. Corner of Kenan & Pine St.	37-195-0002	TSP

Appendix A

AIR POLLUTION MONITORING AGENCIES

STATE AGENCY

Division of Environmental Management
P O Box 27687
Raleigh, North Carolina 27611
(919) 733-3340

REGIONAL AGENCIES

Asheville Regional Office
Interchange Building
59 Woodfin Place
Asheville, NC 28801
(704) 251-6208

(Avery, Cherokee, Clay, Cleveland, Grahm, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Rutherford, Swain, Transylvania, Watauga, and Yancey Counties)

Fayetteville Regional Office
Wachovia Building
Suite 714
Fayetteville, NC 28301
(919) 486-1541

(Anson, Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Robeson, Richmond, Sampson, and Scotland Counties)

Mooresville Regional Office
PO Box 950
Mooresville, NC 28115
(704) 663-1699

(Alexander, Burke, Cabarrus, Caldwell, Catawba, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly, and Union Counties)

(Continued Next Page)

Raleigh Regional Office
3800 Barrett Drive
PO Box 27687
Raleigh, NC 27611
(919) 733-2314

(Chatham, Durham, Edgecombe, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northhampton, Orange, Person, Vance, Wake, Warren, and Wilson Counties)

Washington Regional Office
PO Box 1507
Washington, NC 27889
(919) 946-6481

(Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington, and Wayne Counties)

Wilmington Regional Office
7225 Wrightsville Avenue
Wilmington, NC 28401
(919) 256-4161

(Brunswick, Carteret, Columbus, Duplin, New Hanover, Onslow and Pender Counties)

Winston Salem Regional Office
Suite 100
8025 North Point Blvd.
Winston Salem, NC 27106
(919) 761-2351

(Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Rockingham, Randolph, Stokes, Surry, Yadkin, and Wilkes Counties)

(Continued Next Page)

LOCAL AGENCIES

Western North Carolina Regional Air Pollution Control Agency
(Buncombe & Haywood Counties)
Buncombe County Courthouse Annex
Asheville, North Carolina 28801-3569
(704) 255-5655

Forsyth County Environmental Affairs Department
(Forsyth County)
537 North Spruce Street
Winston Salem, North Carolina 27101
(919) 727-8064

Mecklenburg County Department of Environmental Protection
(Mecklenburg County)
1200 Blythe Blvd.
Charlotte, North Carolina 28203
(704) 376-4603

Guilford County Department of Environmental Health
(Guilford County)
301 N. Eugene Street
Greensboro, North Carolina 27401
(919) 373-3771

Appendix B
EXCEPTIONAL EVENTS

1. **Natural Events**
   Sustained high windspeeds (PM)*
   Stagnations/inversions (all pollutants)
   Unusual lack of precipitation (PM)
   Stratospheric ozone intrusion (O_3)
   Volcanic eruption (CO, SO_2, PM)
   Forest fires (CO, PM)
   High pollen count (PM)

2. **Unintentional Man-made Events**
   Large accidental structural fires (CO, PM)
   Major traffic congestion due to accident or nonrecurring obstruction (CO)
   Chemical spills (SO_2, NO_2, PM, CO)
   Industrial accidents (SO_2, NO_2, PM, CO)

3. **Intentional Man-made Events**
   Short-term construction/demolition (PM)
   Sandblasting (PM)
   High-sulfur oil refining (SO_2)
   Roofing operations (PM, SO_2)
   Salting or sanding of streets (PM)
   Infrequent large gatherings (PM, CO)
   Soot blowing from ships (PM)
   Agricultural tilling (PM)
   Prescribed burning (CO, PM)
   Noncompliance--local source (CO, SO_2)

* PM = particulate matter results affected
CO = carbon monoxide results affected
NO_2 = nitrogen dioxide results affected
$S O_2$ = sulfur dioxide results affected
O_3 = ozone results affected

APPENDIX C

NONATTAINMENT AND NORTH CAROLINA

What is nonattainment and what is the source of the problem?

The United States Environmental Protection Agency (EPA) sets National Ambient Air Quality Standards. North Carolina monitors concentrations of air pollutants in the ambient air. Some of these monitors have measured concentrations of ozone and carbon monoxide exceeding the Standards. The areas around these monitors can be designated as nonattainment areas. Around 90% of the carbon monoxide emissions come from motor vehicles. 30% to 50% of the man-made hydrocarbons or volatile organic compound emissions come from motor vehicles; the rest comes from petroleum marketing, factories, businesses, and households. Volatile organic compounds react with nitrogen oxides and sunlight in warm weather to produce ozone.

Why is my county nonattainment?

EPA has indicated that they will designate nonattainment areas based on Metropolitan Statistical Areas as established by the Office of Management and Budget, even though monitors showing violations of Standards may not be in every county. Previous emission control programs instituted in single counties across the nation have often failed to produce compliance with Standards. Pollution from one county blows into neighboring counties (especially ozone). People travel from one county to another. EPA concluded that the control plans must cover metropolitan areas, not single counties.

Once we are nonattainment, what is the process for getting into attainment?

North Carolina is required by the federal Clean Air Act and EPA to produce and implement emission reduction plans and show that these plans are strong enough to produce compliance with the Standards. The plans could involve resource-intensive monitoring, emissions inventory, modelling, public participation, and strategy formulation efforts. There are deadlines for producing the plans and for achieving compliance with the Standards. EPA must approve the plans.

How does the public get involved in the formulation of the emission reduction plans, known as State Implementation Plan (SIP) revisions?

Local agencies and officials as well as State agencies will be involved in drawing up the SIP revisions. It is likely that there will be public meeting or ad hoc citizen panels. When draft SIP revisions are done, there will be public hearings on them. The SIP revisions must be approved by the Environmental Management Commission and possibly by local bodies as well. EPA's approval process also includes an opportunity for public comment.

How will it affect the citizen?

Possible emission reduction strategies fall into several categories. Motor vehicle inspection/maintenance may be required for hydrocarbons or carbon monoxide or both. Traffic patterns may be altered by changing roads or traffic signals. Both new and existing factories and business may have to reduce emissions by installing control equipment or changing processes. This might include, for example, requiring that gas stations trap vapors that escape when a vehicle is refueled or that gasoline contain pollution-reducing additives.

What is the likelihood of receiving sanctions if we are showing progress in reducing pollution?

If North Carolina were to produce SIP revisions that EPA can approve by the deadlines and were to carry out those plans, sanctions could be avoided. If pollution concentrations did not recede and attain the Standards as projected, construction bans could be imposed. EPA has some discretion about imposing sanctions. Sanctions are a last step to persuade states to take required positive action.

What does inspection/maintenance cost?

The inspection/maintenance or motor vehicle tailpipe testing process costs the motorist $ 6.25 ($8.15 on October 1, 1990) more than the $ 6.25 ($ 7.25 on October 1, 1990) charged for the safety inspection alone. If a vehicle fails the test, it must be repaired. A waiver is available if a vehicle still fails after $50.00 worth of repairs have been done; the $50.00 limit does not apply in the case of tampered or misfueled vehicles. The benefits of better fuel economy and engine wear can exceed the inspection/maintenance cost by two-fold. Currently, the inspection/maintenance program covers only carbon monoxide emissions from Mecklenburg and Wake County-registered gasoline motor vehicles, except motorcycles, of the last 13 model years, except the current model year. Pass-fail cut-points vary with vehicle age.

Appendix D

OZONE EXCEEDANCES IN THE LAST THREE YEARS

SITE NAME / NUMBER	CONC PPM	1987 DATE	NUM EXCD	CONC PPM	1988 DATE	NUM EXCD	CONC PPM	1989 DATE	NUM EXCD	EXCEEDANCE 3-YR TOTAL
STATE AGENCY SITES										
Butner (Durham)	0.126	7-20	3	0.137	6-22	6	0.133	7-11	3	12
37-077-0001 SLAMS	0.126	8-08		0.128	7-07		0.129	6-26		
	0.125	7-12		0.132	7-09		0.127	6-27		
				0.128	8-17					
				0.131	8-19					
				0.129	8-26					
Eastover (Fayetteville)	0.125	7-21	1	0.131	5-31	3			0	4
37-051-0001 NAMS				0.130	6-01					
				0.141	6-02					
Farmville (Pitt County)										
37-147-0099SPM	NOT OPERATING			0.125	6-08	1			0	1
Fork (Davie County)	NOT OPERATING			0.126	6-14	7				
37-059-0099 SPM				0.145	7-07		NOT OPERATING			7
				0.153	7-08					
				0.151	7-09					
				0.135	7-10					
				0.125	7-16					
				0.139	8-17					
Iron Station (Lincoln Co.)	NOT OPERATING			0.126	7-07	2			0	2
37-109-0099 SPM				0.141	7-08					
McLeansville (Greensboro)			0	0.139	6-08	8			0	8
37-081-0011 SLAMS				0.132	6-22					
				0.144	7-07					
				0.144	7-08					
				0.131	7-09					
				0.128	7-10					
				0.150	7-16					
				0.144	8-19					
Wake Forest (Raleigh)	0.129	8-05	2	0.137	6-01	10			0	12
37-183-2001 NAMS	0.125	7-20		0.157	6-08					
				0.126	6-13					
				0.125	6-21					
				0.141	6-22					
				0.137	6-23					
				0.142	7-07					
				0.140	7-09					
				0.135	8-18					
				0.159	8-19					
STATE AGENCY TOTALS			6			37			3	46

(Continued)

Appendix D

OZONE EXCEEDANCES IN THE LAST THREE YEARS

SITE NAME/NUMBER	CONC PPM	1987 DATE	NUM EXCD	CONC PPM	1988 DATE	NUM EXCD	CONC PPM	1989 DATE	NUM EXCD	EXCEEDANCE 3-YR TOTAL
LOCAL AGENCY SITES										
Arrowood (Mecklenburg)	0.151	7-21	4	0.130	6-01	8			0	12
37-119-1005 SLAMS	0.135	7-24		0.149	6-08					
	0.131	7-22		0.140	6-13					
	0.128	7-25		0.137	6-21					
				0.143	7-07					
				0.167	7-08					
				0.125	7-15					
				0.158	8-18					
County Line (Mecklenburg)	0.138	8-21	1	0.132	6-08	9	0.147	8-4	2	12
37-119-1009 NAMS				0.126	6-16		0.132	6-1		
				0.144	6-17					
				0.127	7-07					
				0.169	7-08					
				0.127	7-09					
				0.156	7-10					
				0.134	8-18					
				0.126	9-14					
Plaza (Mecklenburg)	0.127	7-20	2	0.169	6-08	7	0.162	8-4	1	10
37-119-0034 NAMS	0.127	8-05		0.148	6-17					
				0.131	6-22					
				0.125	7-07					
				0.158	7-08					
				0.126	7-10					
				0.158	8-18					
Prince Ibraham (Forsyth)	0.129	8-21	1	NOT OPERATING			NOT OPERATING			1
37-067-0004 SLAMS										
Belews Creek (Forsyth)	0.129	8-2	1	0.142	6-14	3			0	4
37-067-0006 SLAMS				0.137	7-07					
				0.128	7-09					
Ferguson School (Forsyth)										
37-067-0007 SLAMS	NOT OPERATING			0.134	6-14	3			0	3
				0.137	7-07					
				0.134	7-09					
Union Cross (Forsyth)	NOT OPERATING			0.128	7-07	2			0	2
37-067-1008 SLAMS				0.138	7-08					
LOCAL AGENCY TOTALS			9			32			3	44
ALL STATE TOTALS			15			69			6	90

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